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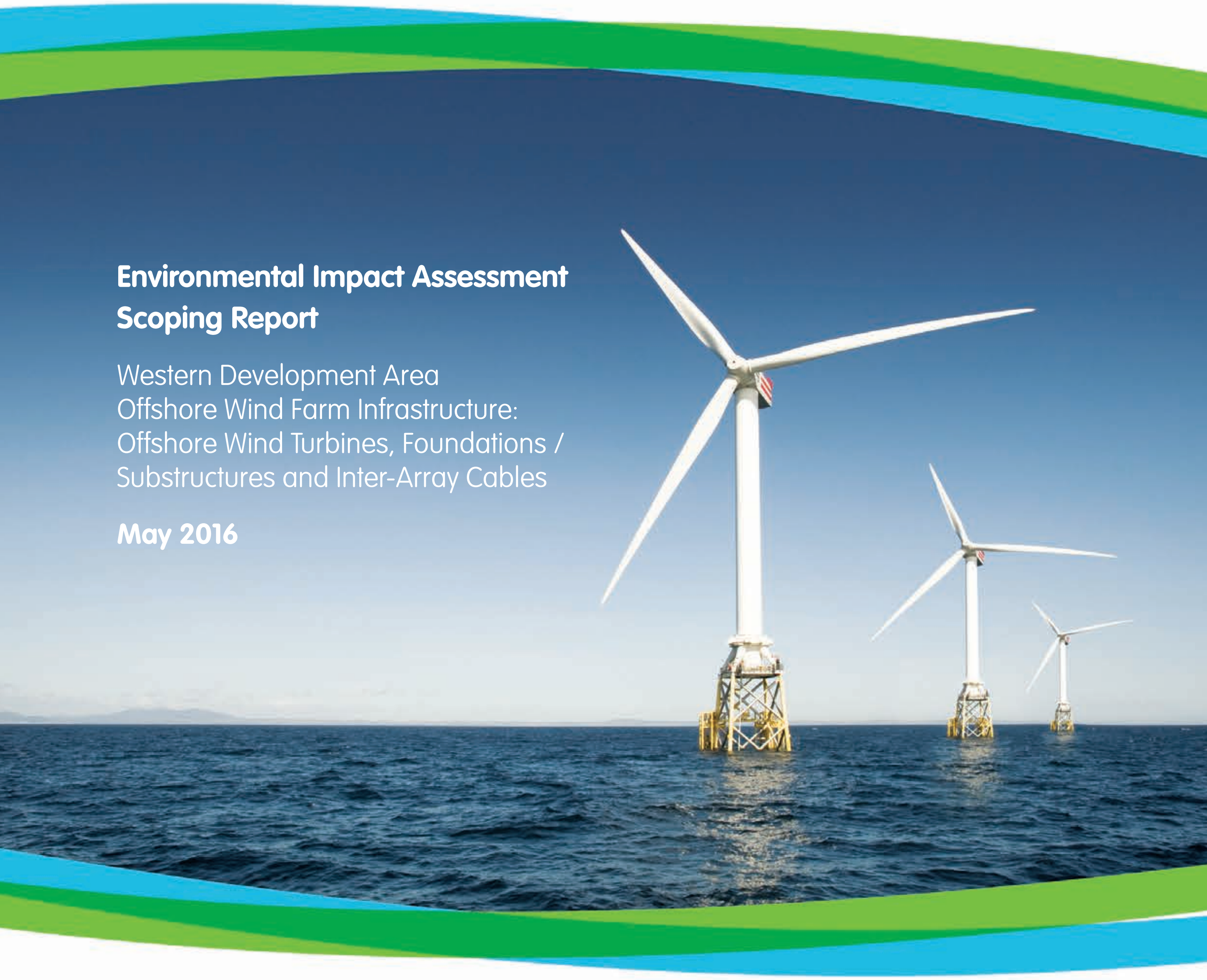
Developing Wind Energy In The Outer Moray Firth



Environmental Impact Assessment Scoping Report

Western Development Area
Offshore Wind Farm Infrastructure:
Offshore Wind Turbines, Foundations /
Substructures and Inter-Array Cables

May 2016

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Executive Summary

In January 2010, Moray Offshore Renewables Limited (MORL) was awarded a Zone Development Agreement (ZDA) by The Crown Estate (TCE) to develop Zone 1 of the nine UK offshore wind Round 3 zones. Zone 1 (the MORL Zone) is located in the outer Moray Firth within the UK Renewable Energy Zone (REZ).

Following the award of the ZDA MORL undertook a spatial constraints analysis of the Zone. As a consequence it was decided to develop the MORL Zone in two phases. First, the Eastern Development Area (EDA) for which necessary consents were awarded in 2014 for three offshore wind farms with a total capacity of 1,116 MW and associated transmission infrastructure. The second phase of offshore wind development in the MORL Zone is located in the Western Development Area (WDA). MORL conducted a review of the development constraints for the WDA in 2016. Due to fewer development constraints now affecting the WDA than in 2010 together with the technical and economic advantages associated with shallower water depths MORL has determined that the development of the WDA can now be progressed.

The WDA is located on the Smith Bank in the Outer Moray Firth approximately 22.5 km from the Scottish coast at its closest point and covers an area of 225 km^2. The water depths in the WDA vary between approximately 35 – 54 m. It is currently anticipated that there could be up to 90 wind turbines located within the WDA with a potential generation capcity of up to 750 MW.

This Scoping Report relates to the wind turbines, their substructures and foundations and inter-array cables and any potential meterological masts for the WDA. It is currently anticipated that MORL will also consent the associated transmission infrastructure (including offshore and onshore export cable circuits, offshore substation platform(s), onshore substation, ancillary onshore works and works in the inter-tidal zone). These are not discussed in detail within this Scoping Report. A separate Scoping Report will be prepared for these offshore and onshore transmission works at a later date when more details of the export cable routes and onshore substation location are known.

This Scoping Report has two purposes:

1. To gather further information on constraints to siting the wind farm and assist in identifying the wind farm site(s) in the WDA; and
2. To seek the opinion of statutory and non-statutory consultees on the scope of the Environmental Impact Assessment (EIA) which will be submitted with the application for the consents required for the construction and operation of a wind farm in the WDA.

Details of the WDA along with baseline environmental information currently available are provided in this Scoping Report. It also identifies potential impacts that may arise as a result of this development. Within this Scoping Report, studies and surveys are proposed in order to inform the EIA process and preliminary discussion on potential mitigation and monitoring measures is included.

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List of Abbreviations

AC	Alternating Current
ADDs	Acoustic Deterrent Devices
AIS	Automatic Identification Systems
ALBs	All-weather Life Boats
ASACS	Airspace Surveillance and Control Systems
ATC	Traffic Control
BGS	British Geological Survey
BOWL	Beatrice Offshore Wind Farm Limited
CAA	Civil Aviation Authority
Cefas	Centre for Environment, Fisheries and Aquaculture
CEH	Centre for Ecology and Hydrology
CfD	Contracts for Difference
CIA	Cumulative Impact Assessment
cm	Centimetre
CO_2	Carbon Dioxide
CPA	Coastal Protection Act
CPT	Cone Penetration Test
CRM	Collision Risk Modelling
DC	Direct Current
DECC	Department of Environment and Climate Change
EAR	Ecological Acoustic Reader
ECC	East Caithness Cliffs
EDA	Eastern Development Area
EDPR	EDP Renovaveis
EDPR UK	EDP Renewables UK Ltd
EIA	Environmental Impact Assessment

EMF	Electro-magnetic Fields
EMP	Environmental Management Plan
ES	Environmental Statement
EU	European Union
FEED	Front End Engineering Design
FL	Flight Level
ft	Feet
GAM	Generalised Additive Model
GBS	Gravity Base Structures
GSD	Ground Sample Distance
GVA	Gross Value Added
GW	Gigawatt
HAT	Highest Astronomic Tide
HIAL	Highland and Islands Airports Ltd
HIE	Highlands and Islands Enterprise
HPDI	Highest Posterior Density Intervals
HRA	Habitats Regulations Appraisal
HVAC	High-Voltage Alternating Current
HVDC	High-Voltage Direct Current
ICES	International Council for the Exploration of the Sea
IGDLs	Inventory Designed Gardens and Designed Landscapes
IMC	Instrument Meteorological Conditions
IMO	International Maritime Organisation
JNCC	Joint Nature Conservation Council
km	Kilometre
km^2	Square kilometre
LAT	Lowest Astronomical Tide
LNRs	Local Nature Reserves

m	Metres
m^2	Squared metres
MAIB	Maritime Accident Investigation Branch
MaRS	Marine Research System
MCA	Maritime and Coastguard Agency
mCD	Metres Above Chart Datum
MDA	Managed Danger Area
MESH	Mapping European Seabed Habitat
MFOWDG	Moray Firth Offshore Wind Developers Group
MGN	Marine Guidance Notice
MHWS	Mean High Water Springs
MINNS	Marine Invasive Non-native Species
MMMP	Marine Mammal Monitoring Programme
MMO	Marine Management Organisation
MNRs	Marine Nature Reserves
MOD	Ministry of Defence
MORL	Moray Offshore Renewables Limited
MPAs	Marine Protected Areas
MRCC	Marine Rescue Coordination Centre
MSA	Minimum Safe Altitude
MSFD	Marine Safety Framework Directive
MS-LOT	Scottish Government, Marine Scotland Licensing Operations Team
MSS	Marine Scotland Science
MW	Megawatt
NATS	National Air Traffic Services
NCC	North Caithness Cliffs
NERL	NATS En-Route Ltd
NM	Nautical Mile

NMP	National Marine Plan
NNR	National Nature Reserve
NO_x	Nitrogen Oxides
NRMSDF	National Research and Monitoring Strategy for Diadromous Fish
OFTO	Offshore Transmission Operator
OnTI	Onshore Transmission Infrastructure
OREIs	Offshore Renewable Energy Installations
OS	Ordnance Survey
OSPs	Offshore Substation Platforms
PAD	Protocol for Archaeological Discovery
PAH	Polycyclic Aromatic Hydrocarbons
PEMP	Project Environmental Monitoring Programme
PMF	Priority Marine Features
PSD	Particle Size Distribution
PSR	Primary Surveillance Radar
PTS	Permanent Threshold Shift
PVA	Population Viability Analysis
REZ	Renewable Energy Zone
RNLI	Royal National Lifeboat Institute
RSPB	Royal Society for the Protection of Birds
SAC	Special Areas of Conservation
SAR	Search and Rescue
SCADA	Supervisory Control and Data Acquisition
SCANS	Small Cetaceans in the European Atlantic and North Sea
SCOS	Special Committee on Seals
SE	Scottish Enterprise
SEA	Strategic Environmental Assessment
SFF	Scottish Fishermen's Federation

SHE-T	Scottish Hydro Electric Transmission
SLVIA	Seascape, Landscape and Visual Impact Assessment
SMRU	Sea Mammal Research Unit
SNCBs	Statutory Nature Conservation Bodies
SNH	Scottish Natural Heritage
SO_2	Sulpher Dioxide
SPA	Special Protection Areas
SSCs	Suspended Sediment Concentrations
SSE	Scottish and Southern Energy
SSSI	Sites of Special Scientific Interest
TCE	The Crown Estate
TCE Scotland	The Crown Estate Scotland
TMZ	Transponder Mandatory Zone
TOC	Total Organic Carbon
TRA	Temporary Reserved Area
QA	Quality Assurance
QET	Quasi-extinction threshold
UK BAP	UK Biodiversity Action Plan
UKHO	UK Hydrographic Office
UXO	Unexploded Ordnance
VFR	Visual Flight Rules
VMS	Vessel Monitoring System
VP	Vantage Point
WDA	Western Development Area
WSI	Written Scheme of Investigation
WTG	Wind Turbine Generator
ZDA	Zone Development Agreement
ZTV	Zone of Theoretical Visibility

1 Introduction and Project Description

1.1 Introduction

In January 2010, Moray Offshore Renewables Limited (MORL) was awarded a Zone Development Agreement (ZDA) by The Crown Estate (TCE) to develop Zone 1 of the nine UK offshore wind Round 3 zones. Zone 1 (the MORL Zone) is located in the outer Moray Firth within the UK Renewable Energy Zone (REZ) (Figure 1.1-1).

Using a zonal constraints analysis, MORL identified two potential development areas. The Eastern Development Area (MORL EDA) and the Western Development Area (WDA) (Figure 1.1-2). Through a spatial constraints analysis exercise in 2009 the MORL EDA was considered at that time to have the higher potential for development due to a lower number of constraints and a decision was taken to progress this area ahead of the WDA. The MORL EDA has since been subject to Environmental Impact Assessment (EIA), and Section 36 consents under the Electricity Act 1989 were awarded in March 2014 for the construction and operation of up to three offshore wind farms, the sites for which occupy the entire MORL EDA.

Following a further spatial constraints analysis in 2016, MORL has taken the decision to progress the necessary development activity to support a future consent application for the WDA. For further detail on the constraint analysis see Section 1.2.3 below. The site of the WDA offshore wind farm is currently being determined through a Zone appraisal process conducted with The Crown Estate Scotland (TCE Scotland) to ensure the efficient use of its seabed assets. Final site selection will be based upon feedback to this Scoping Report, technical assessments, understanding gained through the EIA process for the MORL EDA and assessments and consultation during the WDA EIA process.

The right to develop the MORL Zone is subject to MORL obtaining the necessary consents and licences for the construction, operation and decommissioning of each of the individual projects to be located within the MORL Zone. At the time of submission of this Scoping Report, MORL has obtained the necessary consents for the wind farms in the MORL EDA for a total capacity of 1,116MW. The final capacity to be built under these consents will be fixed through the Contracts for Difference (CfD) auctions to be held between 2016 and 2020 (DECC, 2015). The plan to develop the remainder of the MORL Zone is likely to consist of a single project (potentially developed in more than a single phase) in the WDA to which this Scoping Report relates. The development of the WDA applications will take into account the final project definition for the MORL EDA where that is known at the time of application.

The WDA is located approximately 22.5 km from the Scottish coast at its closest point and covers an area of 225 km^2. The current assumption is that there could be up to 90 wind turbines with a potential generation capacity of up to 750 MW.

The EC Directive 85/337/EEC as amended by Directive 97/11/EC and codified by Directive 2011/92/EC (the EIA Directive) requires wind farms to be subject to EIA. The purpose of the Directive is to ensure that, in considering whether to grant consents for developments that are likely to have significant environmental effects, the consenting authorities have all the necessary environmental information on which to base their decision. This Scoping Report is being submitted to Marine Scotland Licensing Operations Team (MS-LOT) in order to gather the views of the statutory and non-statutory consultees through a Scoping Opinion from MS-LOT on the scope of the EIA relating to MORL's proposals for the WDA, which will be submitted with the application for the consents required for the development.

It should be noted that this Scoping Report only covers the wind turbines, their substructures and foundations and inter-array cables and any potential meterological masts. It is currently anticipated that MORL will also consent the Offshore Transmission Operator (OFTO) infrastructure (including offshore and onshore export cable circuits, offshore substation platform(s), onshore substation, ancillary onshore works and works in the inter-tidal zone). These are not discussed in detail within this Scoping Report. A separate Scoping Report will be prepared for these offshore and onshore transmission works at a later date when more details of the export cable routes and onshore substation location are known. However, it should be noted that the offshore wind farm EIA will take into account in-combination effects, i.e. any potential effects resulting from the combination of the developments.

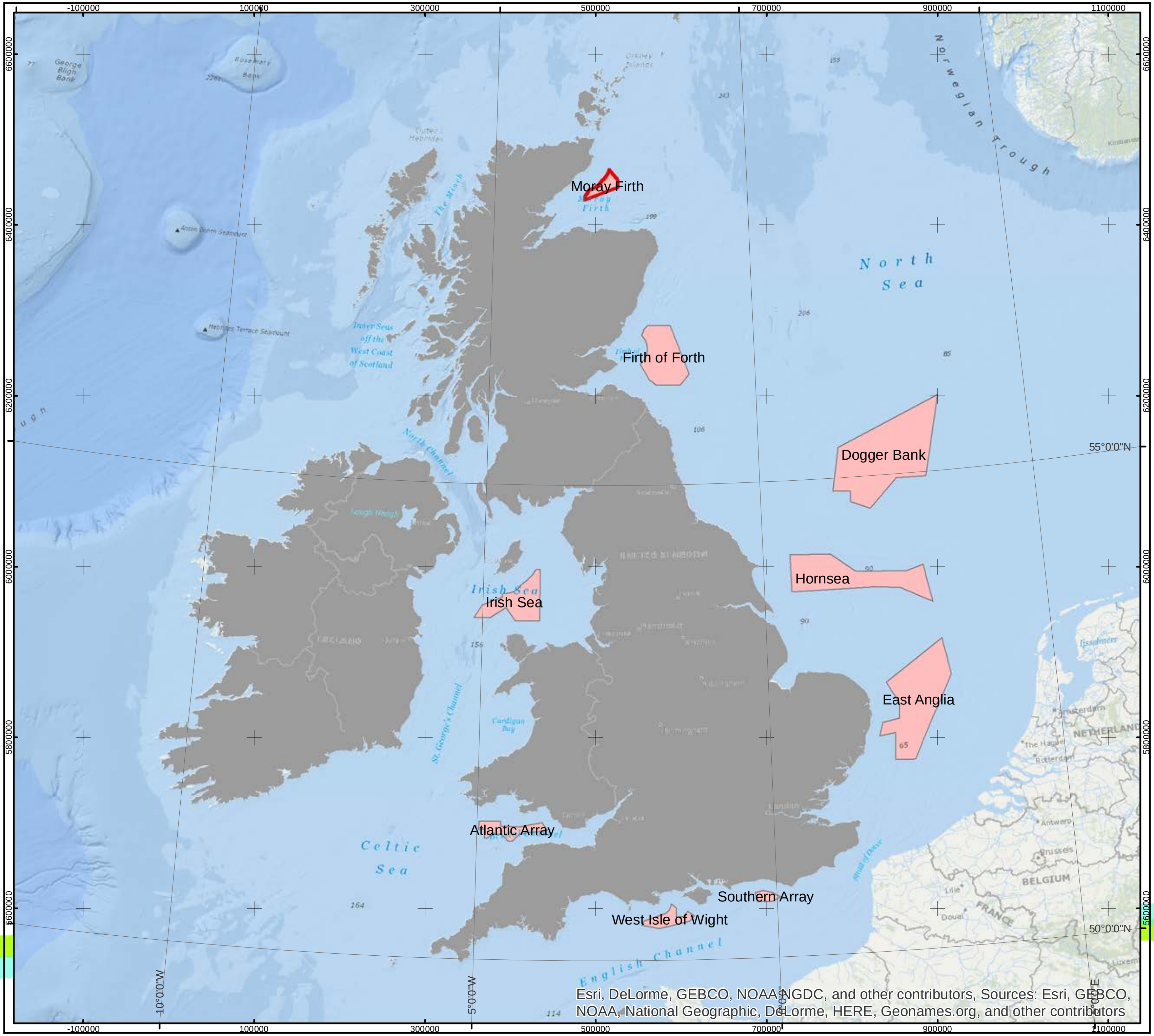
Scoping at an early stage of the environmental assessment process and is designed to ensure that the environmental studies undertaken provide all the relevant information required for the assessment. Scoping is the process for determining the content and extent of the matters which should be covered in the environmental information to be submitted to a competent authority for projects which are subject to EIA. The scoping process is designed for consultees to input into the wider EIA process for a particular project. In respect to the WDA, the scoping process will also be used to collect information to assist with the process of defining a suitable wind farm site within the WDA.

This Scoping Report provides details of the WDA along with baseline environmental information currently available. The primary sources for baseline information are the MORL Environmental Statement 2012 and MORL Modified Environmental Statement 2014. In addition to this, the Marine Mammals Section has been informed by the ongoing discussion with the MS-LOT in relation to the MORL EDA draft Piling Strategy and Piling Protocol (see Section 3.5 below) and early engagement has taken place with Marine Scotland Science (MSS), Scottish Natural Heritage (SNH) and Joint Nature Conservation Committee (JNCC) in relation to assessment approach and survey requirements for Ornithology (see Section 3.6 below). The potential effects of the development of the WDA have been identified, and the further assessment required for the EIA has been presented together with information on the EIA methodology.

The results of the EIA stage will be published in the Environmental Statement (ES). The overall purpose of the ES will be to demonstrate that:

1) The proposed site has been selected to minimise environmental effects and conflicts of interest, where possible; and
2) The scheme has been designed to mitigate any potential effects as far as reasonably possible.

The final ES will clearly inform stakeholders of the residual effects and facilitate informed consent decisions.



Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors, Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, HERE, Geonames.org, and other contributors

Moray Offshore Renewables Ltd

KEY

☐ MORL Zone

🟥 Round 3 Wind Farm Sites

Horizontal Scale: 1:6,000,000 A4 Chart

0 100,000 200,000 Meters

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: AH
Approved: SP

Date: 03/05/2016 Revision: A

REF: 8460001-PQW0010-MOR-MAP-001

Figure 1.1-1
Round 3 Zones

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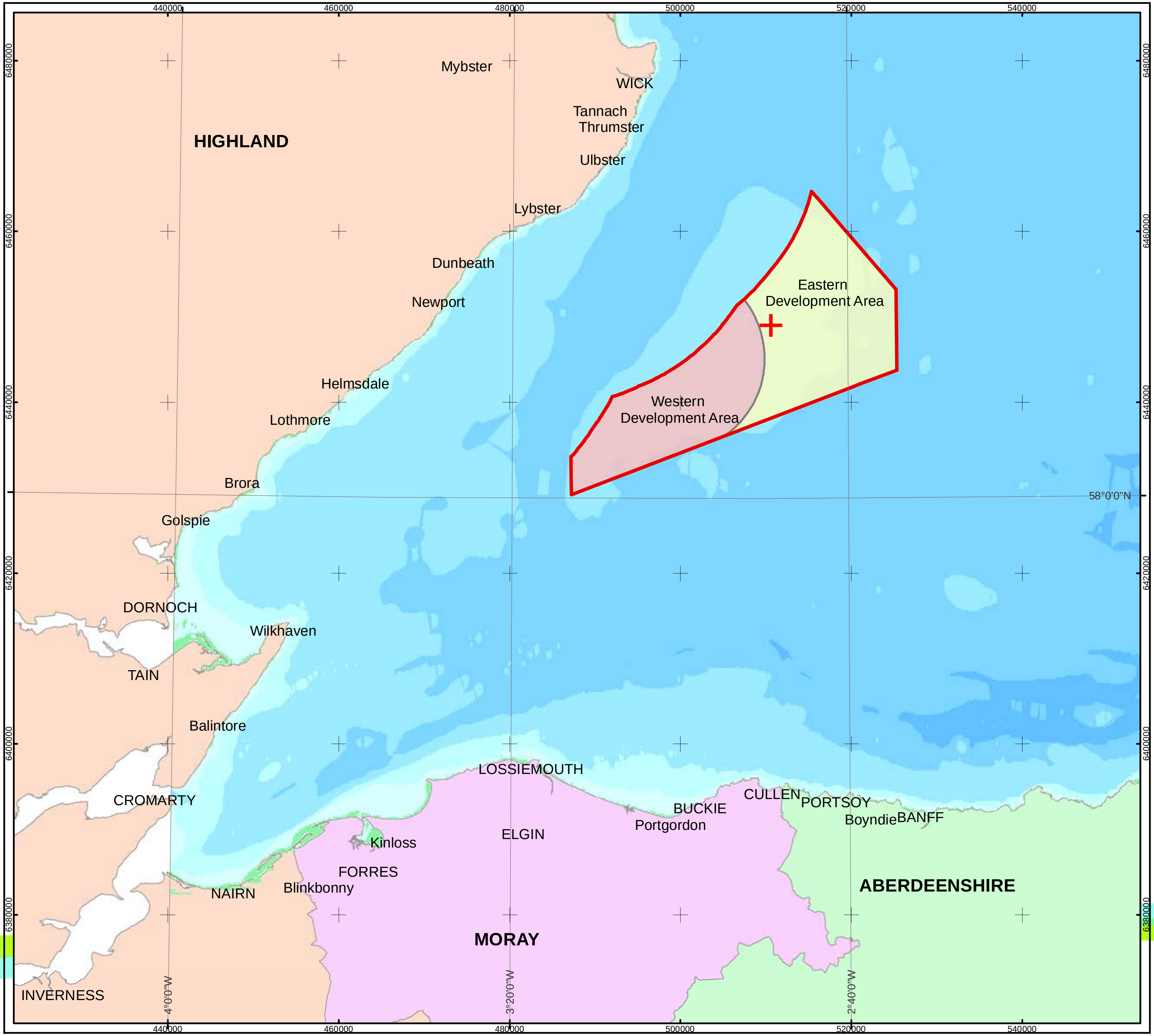


renewables

Moray Offshore Renewables Ltd

KEY

▭	MORL Zone
+	MORL Offshore Meteorological Mast
🟥	Western Development Area (WDA)
🟨	Eastern Development Area (EDA)

Horizontal Scale: 1:600,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: AH
Approved: SP

Date: 04/05/2016 Revision: A

REF: 8460001-PQW0010-MOR-MAP-002

Figure 1.1-2
The MORL Zone
WDA and EDA

Moray Offshore
Renewables Ltd

1.1.1 The Developer

1.1.1.1 Moray Offshore Renewables Limited (MORL)

MORL is owned 100% by EDPR UK Limited (EDPR UK). MORL will develop, consent, finance, construct, operate and maintain the offshore wind projects within the MORL Zone.

1.1.1.2 EDP Renovaveis

EDP Renovaveis (EDPR) owns EDPR UK. It is a leading, global renewable energy company devoted to value creation, innovation and sustainability. It operates in markets around the globe and it is continuously expanding its business to new regions, making the commitment to lead in each market as well as create value for its stakeholders and shareholders. As of March 2016 EDPR managed a global portfolio of 9.7 GW spread over 10 countries, of which 5.1 GW are in Europe, comprising 2.4 GW in Spain, 1.2 GW in Portugal, and 1.5 GW in the rest of Europe. EDPR also manages a portfolio of 4.4 GW in North America and the balance in Brazil. As of March 2016, EDPR had 476 MW of onshore wind under construction.

EDPR has developed wind farms since 1996 and was first listed publicly in June 2008. EDPR's global presence is managed by two regional platforms which oversee the development, construction and operation of assets in their geographic areas. EDPR Europe, headquartered in Madrid, develops and manages renewable energy assets located in Europe, Brazil and EDPR North America, headquartered in Houston, manages assets in the United States, Mexico and Canada. EDPR has located its global Headquarters for its offshore wind business in Edinburgh since 2009.

1.1.2 National Policy and Offshore Wind Development

The introduction of the Climate Change Act 2008 committed the UK to a legally binding target of at least 34% reduction by 2020 in greenhouse gas emissions and at least an 80% cut in greenhouse gas emissions by 2050. The Climate Change (Scotland) Act 2009 committed Scotland to cut emissions by 42% by 2020 and 80% by 2050. These targets meet and exceed European agreements of which the UK is subject.

The UK Government's primary target is to achieve 15% of energy consumption from renewable sources by 2020 (as required by the 2009 EU Renewable Energy Directive) (DECC, 2009a). The UK Renewable Energy Strategy highlights that in order to best achieve this target around 30 per cent of electricty will require to be generated from renewables by 2020.

The Scottish Government has set a target of *"delivering the equivalent of at least 100% of gross electricity consumption from renewables by 2020"* noting that *"renewables will form part of a wider, balanced electricity mix"* (Scottish Government Electricity Generation Policy Statement 2013).

European Union (EU) countries have agreed on a new 2030 Framework for climate and energy (European Commission, 2014), including EU-wide targets and policy objectives for the period between 2020 and 2030. These targets include a binding EU target of at least a 40% reduction in greenhouse gas emissions by 2030, compared to 1990 and a binding target of at least 27% of renewable energy in the EU. Each member state will be required in due course to develop an Energy Strategy setting out how it will meet the 2030 targets for review by the European Commission. In the meantime it is understood that the Scottish Government will consult on its own Energy Strategy later in 2016.

Wind energy is a means of generating electricity without producing significant airborne or waterborne toxic emissions, and is not dependant on finite reserves of fossil fuels. It is ultimately a sustainable and proven technology, a fact that is recognised by the UK Government approach to wind development. To date there have been three UK wide rounds of offshore wind development in the UK, administered by TCE. As of April 2016 the UK had an installed offshore wind generation capacity of 5,086 MW, with a further 14.3 GW with planning approval (Renewable UK, April 2016).

1.1.3 The Round 3 Process

In support of the UK Government's renewable energy targets, TCE initiated a number of offshore wind leasing rounds between 2008 and 2009, including the Round 3 offshore wind leasing round.

In 2009 TCE requested initial expressions of interest from companies wishing to be considered for developing commercial scale wind farms within the Round 3 process and the final allocation of ZDAs under the Round 3 process was determined in January 2010. ZDAs were awarded for nine zones distributed within UK waters, with a total award capacity of 32 GW.

1.1.4 Strategic Environmental Assessment

The Department of Energy and Climate Change (DECC) undertook a Strategic Environmental Assessment (SEA) of a draft plan/programme to hold further rounds of offshore wind leasing in the UK Renewable Energy Zone and the territorial waters of England and Wales with the objective of achieving 25 GW of additional generation capacity by 2020.

In January 2009, DECC published the SEA Environmental Report (DECC, 2009b). The purpose of this report was to identify, describe and evaluate the likely significant effects on the environment of implementing the draft plan/programme. This included the implication of alternatives to the plan / programme and the potential spatial interactions with other users of the sea. The report was intended to provide a basis of information for formal consultation with the statutory consultation bodies and authorities and with the public.

The following alternatives to the draft plan/programme were assessed by the SEA:

1) Not to offer any areas for leasing/licensing;
2) To proceed with a leasing and licensing programme; and
3) To restrict the areas offered for leasing and licensing temporally or spatially.

After the consultation period and the Appropriate Assessment, the conclusion of the SEA was unaltered and alternative 3 was considered the preferred option, with the area offered restricted spatially through the exclusion of certain areas, although the MORL Zone was unaffected (DECC, 2009c).

In March 2015, the Scottish Government published 'Scotland's National Marine Plan – a Single Framework for Managing our Seas' (the NMP) (Scottish Government, 2015) under the Marine (Scotland) Act 2010 which sets out marine planning policy. "The plan provides a comprehensive overarching framework for all marine activity in our waters. It will enable sustainable development and use of our marine area in a way which will protect and enhance the marine environment whilst promoting both existing and emerging industries". (Richard Lochead, Cabinet Secretary for Environment). The MORL Zone as a Round 3 offshore wind site is recognised within the National Marine Plan (NMP) as a planned development (Chapter 11, Map 9).

In March 2016, DECC published the UK Offshore Energy Strategic Environmental Assessment (DECC, 2016a). However, this does not consider potential leasing for offshore renewable energy in the Scottish REZ or in Scottish Territorial waters.

1.1.5 The MORL Zone

TCE awarded MORL a ZDA in 2010 which granted MORL exclusive rights to investigate and develop offshore wind farms in the MORL Zone. The TCE award was made in a competitive process which sought to maximise the offshore generation capacity available to the UK. In terms of the ZDA the right to develop such wind farms in the MORL Zone is subject to MORL obtaining the necessary consents and licences from statutory bodies for the construction, operation and decommissioning of each of the individual projects that will be located within the MORL Zone.

At the time of submission of this Scoping Report, MORL has obtained the necessary consents for wind farms in the MORL EDA for a total capacity of up to 1,116 MW. It is anticipated that the final capacity to be built under these consents will be fixed between 2016 and 2020 through the CfD auction process controlled by the UK Government.

The plan to develop the remainder of the MORL Zone is likely to consist of a single project (potentially developed in more than a single phase) in the WDA to which this Scoping Report relates. The basis for the site selection is set out in Section 1.2.3 below. The Cumulative Impact Assessments (CIAs) for each receptor for the MORL EDA included the potential development of the WDA. These qualitative assessments were based on the assumption that the WDA would comprise up to 100 wind turbine generators (WTGs) assumed to be of 5 MW capacity. The development of the WDA applications and the accompanying CIA will take into account the final project definition for the MORL EDA where that is known at the time of application together with any updated baseline data and changes in assessment methodologies.

1.1.6 Regulatory Background

The WDA is located in the Scottish REZ. The Scottish Ministers are the relevant decision makers in respect of the Section 36 consents and marine licences required for the construction and operation of the wind farm. The relevant consents for the offshore wind farm infrastructure are outlined below.

1.1.6.1 The Marine and Coastal Access Act 2009

The Marine and Coastal Access Act 2009 introduces a framework for sustainable management of the UK seas including around Scotland beyond 12 nm, which aims to ensure environmental protection is balanced with economic growth of marine industries. The requirement for a marine licence was introduced under the 2009 Act. A marine licence would be required for marine licensable activities for the WDA including the deposit on the seabed of cables and substructures for the wind turbines.

1.1.6.2 Electricity Act 1989 (Section 36)

The development of the WDA offshore wind farm is subject to an application to Scottish Ministers under Section 36 of the Electricity Act 1989 for consent for the construction and operation of an electricity generating station. The scope of this consent for the WDA will include the installation, operation and maintenance of wind turbines, meteorological mast and inter-array cables.

1.1.6.3 Energy Act 2004 (Section 95)

Under Section 95 of the Energy Act 2004 where a renewable energy installation is proposed to be constructed, and DECC (in consultation with the Scottish Ministers) consider it appropriate for safety reasons, a notice declaring that specified areas are to be designated as safety zones may be issued. Such zones are intended to secure the safety of the renewable energy installation or other installations in the vicinity during construction, operation, extension or decommissioning. Importantly, the purpose of the safety zone is also to secure the safety of individuals in or around the installation, vessels in the vicinity and individuals on such vessels.

1.1.6.4 Requirement for an Environmental Impact Assessment (EIA)

In terms of the EIA Directive certain developments are subject to EIA. The types of development to which the Directive applies are specified in Annexes I and II to the Directive. The purpose of the EIA Directive is to ensure that, in considering whether to grant consents for developments that are likely to have significant environmental effects, the consenting authorities have all the necessary environmental information on which to base their decision.

Offshore wind farms are listed as a Schedule 2 project as ‘installations for the harnessing of wind power for energy production (wind farms)’. It is considered that due to the nature, scale and size of the potential development of the WDA that there is potential for significant environmental effects and accordingly an EIA will be required to accompany the applications for the WDA wind farm consents.

The requirement for an EIA for electricity generation projects requiring consent under Section 36 of the Electricity Act 1989 is provided for in Scotland by the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000. The Marine Works (Environmental Impact Assessment) Regulations 2007 also require an EIA for deposits on the seabed. Both sets of Regulations set out the statutory process and minimum requirements for EIA. Regulations 7 and 13 of the 2000 and 2007 Regulations respectively make provision for a written request to be submitted to the Scottish Ministers for an opinion as to the scope of the information to be provided within the ES (a Scoping Opinion). MORL has submitted a Scoping Request to the Scottish Ministers in respect of the development of the WDA and this Scoping Report has been prepared to enable statutory and non-statutory consultees to respond to consultation in respect of this request.

There is also a requirement to consider cumulative and in-combination effects as part of the EIA process. Projects to be included in such an assessment include existing projects and those currently in the planning system. The assessment must also consider, not only the other potential renewable energy projects, but also other types of project taking place in the marine environment.

Consent for the transmission infrastructure is slightly more complex in that it involves both offshore and onshore elements. This means that a Marine Licence must be applied for to cover the offshore elements of this infrastructure (Offshore Substation Platforms (OSPs) and offshore export cable), while planning permission for the onshore infrastructure will be applied for under the Town and Country Planning (Scotland) Act 1997. In respect of the onshore transmission infrastructure (OnTI), the relevant EIA regulations are the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011.

Although this Scoping Report is only for the generation station, as the project will be comprised of both a generating station and transmission infrastructure, these elements will be assessed together as one entire project either in an ES for the whole project or, if applications for the generation infrastructure and transmission infrastructure are submitted at different times, the generation infrastructure ES will assess the transmission elements to the extent that details of the transmission infrastructure are available at the time of the assessment and the ES for the transmission infrastructure will include a detailed assessment of the whole project. The relevant regulations set out the minimum information requirements and procedural requirements for EIA development.

1.1.6.5 The Crown Estate Act 1961

The Crown Estate Commissioners, are the owner of the foreshore and the seabed below the territorial seas of the UK under the Crown Estate Act 1961 and are the party entitled to exercise the right to exploit areas outside the territorial seas for the production of energy from water or winds within designated areas. The Commissioners require a lease of the seabed and foreshore within the territorial seas or a lease of rights of the areas outside the territorial seas to be granted for developments on the marine estate, including cable laying and construction of offshore wind turbines. This is a statutory consent granted in the form of a lease.

1.1.6.6 Habitats Directive (Directive 92/43/ECC) and Wild Birds Directive (Directive 2009/147/EC): Requirement for Appropriate Assessment

The Habitats Directive provides for the conservation of natural habitats and of wild flora and fauna including in offshore areas. The Wild Birds Directive applies to the conservation of all species of naturally occurring wild birds including in offshore areas. Both Directives have been transposed into Scottish Law by the Conservation (Natural Habitats &c) Regulations 1994 (as amended) (Habitat Regulations) and in the offshore marine area by the Offshore Marine Conservation (Natural Habitats &c) Regulations 2007 (as amended) (Offshore Marine Regulations). They require a Habitats Regulations Appraisal (HRA) to be conducted by the ‘competent authority’ before a plan or project that is likely to have a significant effect on designated or candidate Special Protection Areas (SPAs) or Special Areas of Conservation (SACs), can be given consent, permission or other authorisation. The UK SACs and SPAs form part of the Natura 2000 network, which is at the core of the Habitats Directive.

1.1.6.7 European Protected Species

Annex IV of the Habitats Directive lists certain species of European Community interest which are in need of strict protection. These species are referred to in the UK as 'European Protected Species'.

Licences may be given authorising activities affecting European Protected Species of plants or animals which would otherwise be illegal under the legislation. The licences are granted by SNH or the Scottish Ministers depending on the reason for the licence application.

1.1.6.8 Wildlife and Countryside Act 1981 and The Nature Conservation (Scotland) Act 2004

The Wildlife and Countryside Act 1981 (as amended) is the principal legislation by which wildlife is protected in the UK. All species of wild birds are afforded protection under the Act. Protection is afforded to animal species listed in Schedule 5 through Section 9 of the Act.

1.1.6.9 Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003

Consideration is required to be given to the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003. The Act offers protection to salmon and sea trout.

1.1.6.10 Marine Strategy Framework Directive (Directive 2008/56/EC)

The Marine Strategy Framework Directive 2008/56/EC (MSFD) aims to achieve Good Environmental Status in Europe's seas by 2020. Good Environmental Status involves protecting the marine environment, preventing its deterioration and restoring it where practicable, while using marine resources sustainably. This fits well with the UK's vision of 'clean, healthy, safe, productive and biologically diverse oceans and seas'. The MSFD sets out 11 high level Descriptors of Good Environmental Status which cover all the key aspects of the marine ecosystem and all the main human pressures on them.

1.1.7 The OFTO Process

Due to European legislation, it is not permissible for a developer to hold both a generation and transmission licence. The consequence of this is that a wind farm owner cannot retain operational control of any transmission infrastructure. It is, however, permissible for the wind farm owner to construct and install transmission infrastructure assets and transfer these to an OFTO prior to operation. MORL, through an SPV, may choose a process known as the OFTO 'generator build' option which involves the generator constructing the transmission infrastructure before transfering all relevant agreements, wayleaves and consents to the OFTO prior to operation. The other option is an OFTO–build strategy where agreements, wayleaves and consents will be transferred to the OFTO prior to construction of the transmission assets. At the present time it is MORL's intention to proceed by way of the 'generator build' option.

The OFTO infrastructure will include offshore substations, offshore export cables, landing points, the onshore substation and any onshore export cables required to reach the onshore substation.

An OFTO will be appointed through a tendering process, run periodically and managed by OFGEM. This process will require MORL to submit all applicable data, studies and consents into a 'data room' for potential OFTOs to review and base their tender upon.

MORL is currently acting as an ‘interim OFTO’ and will seek to agree with National Grid a Grid Connection Agreement which will determine the location of the Interface Point where the WDA electrical transmission infrastructure physically connects to the onshore electricity transmission system infrastructure. MORL will carry out all relevant onshore and offshore surveys, in order to support the EIA for the WDA electrical transmission infrastructure and will obtain the relevant consents and licences for the OFTO infrastructure.

1.2 Project Description

This section provides a high level description of the proposed development based on information available at the time of writing. It should be noted that the wind farm design process is at an early stage, and therefore many of the detailed parameters of the project are yet to be determined.

1.2.1 Objectives of the Development

The UK Government’s primary target is to achieve 15% of energy consumption from renewable sources by 2020 (as required by the 2009 EU Renewable Energy Directive) (DECC, 2009a). The UK Renewable Energy Strategy highlights that in order to best achieve this target around 30 per cent of electricty will require to be generated from renewables by 2020. By 2030 the EU will require to achieve at least 27% of energy consumption from renewable sources (European Commission, 2014). Development of the WDA would offset the emission of greenhouse gases, in line with the UK’s commitments under the Kyoto Protocol. It is estimated that the WDA could produce enough power for approximately 462,900 UK households.

1.2.2 Site Location

The WDA is located in the north-east of Scotland, 22.5 km from the Caithness coast on the Smith Bank in the Moray Firth. The area measures approximately 225 km^2 (See Figure 1.1-2 above). The water depths in the WDA vary between approximately 35-54 m.

1.2.3 Site Selection

The MORL Zone was identified along with eight other zones by TCE using their strategic management system MaRS (Marine Resource System). *“MaRS is a decision support tool which interrogates third party data sets using GIS technology to identify potential areas for sectoral development. The tool produces three key outputs: site suitability for potential business activity, the sustainability value of that activity and financial analysis of the potential revenue to the business which will enable long term informed decision-making for marine development”* (The Crown Estate, 2010).

In order to identify development areas within the MORL Zone, MORL undertook a zonal constraints assessment process: this included an assessment of the known spatial constraints to wind turbine development associated with engineering properties of the area and physical, biological and human environmental constraints. All information used in the assessment was obtained from public sources.

With regards to wind farm development, the zone wide constraints were determined to be the following:

- Presence of marine mammals throughout the MORL Zone;
- Presence of seabirds throughout the MORL Zone;
- Potential interference to military and civilian aviation radar;
- Existing oil and gas infrastructure;
- Although levels of navigation were low through the MORL Zone, there was potential for interference to navigation through the Zone area; and
- Potential interference to commercial fisheries. It was not possible using available data to identify “hot spots” of fisheries activity within the MORL Zone.

The shallowest water depths in the MORL Zone are within the WDA. However, of the entire MORL Zone, the WDA was considered to have more significant spatial constraints to wind farm development. These constraints included:

- Presence of a large section of the Ministry of Defence Practice Area (D807), at which time, an objection to turbine development was received from the Defence Estates because of the potential interference to aircraft training activities;
- Potential for development of the Polly Well within the Beatrice Oil Field;
- Potential interference to helicopter access within 6 nm of the existing oil platforms in the north-west of the MORL Zone;
- Potential interference to the navigation access route to the existing oil platforms in the north-west of the MORL Zone; and
- Closer proximity to the Moray Firth and Dornoch Firth & Morrich More SACs, compared to the eastern section of the MORL Zone.

For these reasons it was decided to develop the MORL EDA ahead of the WDA. Since the initial spatial analysis exercise and the grant of the consents for the MORL EDA, MORL has conducted a review of the development constraints for the MORL Zone. This review has identified that a number of key spatial constraints have since been removed or are currently programmed to be removed. As such the WDA now has greater potential for development.

The changes in constraints include the removal of Ministry of Defence Practicce Area (D807) and the planned decommissioning of the Beatrice Oil Field and Jacky Platform referred to above. Decommissioning of the existing oil infrastructure will remove constraints associated with the physical infrastructure, the required helicopter approach restrictions and associated navigational traffic to the site. MORL understands through discussions with Talisman Energy in April 2016 that decommissioning of the Beatrice Oil Field is currently anticipated to commence in 2017 and complete in 2021. It is also understood from Ithaca Energy that preparatory works for decommissioning of the Jacky Platform may commence in the summer of

2016 with removal of the platform expected to take place in 2017 subject to receiving DECC consent. In addition, MORL's understanding of both the potential effects of the development of offshore wind farms on the marine environment, including marine mammals, and assessment methodologies has advanced significantly since 2010.

Due to fewer development constraints now affecting the WDA together with the technical and economic advantages associated with shallower water depths MORL has determined that the remainder of the MORL Zone can be brought forward in this Scoping Report for the WDA.

1.2.4 Description of the Development

1.2.4.1 Design Envelope Approach

A Project Design Statement which outlines the proposed infrastructure, and the construction, operation and decommissioning methods can assist the EIA process. In the case of offshore wind developments of the proposed scale of the WDA, the developer must apply for consents several years in advance of commencing the construction process. At this stage much of the infrastructure (e.g. the larger turbines) are still at the concept stage and will not be ready until closer to construction.

Detailed engineering will be stepped up once consents are awarded. This is because of the costs associated with the detailed engineering process and particularly because it allows for further development and trialling of novel techniques and methods which are currently emerging allowing developers to take advantage of this progress. Therefore, it is intended that the application for consents will set out a series of maximum extents for which the significant effects are established. This is known as a 'Design Envelope'. The Design Envelope therefore describes the maximum extent of the project which is to be assessed in the EIA. The detailed design of the project can then vary within this 'envelope' without rendering the Environmental Statement inadequate.

The concept engineering for the WDA is ongoing, however, the range of concepts suitable for the infrastructure, and construction and operation methodologies have been identified to inform this Scoping Report. The Design Envelope under consideration for the WDA is explained in this section.

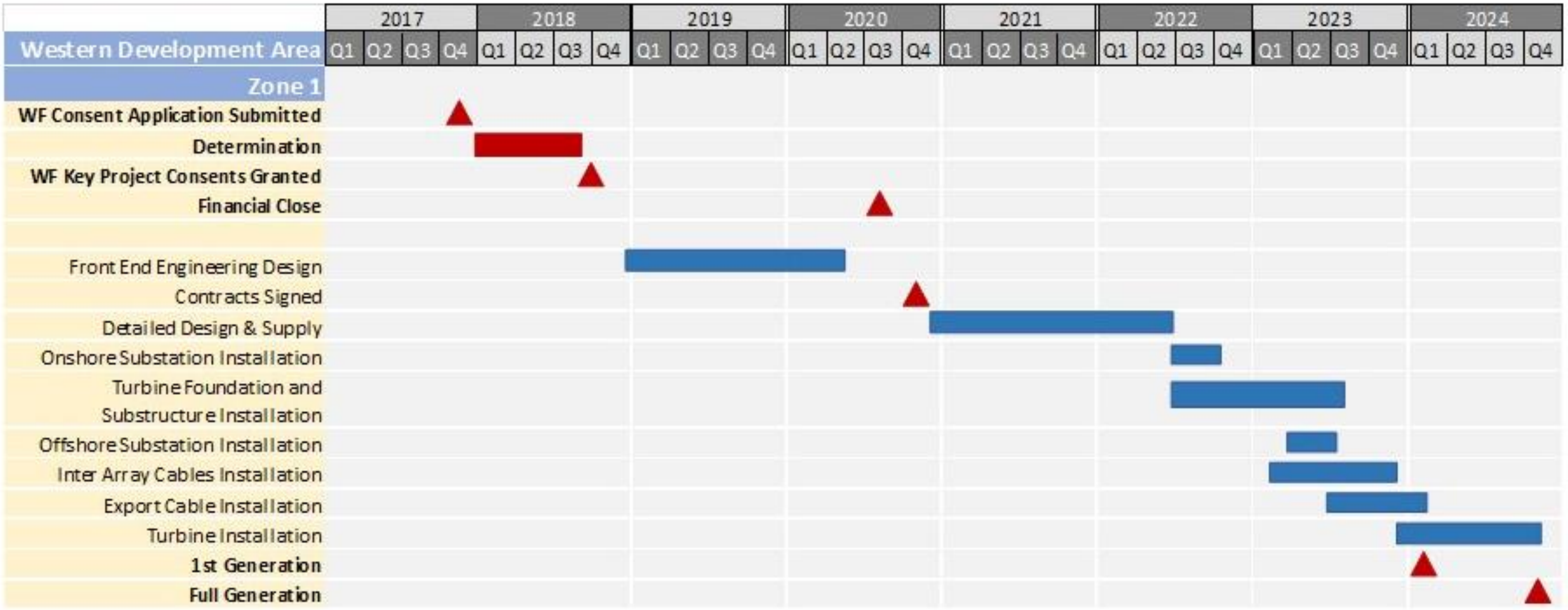
The realistic worst case scenario based on the options within the Design Envelope will be assessed in the EIA. Experience gained from the MORL EDA EIA process together with expert judgement has informed the identification of effects for this Scoping Report. The responses to this Scoping Report will inform the selection of the realistic worst case scenario for assessment in the WDA EIA.

1.2.4.2 Indicative Programme

An indicative timeline for development of the WDA is provided in Figure 1.2-1 below. The Scottish Government has set an objective for Section 36 consent applications to be determined within a 9 month period unless a public inquiry is held. Therefore, the award of consents would be anticipated for 2018. The date for commencement of construction, the number of construction phases and the corresponding final commissioning dates of the development will be dependent on the CfD process. The dates in the indicative programme below are based on assumptions in relation to the CfD process and are therefore subject to change. It is anticipated that a phased installation process would begin in 2022 and therefore first generation is anticipated in 2024.

Project definition of the MORL EDA project(s) and construction thereafter will follow on the award of any CfD(s) for the MORL EDA. It is anticipated that development of the WDA proposal and applications will coincide with MORL EDA construction. See Section 1.1.5 above for further information on the MORL Zone strategy.

Figure 1.2-1 WDA Indicative Programme



1.2.4.3 Offshore Wind Turbines

Table 1.2-1 provides a summary of the indicative wind turbine parameters proposed at this early stage of the development phase.

Table 1.2-1 Indicative Wind Turbine Parameters

Indicative Parameter	**Parameter Range**
Indicative Capacity (MW)	Up to 750 MW
Indicative Number of Turbines	Up to 90
Turbine Rating (MW)	8 – 15
Hub Height Range (m HAT)	97 – 147
Maximum Rotor Diameter (m)	250
Maximum Tip Height (m HAT)	272
Minimum Air Draft Range (m HAT)	22
Minimum Downwind Spacing (m)	1,200
Minimum Crosswind Spacing (m)	1,050
Layout Concept	The wind turbine layout will have some form of regularity in plan (i.e. Grid or Diamond patterns) with the exception of the wind turbines around the perimeter which could have a smaller spacing compared to the ones within the wind farm array. It should be noted that there may be empty spaces within the layout pattern.

It should be noted that as per the indicative programme in Section 1.2.4.2 above construction of the WDA is anticipated to commence in 2022 at the earliest. Parameters within the design envelope will reflect likely technological advancement within this timeframe. Further detail on the range of wind turbine parameters to be constructed will be provided in the Environmental Statement.

1.2.4.4 Offshore Wind Farm Infrastructure

Foundations and Substructures

This section includes information on the foundations and substructures for the wind turbines and meteorological masts (if required). Table 1.2-2 below provides a summary of the indicative parameters proposed at this early stage of the development phase for foundations and substructures.

Table 1.2-2 Indicative Foundation and Substructure Parameters

Infrastructure Type	**Indicative Parameter**	**Maximum Parameter**
Gravity Base Structures	Maximum Base Diameter (m)	81
Steel Lattice Jacket (with Pin Piles)	Maximum Number of Legs	4
	Maximum Width (m)	60
	Maximum Number of Piles per Foundation	4
	Maximum Diameter of Pile (m)	4
Steel Lattice Jacket (with Suction Caissons)	Maximum Diameter (m)	65
Suction Caisson	Maximum Diameter (m)	25
Monopile	Maximum Diameter of Pile (m)	12

The overriding factors influencing the choice of foundation and support structure for a specific project are the type of wind turbine to be used, nature of ground conditions in the area and water depth. Studies of the WDA ground conditions were carried out by Osiris in 2010 and Fugro in 2012.

Investigation on ground conditions in the MORL EDA have been undertaken in greater detail with detailed geophysical and geotechnical survey campaigns in 2010, 2014 and 2015.

Based on the known physical properties within the MORL Zone and the inherent uncertainty with the seabed properties a range of foundations and substructures are being considered for the WDA. These include the following:

- Three or four legged steel lattice jacket structure with pin piles;
- Three or four legged steel lattice jacket structure with suction caissons;
- Gravity Base Structures (GBS);
- Suction caisson; and
- Monopile.

At this scoping stage, MORL is not excluding any particular foundation type due to changing economic and technological circumstances that may prove one or another technology more appropriate nearer the time of construction.

Turbine support structures will include access facilities and appropriate lighting and marking for surface navigation. Options for the configuration of the support structures, and details of their potential environmental impacts, will be included in the ES.

Steel Jacket Structure

Jackets are steel structures with three or four legs, each of which is fixed to the seabed using a steel "pin" pile or use of a suction caisson. Jacket structures can assume different configurations with sub–concepts including braced monopods, tripod structures and three or four-legged lattice structures. Pin piles are generally expected to be driven but drilling may be required at some locations. Pin pile diameters would vary depending on specific design but are expected to be up to 4 m in diameter. It is possible that suction caisson foundations could be used at the base of the jacket instead of the pin piles. These would be of a greater diameter, possibly up to 15 m. Scour protection (e.g. scour mats or rock) may be used around each leg. Corrosion protection will be required for the steel structures, both above and below water level. This is likely to take the form of cathodic protection and / or protection coatings for the submerged areas, and protective coating for areas above the water line.

Gravity Base Structure

The generic GBS is composed of one or more hollow concrete base, which are filled with ballast for stability, and either a concrete or steel structure on top. The GBS may have a steel "skirt" which penetrates the seabed. The maximum base diameter of the structure is anticipated to be 81 m. The concept may require the preparation of the seabed with the installation of a flat gravel bed to provide a stable foundation for the GBS. Depending on the seabed soil conditions an area of seabed may require to be dredged prior to the installation of the gravel bed. If dredging is required it is expected that the area of seabed which is excavated will be greater than the final area of the laid gravel bed. In some cases, grouting injected under the GBS or rubber friction enhancing mats may be a suitable alternative to the gravel bed foundation. The placing of scour protection around the concrete base (graded rock placement, concrete mattress or scour mats) is likely. As with a steel jacket or monopile, corrosion protection will be required for any steel work (including boat landings and ladders) of the substructure. This is likely to take the form of cathodic protection and / or protective coatings for the submerged areas, and protective coating for areas above the water line.

Suction Caisson

This concept has had limited use to date in the offshore wind industry but has been used extensively in oil and gas as alternatives to piles at the base of jackets. The concept consists of a steel cylindrical skirt or skirts up to an anticipated diameter of 25 m which penetrate into the seabed. Corrosion protection will be required for this substructure. This is likely to take the form of cathodic protection and / or protective coatings for the submerged areas, and protective coating for areas above the water line.

Monopile

This concept is the most commonly used solution on operational wind farm developments to date in water depths typically ranging up to 35 m, but technology evolution is making possible its use in deeper waters. The structure consists of a steel cylindrical pile with an anticipated maximum diameter of 12 m. Conical transitions are occasionally used to reduce the diameter of the structure at the top of the foundation. Corrosion protection will be required for this substructure. This is likely to take the form of cathodic protection and / or protective coatings for the submerged areas, and protective coating for areas above the water line.

Scour Protection

The substructure and foundation concept as well as the environmental conditions (current and waves) determines the type and extent of scour protection required, and typically a 'scour allowance' is specified during the design phase.

Generally as foundation size increases the potential scour depth around the structure also increases and hence there is a greater need to protect the foundation.

Measures to minimise the extent of scour include the installation of rock armour on the seabed around foundations or the gravel bed in the case of a GBS foundation Such a method has been commonly used in the North Sea, including the MORL EDA Offshore Meterological Mast. This involves the placement of carefully specified graded rock to act as a scour protection blanket.

The suitability of installing rock armour or mattresses for cable protection especially around turbine bases will be assessed based on seabed sediment information and using the seabed current data across the WDA.

Inter-Array Cabling

Table 1.2-3 provides a summary of the indicative parameters proposed at this early stage of the development phase for the network of subsea inter-array cables that will connect the wind turbines to the OSPs.

Table 1.2-3 Indicative Inter-Array Cable Network Parameters

Indicative Parameter	**Parameter Range**
Configuration of Strings	Branched or Looped
Voltage of Cabling (kV)	33 to 72.5
Enrty / Exit Method from Turbine	J-tube or Flexible Conduit Type Arrangement
Target Burial Depth (m)	0 - 3
Indicative Cable Installation Method	Ploughing, Jetting, Trenching, Rock Cutting
Protection where Burial Unachievable	Rock Placement, Concrete Mattresses, Propietory Steel, Plastic Ducting, Protecting Sleeves, Grout Bags

The electrical infrastructure required in order to collect the energy generated by the wind turbines will comprise of inter-array cabling between the turbines and any OSP(s). These cables are likely to be designed to operate at a voltage in the range of 33 to 72.5 kV and may include fibre-optic communication links. All other electrical infrastructure required to transmit power to the onshore tranmission network will ultimately be owned and operated by an OFTO under the offshore tranmission regulatory regime. These further aspects of the electrical infrastructure, including onshore electrical infrastructure, will be covered by a separate WDA Transmission Infrastructure Scoping Report.

At this stage it is anticipated that the subsea inter-array cables will be buried to a target depth of up to 3 m other than close to turbine and substation foundations and areas where ground conditions make it impracticable. The actual design depth of burial will be addressed in the concept development and defined in the Front End Engineering Design (FEED), based on a number of factors, including seabed conditions, potential environmental effects, fishing and other activities e.g. dropped object risk assessments etc.

1.2.4.5 Offshore Transmission Infrastructure

As mentioned above, the purpose and functions of the offshore and onshore transmission infrastructure associated with the WDA will be detailed in a separate WDA Transmission Infrastructure Scoping Report. The following sections aim only to provide stakeholders with an overview of the entire offshore wind farm development as it would exist in operation.

Electrical Infrastructure

The project will require electrical transmission infrastructure for transferring the energy generated by the wind turbines into the wider electrical transmission system. The transmission owner in the project area is Scottish Hydro Electric Transmission (SHE-T), however MORL's connection agreement will be with National Grid. MORL may adopt a generator build approach, whereby the transmission assets associated with the wind farm are developed and constructed by MORL on behalf of the OFTO and later transferred to the ownership of the OFTO. See Section 1.1.7 above for further detail. The EIA associated with the offshore transmission infrastructure will be subject to a separate Scoping Report and potentially a separate EIA and ES. However, a description of the infrastructure that is likely to be required is provided below.

The electrical infrastructure required will comprise the following:

- OSPs: one or more platforms, located within the Project area housing substations which will form the interface between the inter-turbine cables and the offshore export cable transmission system. These typically incorporate step-up transformers and associated equipment for the purpose of increasing the system voltage for transportation of power down the Offshore Export Cable Transmission System. The Offshore Substation Platforms are likely to be high voltage alternating current (HVAC) stepping up the inter-array voltage in the range 33 – 72,5 kV to the export cable voltage in the range of 132 - 400kV. High voltage direct current (HVDC) offshore substations may be used depending on overall wind farm capacity and length of export cable route, to step up the voltage and to convert to DC the energy collected by the inter-array cables;

- Offshore Export Cable Transmission System: one or more submarine export cable circuits between the offshore platforms and the landfall point, which are used to transmit the energy generated by the wind turbines to the shore. The export cable circuits are likely to be high HVAC and use a voltage in the range of 132 - 400kV. HVDC may be used depending on overall wind farm capacity and length of export cable route. The cable circuits may include fibre optic communication links, either embedded within the power cables or as separate cables;
- Cable Landfall: The point at which the submarine cables are physically brought ashore. The method of achieving this will be subject to further assessment once the landfall site has been identified;
- Onshore Export Cable Transmission System: a number of underground cable circuits which transmit the energy generated by the wind turbines from the landfall point to the onshore substation. The cable circuits may include fibre optic communication links, either embedded within the power cables or as separate cables running alongside the power cables;
- Onshore Substation: the substation collecting the power transmitted from the offshore and onshore export cable circuits and adapting it to the required conditions of the Transmission System Connection point (i.e. voltage level and HVAC or HVDC conversion). A number of cables are likely to connect the onshore substation to the Transmission System Interface Point. Should HVDC be selected an onshore convertor substation will be required; and
- Transmission System Interface Point: the interface with SHE-T's transmission network and the wider transmission system operated by National Grid.

The design of the electrical infrastructure is at an early stage. In order to provide the required level of detail on the development that will be required for the EIA, options are currently being considered by MORL for the following key components:

- Type, number and location of turbines;
- Number and location of offshore substation platforms;
- Subsea cabling specification (AC or DC, voltage levels e.g. 33kV / 66kV / 132 kV / 220kV / 400 kV);
- Inter-array cabling characteristics;
- Number and route of subsea export cables;
- Location of cable landfall site;
- Offshore export routes between the OSP(s) and the landfall point, and the onshore export cable route and the onshore substation; and
- Location of transmission system connection point and onshore substation.

Cable Landfall

The choice of sites for the cable landfall will be subject to investigation and assessment and will be guided by the identification of an onshore substation location which will be dependent upon the grid connection offer from National Grid. All potential options will be considered in terms of technical, environmental and commercial terms before a final decision is made.

1.2.4.6 Meterological Mast(s) and Other Monitoring Equipment

Meteorological masts are used to measure the meteorological characteristics of the area. Meterological data currently available for the WDA is limited. MORL has been gathering wind resource data from a meteorological mast installed in the MORL EDA (See Figure 1.1-2 above). This data has fed into the detailed design of the MORL EDA, however, it also gives MORL an indication of the likely wind resource on the MORL WDA. MORL has also been collecting wind data from the following sources:

- Fixed Lidar on the Jacky Platform;
- An Onshore Meteorological Mast situated in Lybster;
- A fixed Offshore Meteorological Mast in the MORL EDA; and
- Numerical weather predictions.

As part of the WDA further meteorological measurement devices are likely to be used. The devices to be deployed may include the following:

- Fixed Offshore Meteorological Mast(s);
- Onshore Meteorological Mast located close to the shoreline;
- A LiDAR system on a fixed platform; and
- Floating LiDAR system.

Depending on the development of new measurement techniques other devices may include a Floating Meteorological Mast.

The exact locations of all the instrumentation have yet to be decided. Similarly, the foundation and substructure is yet to be determined.

The required consents and licences will be sought for all proposed meteorological and oceanographic equipment that may need to be installed throughout the development process.

1.2.4.7 Wind Farm Construction

Environmental Management

Prior to construction, a comprehensive Environmental Management Plan (EMP) will be developed in consultation with statutory consultees and any other stakeholders as advised by MS-LOT, with a suite of complementary management plans corresponding to different aspects of the construction activity. The EMP will form part of the Project Procedures with which all contractors will be required to comply. The documents, which will be tailored specifically to ensure compliance with the consent conditions for the project and current environmental best practice, will include the following:

- Monitoring Protocol (as per statutory consents);
- Incident Reporting and Non Conformance Procedure;
- Emergency Response Plan;
- Collision Risk Management Plan;

- Marine Pollution Contingency Plan;
- Dropped Objects and Materials Recovery Plan;
- Archaeological Plan;
- Noise, Dust and Vibration Management Plan; and
- Waste Management Plan.

Construction

Construction of the WDA is anticipated at this stage to occur between 2022 and 2024. See Section 1.2.4.2 above for an indicative programme.

Only limited information is available at present on the nature of the construction process, since the major parameters of the development have not yet been defined in detail. Key aspects in defining the construction methodologies (and therefore the likely construction activities) will be based on the following:

- Port(s) used as a base for the construction phase; and
- Vessels to be used for the offshore construction works.

Decisions on these will also be influenced by the nature of the foundations / substructures to be used, which will be addressed during the EIA phase. More detail on the options for ports and vessels will be provided in the ES. However, for the purpose of this document, it can be assumed that the principal stages of manufacturing and transporting the various wind farm components to site within the WDA are likely to be as follows:

- Manufacture of components (including foundations, towers, nacelles, blades, gearbox, generators etc, as well as electrical components);
- Transport of components to the area;
- Storage and assembly of components as required at the port location(s) chosen as the construction base;
- Marine transportation of components to site of installation; and
- Moving construction vessels to the installation site.

It can be assumed that the key stages associated with the installation of the wind farm are likely to be as follows:

- Pre-construction site investigation (i.e. Cone Penetration Test (CPT) / boreholes);
- Detailed pre-construction geophysical surveys;
- Detailed unexploded ordnance surveys;
- Foundation installation and associated site preparation;
- Disposal, if necessary, of any spoil excavated during installation;
- Inter-array cabling installation and associated site preparations; and
- Installation of tower, nacelle, hub and blades.

Works associated with the OFTO are likely to include:

- Installation of OSP(s);
- Offshore export cable circuit(s) installation; and
- Construction of the required onshore electrical infrastructure (such as underground terrestrial cable circuits and substations) to link the development to the National Grid transmission system, and associated traffic).

Dredging may be required on-site for installation of foundations. The nature and volume would be site specific and will be finally determined through further ground investigation. MORL will explore the possibility of disposing dredged material on-site or alternatively at an appropriate licensed disposal site. MORL would also look to re-use any material within the installation process e.g. scour protection or ballast material.

Prior to installation it is likely that MORL will have to undertake an exercise to clear boulders from some areas of the worksite. This may be required for turbine or foundation installation and for the laying and burial of inter-array cabling. Should boulders be present within areas in which inter-array cable will be installed then it is anticipated that a towed plough device will be used to clear the affected area of seabed. The boulder clearance plough will re-distribute any boulders that it encounters leaving a clear path for the subsequent cable lay and burial activities. In areas of erratic boulders a grab device may be be used to pick up individual boulders and to re-distribute them to a suitable location within the local vicinity clear of the worksite. It is likely that prior to installation un-exploded ordnance (UXO) identification and removal will be required on-site. This may be required for turbine or foundation installation and laying of inter-array cabling. Further detailed pre-construction ground investigation will be undertaken by MORL in order to identify areas where UXOs are present on-site.

It should be noted that construction compounds and storage facilities are likely to be required at the ports used as the construction base(s). In addition, construction compounds, laydown areas and access / haulage tracks are likely to be required for the construction of any onshore electrical infrastructure.

It is likely that the installation of cables between wind turbines within the array and from the wind farm to the shore will be performed from floating or submerged craft. The applicability / suitability of burying the cables will be assessed using a detailed trenching review and burial protection index study.

1.2.4.8 Wind Farm Operation and Maintenance

Access to Sites

Operation and maintenance of the offshore wind farm(s) will continue 24 hours per day; 365 days per year, and therefore the development will require access to the site at any time.

Lighting and Marking

The lighting and marking of the wind farm will be agreed with MS-LOT in consultation with the Northern Lighthouse Board, the Maritime and Coastguard Agency (MCA), the Civil Aviation Authority (CAA) and the Ministry of Defence (MOD).

The positions of the wind turbines, subsea cables and ancillary structures will be conveyed to the UK Hydrographic Office (UKHO) so that they can be incorporated into Admiralty Charts and the Notice to Mariners procedures.

Wind Farm Control

Once commissioned, the wind farm(s) will operate automatically with each turbine operating independently of the others. The operation and control of the wind farm(s) will be assessed by a Supervisory Control and Data Acquisition (SCADA) system, installed at each turbine and at the onshore control base. The SCADA system will enable the remote control of individual turbines or the wind farm in general, as well as information transfer, storage and the shutdown of any wind turbine in emergency circumstances.

Environmental Management

The wind farm will be designed, constructed and operated to a high standard, incorporating the appropriate levels of environmental control. Effective and environmentally aware management will minimise the effect of the development on the local environment throughout the lifetime of the wind farm.

MORL will require the main contractors responsible for construction, operation and decommissioning of the wind farm to operate an Environmental Management System in accordance with ISO 14001 and the appropriate 'best practice' guidelines will be in place at the time of decommissioning.

Wind Farm Inspection and Maintenance

The wind farm will be serviced and maintained throughout its life (approximately 50 years with repowering) from a local port. Maintenance of a wind farm is normally separated in to three categories:

- Periodic overhauls;
- Scheduled maintenance; and
- Unscheduled maintenance.

Periodic Overhauls

These will be carried out in accordance with the turbine manufacturer's warranty. They are planned for execution in periods of the year with the best conditions, preferably in the summer.

They are carried out according to the supplier's specifications and typically include function and safety tests, visual inspections, analysis of oil samples, change of filters, lubrication, check of bolts, replacement of brake pads, oil change for the gear box or hydraulic systems, etc.

Scheduled Maintenance

This applies primarily to inspections and work on wear parts susceptible to failure or deterioration in between the periodic overhauls. A scheduled inspection of each turbine is likely to occur every 6 -12 months. Tasks will typically include inspection on faults and minor fault rectification.

Scheduled maintenance will be performed using small personnel craft operated from the local harbour.

Inspections of support structures and subsea cables will be performed on a regular basis as will ad-hoc visits for surveillance purposes.

Unscheduled Maintenance

This applies to any sudden defects. The scope of such maintenance would range from small defects to complete failure or breakdown of main components. Such maintenance would require the intervention of vessels similar to those involved with the construction of the wind farm.

1.2.4.9 Wind Farm Decommissioning

The TCE Scotland lease for the WDA will be for 50 years, with the design life of the turbines and other components of the wind farm being of a similar order when repowering is considered. Decommissioning requirements are set out in the Energy Act 2004 and will influence all stages of design of the wind farm. This will be a key requirement under TCE Scotland lease agreement. Decommissioning will be addressed in the ES.

The wind turbines, cables and foundations / substructures will be decommissioned following the end of their operational life. The extent of decommissioning is dependent on the type of foundations / substructures adopted, and options will be assessed in conjunction with the design of the development in the ES.

A decommissioning programme will be produced prior to construction. This will be developed using best practice guidance, including DECC guidance (DECC, 2011a) under the Energy Act 2004 or any applicable guidance which succeeds it.

1.2.4.10 Ports and Harbours

Ports and or harbours will be required during both construction phases and operation and maintenance phases of the project. During the construction phase, deepwater ports with facilities for pre-assembly (e.g. site office, laydown areas, warehouses etc) will be required. The ports or harbours used during the operation and maintenance phase are likely to be smaller than that used during construction with deepwater ports required for major corrective work. MORL will identify and agree which ports and harbours will be used during the lifetime of the development phase prior to construction.

During the wind turbine commissioning period, as part of the contruction phase and to supplement the access with crew transfer vessels, an offshore floating base (flotel vessel) may be positioned within the site. This will provide accommodation for personnel and a mobile base from which smaller crafts (crew transfer vessels or similar) will be launched to approach the different turbine locations.

During the operation and maintenance phase, different means of access can be used from the O&M port, including crew transfer vessels, helicopters or a floating base for personnel (flotel vessel) positioned within the site.

The port may also take the role of marine coordination and base for issuing of permits to work during the construction phase.

1.3 Environmental Impact Assessment Methodology

1.3.1 The EIA Stages

The requirements for EIA are discussed in Section 1.1.6.4 above. The following section provides a high-level description of the EIA stages and process. Detailed discussions will be had with MS-LOT and stakeholders on the assessment methods to be used during the preparation of the EIA.

1.3.1.1 Screening

A screening assessment is used to determine whether EIA is necessary. Installations for the harnessing of wind power for energy production (wind farms) are Annex II development within the meaning of the EIA Directive. It is therefore common practice to undertake EIA for offshore wind farm developments of greater than 50 MW and for this reason, there was no need for MORL to carry out the screening stage of the EIA process.

1.3.1.2 Scoping

Where a development is required to undergo EIA, then the developer may request a Scoping Opinion from the consenting authorities which will assist in the identification of environmental issues and likely significant effects to be considered, as well as discussing methods of impact assessment. This Scoping Report is intended to support the authorities in providing their advice.

1.3.1.3 Environmental Impact Assessment

EIA is a process that identifies the aspects of the environment likely to be significantly affected by aproject, and which describes the likely significant environmental effects of the project. It also identifies the methodologies employed to assess the main effects that the project is likely to have on the environment both on its own and cumulatively with other projects. EIA also involves consideration and description of the measures envisaged to prevent, reduce and offset any significant adverse effects on the environment and a summary of the residual effects of the development after mitigation. The assessment covers the full life cycle of the development, from pre-construction to decommissioning.

The information resulting from the EIA process is presented in an Environmental Statement so that a decision maker has full information on the likely significant environmental effects of a proposed development, at the time that the decision on whether to grant consent is made.

1.3.2 Environmental Impact Assessment Process

1.3.2.1 Baseline Data Gathering

Baseline data will be gathered using a combination of:

- Desk-based research;
- Existing survey data; and
- Site specific surveys and studies.

The scope of any site specific surveys and studies will be influenced by the desk-based and existing survey data information available and the opinions of the consenting authorities and other relevant stakeholders.

1.3.2.2 Scope of the EIA

The effects to be assessed will be determined through the responses to the scoping request, which this Scoping Report supports.

1.3.2.3 EIA Method

The likely significance of the environmental effects identified, both before and after mitigation, will be assessed using a standard approach. The details of the approach will be tailored to the specific characteristics of individual disciplines, following discussion with relevant specialists and the consenting authority.

The significance of an effect is based on an initial two phased approach to determine (i) the magnitude of the likely effects and (ii) the sensitivity of the receptor. The criteria used to classify both effect magnitude and receptor sensitivity will be substantially guided by current receptor specific guidance documents and best practice.

Effects include direct effects and any indirect, secondary, cumulative, short, medium and long term, permanent and temporary, positive and negative effects of the development, resulting from:

- The existence of the development;
- The use of natural resources; and
- The emission of pollutants, the creation of nuisances and the elimination of waste.

The ES will also describe the forecasting methods used to assess the effects on the environment.

1.3.2.4 Mitigation and Residual Effects

Where likely significant adverse effects are identified, mitigation measures will be considered to reduce the level of significance. The effect of the mitigation will be tested and the significance of residual effects will be determined.

1.3.2.5 EIA Linkages

The discipline specific assessments will consider the inter–relationships between the aspects of the environment that are likely to be affected by the construction, operation and decommissioning of the WDA proposals.

The consideration of inter–relationships is required under the EIA Directive, which states that an ES should include:

"An assessment of the aspects of the environment likely to be significantly affected by the proposed Project, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the inter–relationship between the above factors."

These inter–relationships are explained further in Table 1.3-1 below.

Table 1.3-1 Example of inter-linkages within the EIA

	Physical Processes	**Benthic Ecology**	**Fish and Shellfish Ecology**	**Marine Mammals**	**Ornithology**	**Commercial Fisheries**	**Shipping and Navigation**	**Seascape, Landscape and Visual Receptors**	**Archaeology and Cultural Heritage**	**Socio-Economics**	**Other Human Activities**
Physical Processes		√	√			√			√		
Benthic Ecology	√		√	√	√	√	√				
Fish and Shellfish Ecology	√	√		√	√	√					
Marine Mammals		√	√			√	√			√	
Ornithology		√	√			√	√				
Commercial Fisheries	√	√	√	√	√		√			√	
Shipping and Navigation		√		√	√	√			√	√	√
Seascape, Landscape and Visual Receptors									√	√	
Archaeology and Cultural Heritage	√						√	√		√	
Socio-Economics				√	√	√	√	√			
Other Human Activities							√				

Inter–relationships will be considered within each relevant ES chapter and will be identified once the scope of the assessment is clarified.

1.3.2.6 Cumulative EIA Methodology

There is also a requirement to consider cumulative effects as part of the EIA process. Projects to be included in such an assessment will include existing projects, consented projects, those currently in the planning system and (where adequate information is available) other relevant future projects not yet in a consenting process, with potential to affect the same sensitive receptors as the WDA proposals.

There is no single statutory definition of what a cumulative effect is; however guidance is provided as to how the term should be defined. European Commission Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions (European Commission, 1999) provides the following definition of cumulative effects:

"impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the Project. For example:

- *Incremental noise from a number of separate developments;*
- *Combined effect of individual effects, e.g. noise, dust and visual, from one development on a particular receptor; and*
- *Several developments with insignificant effects individually but which together have a cumulative effect".*

Additionally, the EC guidance refers to 'impact interactions' which themselves can combine to create a cumulative effect, defined as follows:

Impact interactions are *"the reactions between impacts whether between the impacts of just one project or between the impacts of other projects in the area"*.

Examples of this are:

- A chemical plant producing two streams of waste that are individually acceptable but react together to produce highly significant levels of pollution;
- Emissions to air from one project reacting with emissions from an existing development; and
- Two major developments being constructed adjacent to one another and during overlapping time periods will have many interactive impacts, from visual impacts to construction and operational noise.

To ensure consistency across assessments a comprehensive table of relevant developments and activities will be created and agreed with MS-LOT. Developments/activities which may be relevant include, but are not limited to:

- Offshore wind farm infrastructure;
- Oil infrastructure and decommissioning activities;
- Marine energy developments;
- Existing commercial fisheries, including aquaculture;
- MoD operations (where known);
- Cable and/or pipelines;
- Aviation activities;
- Shipping activities;
- Port redevelopments;
- Dredging / aggregates; and
- Sea disposal.

The final cumulative impact assessment methodology and projects to be included in the cumulative assessments will be confirmed following the Scoping Opinion response and discussions with relevant stakeholders and the MS-LOT.

The method for cumulative impact assessment will be carried out in accordance with the methods outlined within the Moray Firth Offshore Wind Developers Group (MFOWDG) discussion document 'Moray Firth Offshore Wind Developers Group Cumulative Impact Assessment Discussion Document' (MORL, 2012) unless otherwise agreed with MS-LOT and appropriate stakeholders. This document has been included as Annex 1 to this Scoping Report.

1.3.2.7 Transboundary Effects

Article 7 of the EIA Directive (see Section 1.1.6.4 above), requires the assessment of transboundary effects where a project implemented in one Member State is likely to have significant effects on the environment of another Member State. Given the location of the WDA, the potential for transboundary effects are considered to be unlikely and therefore are not included in this scoping report.

If concerns are raised that there is the potential for transboundary effects, the project will undertake an assessment of the potential effects in line with the 1991 UN Economic Commission for Europe Convention on Environmental Impact Assessment in a Transboundary Context (the Espoo Convention) and the Guidance on the Application of the Environmental Impact Assessment Procedure for Large-scale Transboundary Projects (European Commission, 2013a).

1.4 Stakeholder Consultation

At the outset, when development of the MORL EDA commenced in 2010 MORL made a commitment to work with the organisations, individuals and communities who have an interest in the development of the MORL Zone whether as a result of their activities or their location in order to enable the development of offshore wind in the Outer Moray Firth to benefit from the considerable experience of the communities who live and work there, and to allow the project to develop with the involvement of the individuals and organisations affected by and interested in the development.

MORL has established strong relationships with local stakeholders and remains committed to engaging with communities, organisations and individuals, to address any concerns they may have. This will be achieved through the various processes including letters, meetings, events and exhibitions, newsletters and the Moray Offshore Renewables website (morayoffshorerenewables.com).

As part of the EIA, a full public consultation will be undertaken. This will involve the mapping of stakeholders and representative organisations and individuals who have a geographic or topical interest in the offshore wind farm infrastructure works and their impact, in order that a communications strategy can be deployed to seek views and comment on the proposals.

The consultation will initially focus on the publication of this Scoping Report for the EIA; which will be distributed to identified stakeholders and their opinion sought within a defined consultation period.

MORL will also ensure that consultation is carried out in compliance with the Marine Licensing (Pre-application Consultation) (Scotland) Regulations 2013. A pre-application publication report, will be prepared and submitted with the marine licence application for the WDA offshore wind farm and this will include:

- A description of the consultation event(s);
- A description of the information provided by MORL at the event(s);
- Comments received by MORL at the pre-application event(s);
- A description of amendments to be made to the marine licence application;
- Where applicable an explanation for the approach taken where no alterations are proposed to be made to the marine licence application where comments or objections are received.

Communications will be tailored to suit the geography of the chosen site, and activities during this period will include meetings with relevant stakeholder groups, local public exhibitions, and use of the local authority and community council frameworks to disseminate appropriately targeted literature to stakeholders, and to gather opinion on these proposals.

Communications with these stakeholder groups will be co-ordinated by MORL Communications Manager, Craig Milroy.

2 Physical Environment

2.1 Introduction

This section presents the main characteristics of the offshore physical environment for the WDA. The following topics are covered:

- Physical Processes (Including Bathymetry, Metocean and Geology, Sedimentary Environment and Water Quality);
- Air Quality; and
- Airborne Noise.

In each topic the relevant baseline characteristics, identified potential effects from construction, operation and decommissioning of the WDA and the proposed approach for the EIA are set out. Relevant datasets and specific guidance have been listed where appropriate.

2.2 Physcial Proccesses

This section describes the Physical Processes baseline environment and potential effects associated with the WDA. Information on the WDA baseline characteristics have been derived mostly from the MORL ES 2012. The Physical Processes ES Chapter and Technical Appendices can be accessed via the following links – Chapter 3.1 – 3.5 Bathymetry, Geology, Wind Climate, Hydrodynamics and Sedimentary and Coastal Processes and Technical Appendix 3.4 A Metocean and Coastal Processes Baseline, Technical Appendix 3.4 B Metocean and Coastal Processes Numerical Modelling and Technical Appendix 3.4 C Metocean and Coastal Processes Impact Assessment. Table 2.2-1 below lists the proposed datasets that will inform the assessment.

Table 2.2-1 Datasets for the physical processes EIA

Dataset	**Coverage**	**Date**
Bathymetry and Geological Data		
Geophysical survey (Osiris Projects)	MORL Zone	May –Jul 2010
Geotechnical survey (Fugro)	MORL Zone	2012
British Geological Survey (BGS) 1:250,000 surface sediment maps	UK	1984, 1987
Regional Geology and Geomorphology	Moray Firth	1990, 2005
Metocean surveys – OBS turbidity sensors (Partrac)	MORL Zone	Jul 2010 – Jan 2011
Metocean surveys – OBS turbidity sensors	BOWL site	2010
Current Data		
NOC Surge Statistics Locations	58.167, -3.250 58.167, -2.750	n/a

Dataset	**Coverage**	**Date**
AWAC data	MORL Zone	Jul 2010 – Jan 2011
AWAC data	BOWL site	Feb – Mar 2011
BODC Data Archive	Regional points as appropriate	As per data source
Numerical tidal model	MORL Zone	2012
The Scottish Shelf Model. Part 2: Pentland Firth and Orkney Waters Sub-Domain	Pentland Firth, Orkney, Shetland and the Moray Firth	2015
Wave Data		
Directional Wave Buoy	MORL EDA	Jun 2010 - Jul 2012
AWAC data	MORL Zone	July 2010 - Jan 2011
AWAC data	BOWL site	Feb – Mar 2011
Directional Wave Buoy	BOWL site	Feb 2010 - Nov 2010
WaveNet Moray Firth wave buoy (Cefas)	57.97, -3.33	Aug 2008 – Feb 2014
Jacky Platform Wave Buoy	58.183, -2.979	Nov 2008 – Jun 2010
Numerical wave model	MORL Zone	1980 - 2012
Numerical wave model	MORL EDA	1957 - 2013
The Scottish Shelf Model. Part 2: Pentland Firth and Orkney Waters Sub-Domain	Pentland Firth, Orkney, Shetland and the Moray Firth	2015
Stratification Data		
CDT sensor on MORL offshore met mast (Sea temp, pressure & conductivity)	MORL Zone	From Jun 2015
Temperature and salinity data (Partrac)	MORL Zone	Jul 2010 – Jan 2011
Temperature and salinity data	BOWL site	2010 - 2011
JNCC Coastal Directory Series: Regional Report 3 North East Scotland	Cape Wrath to St Cyrus	1996
OSPAR Quality Status Report	Greater North Sea	2000
Strategic Environmental Assessment - SEA 5	UK	2004

Dataset	**Coverage**	**Date**
The Scottish Shelf Model. Part 2: Pentland Firth and Orkney Waters Sub-Domain	Pentland Firth, Orkney, Shetland and the Moray Firth	2015
Sea Levels		
AWAC data	MORL Zone	Jul 2010 - Jan 2011
AWAC data	BOWL site	Feb – Mar 2011
Wick tide gauge	Wick	1965 - present
Admiralty Publications	Moray Firth region	n/a
VORF	Moray Firth region	n/a
NOC Surge water level predictions	58.167, -3.250 58.167, -2.750	n/a
Wind Data		
MORL offshore met mast	MORL Zone	From Jun 2015
MORL onshore met mast	Lysbter	From Sep 2012
LiDAR on Jacky platform		From Jul 2011
Numerical weather models	WDA	1995 - 2016
Wick Airport anemometer	Wick	From 1996
Lossiemouth anemometer	Lossiemouth	1976 - 1988

The guidance documents to be used in the preparation of the EIA include:

- Cefas (2004). Offshore Wind Farms: Guidance Note for Environmental Impact Assessment in Respect of Food and Environmental Protection Act (FEPA) and Coast Protection Act (CPA) Requirements: Version 2.
- COWRIE (2009). Coastal Process Modelling for Offshore Wind Farm Environmental Impact Assessment: Best Practice Guidance.
- EMEC & Xodus Aurora (2010). Consenting, EIA and HRA Guidance for Marine Renewable Energy Deployments in Scotland. Report commissioned for Marine Scotland.
- Maritime and Coastguard Agency (MCA) (2016). Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response. MCA Guidance Note Marine Guidance Note (MGN)543.

- Office of the Deputy Prime Minister (2001). Guidance on Environmental Impact Assessment in Relation to Dredging Applications.
- Surfers Against Sewage (2009). Guidance on Environmental Impact Assessment of Offshore Renewable Energy Development on Surfing Resources and Recreation.

2.2.1 Bathymetry

2.2.1.1 Baseline Characteristics

The sections below provide summaries of the regional bathymetry, geology and sedimentary environments. Full descriptions of these environments are provided in MORL ES 2012; Chapter 3, subsections 3.1 - 3.5. Details of the specific WDA characteristics have been obtained from Osiris (2011).

Bathymetry: Regional Context

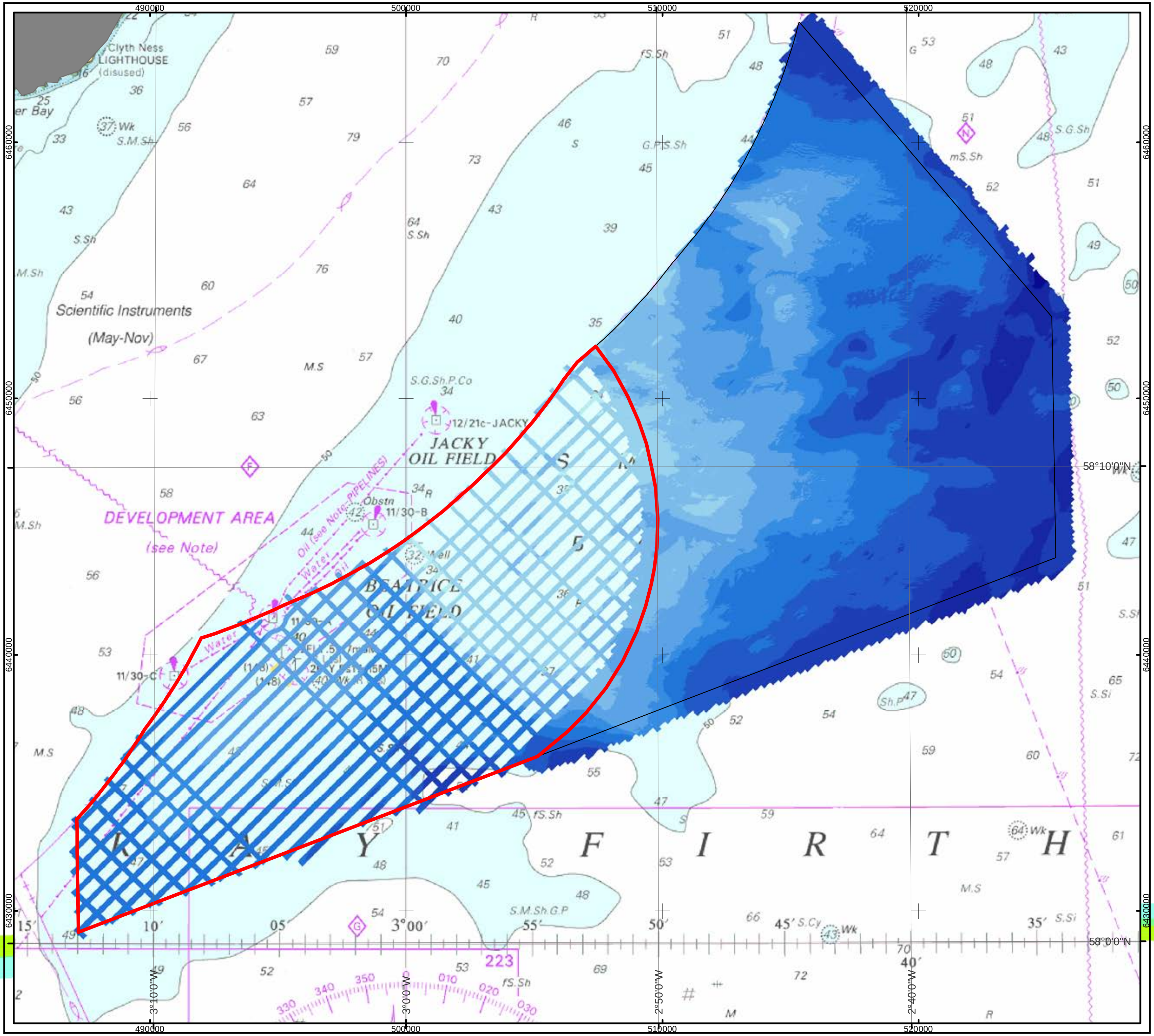
The WDA is located on the western flank of the Smith Bank, a morphological high point in the outer Moray Firth measuring, approximately, 35 km long from south-west to north-east, and 20 km wide (225 km^2). The Smith Bank is separated from the Caithness coast to the north by a relatively deep channel (up to approximately 75 mCD). Other sedimentary features smaller than the Smith Bank are also present in the central parts of the outer Moray Firth. The southern part of the outer Moray Firth is characterised by a long deep channel feature (the Southern Trench) which is up to approximately 220 mCD.

Official estimates of the effects of global climate change by the United Kingdom Climate Change Impact Programme (http://www.ukcip.org.uk/) suggest that by 2050, relative sea level in the Moray Firth will have risen between 0.22 and 0.35 m above 1990 levels. This will be apparent as an increase in water depth (bathymetric depth) below the relevant vertical datums (e.g. lowest astronomical tide (LAT)).

Bathymetry: WDA

A high resolution swath bathymetry survey of the WDA was undertaken between May and September 2010 and is shown in Figure 2.2-1 below (Osiris, 2011). The survey provides 20% coverage in a coarse but regular grid. The WDA has depth ranges between approximately 35 m below LAT at the northern boundary with the MORL EDA, and a depth of 54 m below LAT at the southern limits of the WDA. The northern section of the WDA predominately covers a depth range of 35 to 45 m below LAT, and below this, a step is present where the seabed deepens from approximately 40 m to approximately 47 m below LAT. To the south-west of this step, the seabed is at its deepest, between 47 to 53 m below LAT.

The WDA is also characterised by shallow troughs and sand ridges which range in height between 0.3 to 1.2 m.



edp renewables

Moray Offshore Renewables Ltd

KEY

Bathymetry Depth, m (LAT)

- -60 - -57
- -56.9 - -55
- -54.9 - -52
- -51.9 - -50
- -49.9 - -47
- -46.9 - -45
- -44.9 - -42
- -41.9 - -40
- -39.9 - -37
- -36.9 - -35
- 🟥 Western Development Area
- ☐ Eastern Development Area

Horizontal Scale: 1:200,000
A4 Chart
0 2,500 5,000 Meters
N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: PL
Approved: SP

Date: 04/05/2016
Revision: A

REF: 8460001-PQW0010-MOR-MAP-003

Figure 2.2-1
Bathymetry MORL Zone
Geophysical Survey, 2010

Moray Offshore
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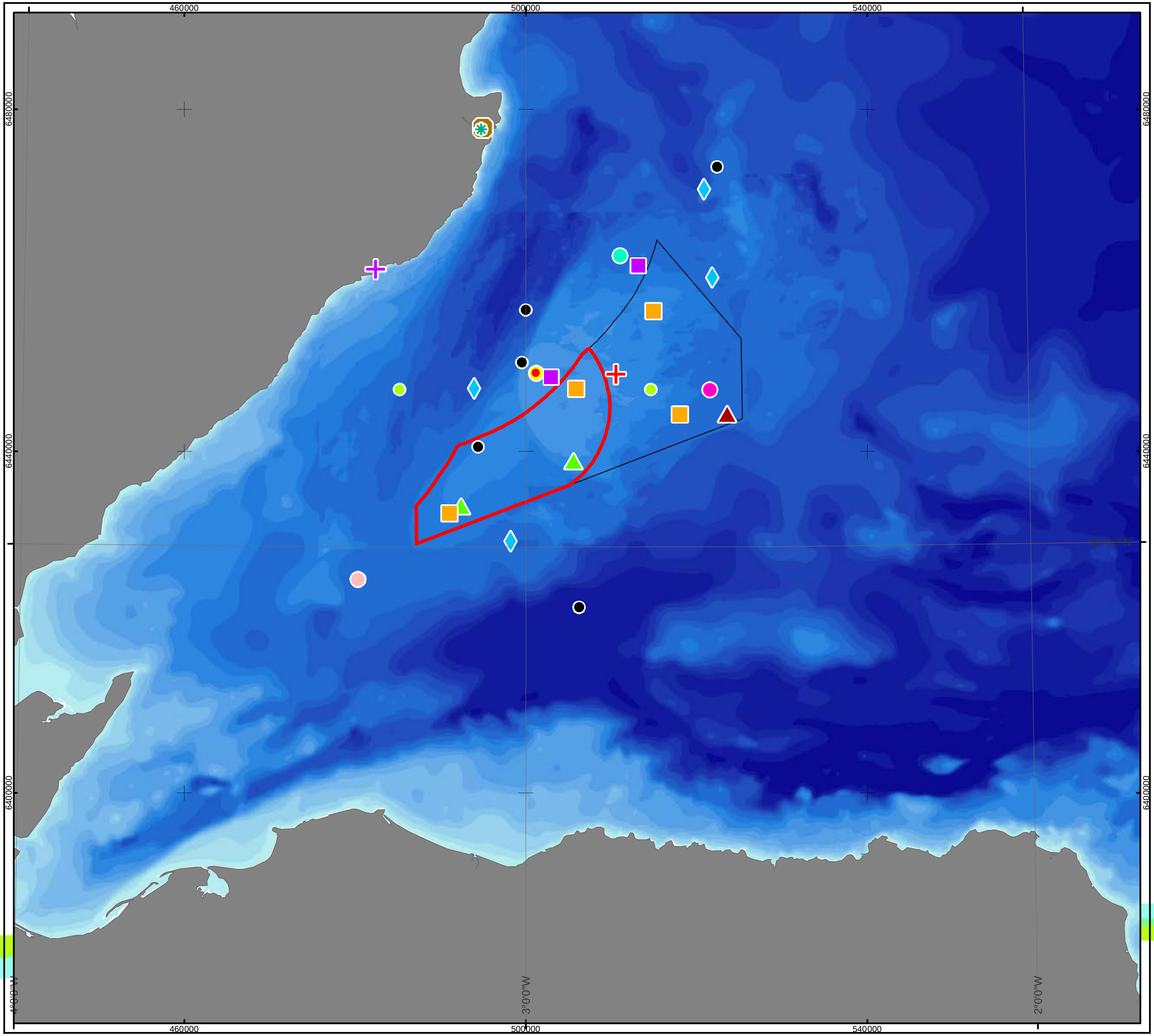
2.2.1.2 Data Gaps

It is considered that the available data is sufficient to identify any potential effects on bathymetry.

2.2.2 Metocean

2.2.2.1 Baseline Characteristics

Due to the proximity, the WDA is expected to have the same hydrodynamic conditions as the EDA, which are described in the following paragraphs. The information below has been obtained from MORL ES 2012 and compiled from a number of sources, including desk-based research, in-field measurements and coastal process modelling. The in-field measurements include data obtained from four AWACs in the MORL Zone (two of which were located within the WDA), two AWACs in the Beatrice Offshore Wind Farm Ltd (BOWL) site (one of which was located directly north of the WDA) and two wave buoys (one in the MORL EDA and the other in the BOWL site). The MORL AWAC data was collected for between 100 and 120 days (between July 2010 to January 2011) and the MORL wave buoy data was collected from June 2010 until July 2012. Full details of the in-field campaign are available in the MORL ES 2012 (Section 3, subsection 3.4.3) and locations of the equipment shown in Figure 2.2-2 below.



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KEY

- ✚ MORL Offshore Meteorological Mast
- ✚ MORL Onshore Meteorological Mast
- ■ MORL AWAC
- ■ Beatrice AWAC
- ● MORL Wave Buoy
- ● Beatrice Wave Buoy
- ● Jacky Platform LiDAR
- ● Jacky Platform Wave Buoy
- ● WaveNet Wave Buoy
- ◆ Admiralty Tidal Diamond
- ▲ Wind analysis point (VORTEX)
- ▲ Wave analysis point (WAM10)
- ● Wave and Current analysis points (BODC)
- ● NOC Surge Predictions (Centroid)
- ✳ Wick Airport Weather Station
- ⬢ Wick Tide Gauge
- ▭ Western Development Area
- ▭ Eastern Development Area

Horizontal Scale: 1:600,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: PL
Approved: SP

Date: 04/05/2016 Revision: B

REF: 8460001-PQW0010-MOR-MAP-004

Figure 2.2-2
Data and Deployment Locations
Moray Firth

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Tidal Regime

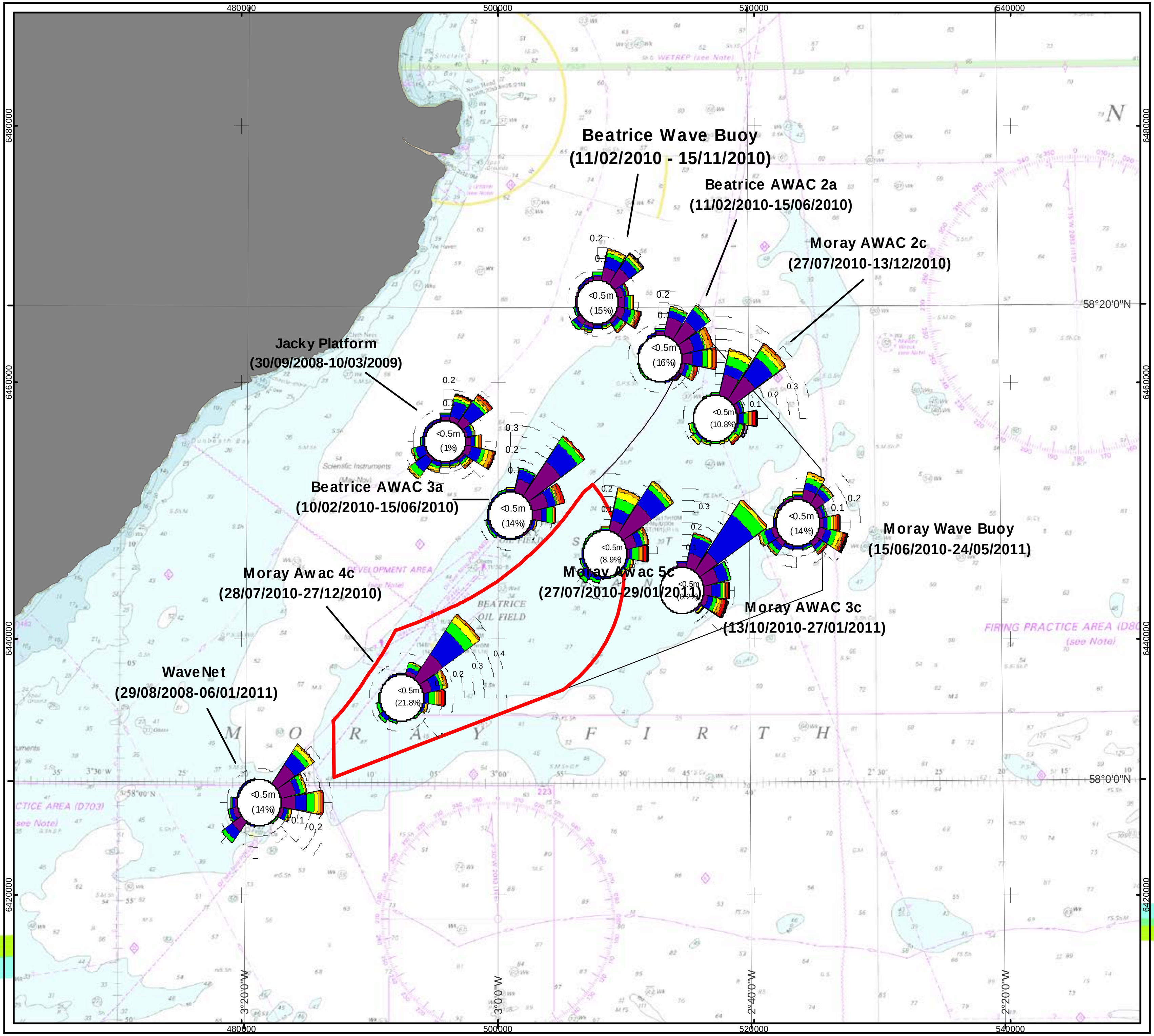
In MORL ES 2012 (Section 3, subsection 3.4.3), the MORL EDA was described as being situated within a meso-tidal setting and characterised by a mean spring tidal range of just under 3 m and a maximum astronomic range (Highest Astronomical Tide (HAT) to LAT of approximately 4 m. Storm surges may cause short term modification to predicted water levels and under an extreme (1 in 50-year return period) storm surge, water levels may be up to 1.25 m above predicted levels.

It is probable that relative sea levels will rise in this region during the course of the 21st Century and by 2100 (beyond the lifetime of the proposal) are likely to be approximately 0.5 to 0.8 m higher across the study area. Climate change may be expected to slightly increase the mean water level over the lifetime of the proposed development; however, the tidal range about the new mean level is not likely to be measurably affected. Climate change is not expected to have any effect on the local tidal current regime (currents are largely controlled by the corresponding tidal range) over the next 25 years.

Current speeds decrease with distance into the Moray Firth. Whereas recorded (depth-averaged) peak spring current speeds in the MORL EDA are around 0.45 to 0.5 m/s, peak mean spring current speeds in the WDA are around 0.3 m/s.

Wave Climate

The wave regime in the outer Moray Firth includes both swell waves generated elsewhere in the North Sea and locally generated wind waves. The wave regime in the outer Moray Firth is typically characterised by wind waves although longer period swell waves can be identified within the observational wave records collected from within and near to the MORL Zone. Wave roses from the available observational data are shown in Figure 2.2-3 below.



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KEY

Wave Rose

Horizontal Scale: 1:400,000 A4 Chart

0 5,000 10,000 Meters

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: PL
Approved: SP

Date: 22/04/2016	Revision: A

REF: 8460001-PQW0010-MOR-MAP-005

Figure 2.2-3
Observational Wave Records within and nearby project area.

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The largest waves come from the more exposed offshore sectors (from north to south-east) and wave heights during extreme events may be 6 to 7 m during relatively frequent (annual) events or as much as 9 m for the 50 year return period condition. Waves coming from other directions within the Moray Firth are generally smaller during extreme events (4 to 5 m or up to 7 m, respectively) due to the relatively shorter distances available for wave growth.

Even though water depths across the wind farm sites are no less than 35 m, storm waves sufficiently large to cause water motion at the seabed are not uncommon.

Climate change is predicted to cause variability in the inter-annual wave climate over the lifetime of the proposed development; however, historical trends have shown that this variability may include and increase in the order of approximately 10% in mean storminess on decadal timescales.

Naturally occurring stratification (measurable gradients in water density over relatively short distances) occurs in the study area due to seasonal heating of the water and vertical fronts (the oceanographic features formed by stratification in a vertical plane) are also observed between regions of slight freshwater influence coming from the Moray Firth. Previously published papers (e.g. Adams and Martin, 1986; Connor *et al.*, 2006) were used to characterise stratification and fronts in the Moray Firth (e.g. the Buchan front) including their general location and characteristics in relation to primary productivity.

Applying general oceanographic theory, it is likely that the (weak) strength and natural position of the Buchan front in the outer Moray Firth is governed by the relative magnitude of tidal current flows in the adjacent inshore areas and of seasonal stratification in adjacent offshore areas.

Climate change is not expected to have any effect on the range of natural variability in the location or strength of stratification and fronts over the lifetime of the proposed development.

Wind Climate

The wind climate for the WDA is considered to be the same as that reported for the MORL EDA in MORL ES 2012 (Section 3, subsection 3.3).

MORL has collected wind data from the following sources in order characterise the wind climate

- Fixed LiDAR on Jacky Platform (4 years 9 months);
- Lybster onland meteorlogical mast (3 years 7 months);
- MORL offshore meteorlogical mast (10 months); and
- Hindcast numerical weather prediction for two locations in WDA (21 years).

Frequency analysis of hindcast data shows that the most frequent wind directions are from the west-south-west and south-west (213.75 to 258.75 ˚N), accounting for almost 22% of the record, and from the south-east (123.75 to 146.25 ˚N), together accounting for around 30% of the total record. Over 70% of the record contains wind speeds in the range of 4 to 15 m/s and observed wind speeds only infrequently (<2% of the time) exceed 20 m/s. During extreme events (return period of one in ten years or more), wind speeds might peak as high as 25 or 35 m/s. This summary is broadly consistent with observations made offshore at the Jacky platform and will be validated with meteorlogical mast data.

2.2.2.2 Data Gaps

A meteorlogical mast has been installed within the MORL EDA (see Figure 1.1-2 above). This will provide more accurate wind measurements for the WDA physical processes EIA. Geophysical and geotechnical surveys have already been undertaken within the WDA (Osiris, 2011). Field surveys of wave and tidal regimes have also been undertaken. No further surveys are proposed. However, further analysis of the optical backscatter data available from the WDA will be required to determine water quality. In addition, for the MORL ES 2012, numerical models for wave and tidal regimes were developed by ABPmer using the water modelling software MIKE by DHI. These models will be updated with any new and relevant data received since their original development which becomes available by the time the physical processes EIA is prepared.

2.2.3 Geology, Sedimentary Environment and Water Quality

2.2.3.1 Baseline Characteristics

Geology and Sediments: Regional Context

The offshore near-surface geology in the outer Moray Firth is comprised predominantly of Cretaceous rocks, whilst both Jurassic and Permo-Triassic rocks are encountered along the southern / inner margins of the Firth. An extensive blanket of Quaternary deposits is present across almost the entire Firth with sediment thicknesses of around 70 m commonly observed.

The Smith Bank is a geologically constrained feature (i.e. it is a raised hard rock feature) overlain by a relatively thin veneer of more recently deposited marine sediments.

Geology and Sediments: WDA

A seismic survey of sub-bottom geology of the WDA was undertaken between May and September 2010. The survey provides 20% coverage in a coarse but regular grid (Osiris, 2011).

The total thickness of marine sediments overlying the unaltered Lower Cretaceous Sediments ranges between 10 m to >120 m thick.

There is a generally consistent cover of Holocene-Pleistocene sediments across the WDA. The survey data indicates that these deposits are up to 33 m in depth and are composed of two units; a Holocene/Upper Pleistocene unit of fine to coarse sand with variable shell and gravel content and a Holocene unit of sand/silt/clay. There are several north-west west-south-east trending channels which are filled by the Holocene unit sediments. There are also localised areas where the thickness of the sediments is less than 2 m.

Pleistocene sediments tend to be thin across the WDA, with an average thickness between 5-10 m. Ice-pushed sediments are generally between 10 to 25 m in thickness but can reach 65 m in localised areas.

The WDA is characterised by granular sediments of fine/medium to coarse grained sands to coarser grained sands and gravels. Fine grained sands are more extensive in the south-west of the site but patchy with more gravelly sediments across the central and eastern sections. Minor ripple bed forms were recorded in gravelly areas with heights to 0.3 m. There are isolated large boulders and a large number of smaller boulders across the site.

Water Quality

Analysis of turbidity data collected from the MORL EDA and BOWL site indicate that suspended sediment concerntrations are generally in the range between 0 to 10 mg/l but can reach concentrations >100 mg/l for short periods (MORL, 2012). It was concluded that there is no clear relationship between waves or other hydrodynamic variables and suspended sediment concentration at either the BOWL site or the MORL EDA. Given the finer particle sizes across the WDA, it is possible that suspended sediment concentrations may differ to that of the MORL EDA.

2.2.3.2 Data Gaps

Geophysical and geotechnical surveys have already been undertaken within the WDA. Field surveys of wave and tidal regimes have also been undertaken. Additional particle size data will become available from any benthic survey work that is done. This in addition to further analysis of the optical backscatter data for the WDA and updates of the numerical model for the MORL Zone, will be required to determine any potential effect on water quality.

2.2.4 Physical Processes – Potential Effects

2.2.4.1 Summary of Potential Effects

Based on the EIA for physical processes for the MORL EDA (MORL, 2012), the following are perceived to be the potential effects of development in the WDA on physical processes:

Potential Effect	Construction	Operation	Decommissioning	Scoped Out
Increase in suspended sediment concentrations as a result of foundation installation activities	✓	×	✓ (effect associated with the removal of foundations)	×
Accumulation of sediment and change of sediment type at the seabed as a result of foundation installation activities	✓	×	✓ (effect associated with the removal of foundations)	×
Increase in suspended sediment concentrations as a result of inter-array cable installation	✓	×	×	×
Indentations left on the seabed by jack-up vessels and large anchors	✓	✓	✓	×

Potential Effect	Construction	Operation	Decommissioning	Scoped Out
Changes to the tidal regime due to the presence of turbine foundations	×	✓	×	×
Changes to the wave regime due to the presence of turbine foundations	×	✓	×	×
Changes to the sediment transport regime and geomorphology due to the presence of the turbine foundations	×	✓	×	×
Scour effects due to the presence of the turbine foundations	×	✓	×	×
Scour effects due to the exposure of inter-array cables and cable protection measures	×	✓	×	×

Whilst a specific assessment will be carried out in relation to the WDA, given the proximity of the MORL EDA and WDA and the potential for similarities in relation to potential effects, the findings of the MORL EDA physical processes assessment have been included below for context.

2.2.4.2 Potential Effects During the Construction Phase

Increase in suspended sediment concentrations as a result of foundation installation activities

Increases in suspended sediment concentrations may arise from dredging overspill (silts and clays) or boulder re-distribution during seabed preparation for foundations, the winnowing of on-site dredge disposal mounds and suction buckets or drill arisings (sands, silts and clays) during the installation of piles. Any increases could potentially affect the form and function of the Smith Bank and/or other coastal habitats if the modified condition falls outside of the baseline range of natural variability.

It is highlighted that the assessments for the MORL EDA identified effects associated with seabed preparation by dredging or drilling activities to be within the natural range of variability. However, there may be localized, temporary effects over short-time scales around installation activities. The significance of the effects were expected to be of minor significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Accumulation of sediment and change of sediment type at the seabed as a result of foundation installation activities

Accumulation of sediment and change in sediment type may arise from dredging overspill (silts and clays) during seabed preparation for foundations, or drill arisings (sands, silts and clays) during the installation of piles or the disposal of dredge material on-site. Any accumulation could affect water depths, seabed formations and sediment particle size and composition.

It is highlighted that the assessments for the MORL EDA identified effects associated with seabed preparation by dredging or drilling activities to be within the natural range of variability. Although there may be accumulations of fine sediments, these could be reworked and dispersed to background concentrations by storms on short to medium timescales. The significance of any effects were expected to be of negligible-minor significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Increase in suspended sediment concentratations as a result of inter-array cable installation

Suspended sediment concentration may increase following cable installation techniques such as trenching by energetic means or from the redistribution of boulders. Any increases could potentially affect the form and function of the Smith Bank and/or other coastal habitats if the modified condition falls outside of the baseline range of natural variability.

It is highlighted that the assessments for the MORL EDA identified effects associated with cable installation techniques to be within the natural range of variability. Although there may be accumulations of fine sediments, these could be reworked and dispersed to background concentrations by storms on short to medium timescales. The significance of any effects were expected to be of minor significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Indentations left on the seabed by jack-up vessels and large anchors

Jack-up legs or anchors may indent the seabed through their weight and movement, respectively. This would potentially affect the form and function of the Smith Bank if disturbance was to lead to a relatively large change (outside of the range of natural variability) in local or regional water depth, seabed sediment charateristics or sediment transport pathways.

It is highlighted that the assessments for the MORL EDA identified effects of jack-up legs and anchors to be of small magnitude with localized effects which were expected to be temporary on medium-term timescales. Any effects were expected to be within the range of natural variability. The significance of any effects were expected to be of negligible significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

2.2.4.3 Potential Effects During the Operational Phase

Changes to the tidal regime due to the presence of turbine foundations

The interaction between the tidal regime and the foundations of the wind farm infrastructure could result in a reduction of current speed and an increase in levels of turbulence locally around the structure. Resistance posed by the array to the passage of water at a large scale might possibly distort the progression of the tidal wave into the Moray Firth, also potentially affecting the phase and height of tidal water levels. Receptors sensitive to these effects could include the form and function of the Smith Bank, physical characteristics of coastal habitats and the location or physical characteristics of frontal systems in the outer Moray Firth.

It is highlighted that the assessments for the MORL EDA identified that any effects on water levels and current speeds would be within the range of natural variability, of very small magnitude and would not impact upon sensitive physical environmental receptors beyond the range of natural variability. The significance of any effects were expected to be of negligible significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Changes to the wave regime due to the presence of turbine foundations

The interaction between the wave regime and the foundations of the wind farm infrastructure could result in a reduction of wave energy locally that may extend into the far field. Persistent changes to waves may have a net effect over time on net patterns of sediment transport (rates and directions). Receptors sensitive to such long-term effects could include the Smith Bank, coastal habitats and surfing venues.

It is highlighted that the assessments for the MORL EDA identified that any effects on the wave regime in the near field would be within the range of natural variability on annual and decadal timescales. Any potential far-field effects were determined not to be measurable. It was concluded that there were unlikely to be any effects on the form and function of the Smith Bank, coastal habitats and surfing venues. The significance of any effects were expected to be of negligible significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Changes to the sediment transport regime and geomorphology due to the presence of the turbine foundations

The interaction between the naturally present metocean regime (waves and currents) and the wind farm foundations may result in a reduction in current speed and wave energy and an increase in levels of turbulence locally. Persistent and extensive changes to wave and currents may have a net effect over time on net patterns of sediment transport. Potential receptors would include the Smith Bank and coastal habitats.

It is highlighted that the assessments for the MORL EDA identified that any effects on sediment transport would be within the range of natural variability. It was concluded that there were unlikely to be any effects on the form and function of the Smith Bank and coastal habitats. The significance of any effects were expected to be of negligible significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Scour effects due to the presence of the turbine foundations

The source of these effects is the interaction between the naturally present hydrodynamic regime (waves and currents) and the foundations of the wind farm infrastructure. This has the potential to cause localised scouring of sediment, leaving a depression with possibly different sedimentary character, which will persist in some form until the structure is removed during the decommissioning phase. The extent and depth of the scour pit may vary over time and may be limited naturally under certain physical conditions or if scour protection is used. The Smith Bank would be the sensitive receptor.

It is highlighted that the assessments for the MORL EDA identified that any effects of foundations in causing scour would be within the range of natural variability. The significance of any effects were expected to be of minor significance. Effects associated with scour protection measures were also considered to be within the range of natural variability and the significance of effect determined to be negligible. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Scour effects due to the exposure of inter-array cables and cable protection measures

The source of the potential effects is the interaction between the naturally present metocean regime (waves and currents) and sections of cable or cable protection measures exposed on the seabed surface during the operational phase of the development. The sensitive receptor would be the Smith Bank.

It is highlighted that the assessments for the MORL EDA identified that any effects of exposure of inter-array cables would be within the range of natural variability. The significance of any effects were expected to be of minor significance. Effects associated with scour protection measures were also considered to be within the range of natural variability and the significance of effect determined to be negligible. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

2.2.4.4 Potential Effects During the Decommissioning Phase

At this stage, it is envisaged that cables will be left in-situ. Decommissioning effects associated with the removal of other infrastructure are envisaged to be similar to those described for the construction phase.

2.2.5 Approach to EIA

For all potential effects, a specific list of sensitive receptors will be identified for study. The existing numerical model for the MORL Zone will be updated with data that was not available in 2012 and used to determine the magnitude, extent and significance of changes in the potential pathways affecting the identified sensitive receptors.

2.2.6 *Cumulative and In-combination Effects*

There is foreseeable potential for the extent or magnitude of any effects identified in Section 2.2.4.1 above to be cumulatively increased by the simultaneous presence of other existing or proposed activities or developments. The extent to which these cumulative effects may arise will depend upon the design and extent of the infrastructure or the frequency and intensity of the activities.

As discussed in Section 1.3.2.6 above, the method for cumulative impact assessment will be carried out in accordance with the methods outlined within the Moray Firth Offshore Wind Developers Group (MFOWDG) discussion document "Moray Firth Offshore Wind Developers Group Cumulative Impact Assessment Discussion Document" (MORL, 2012) unless otherwise agreed with MS-LOT and appropriate stakeholders. This document has been included as Annex 1 to this Scoping Report.

2.2.7 *Potential Mitigation Measures*

If as a result of the EIA, potential mitigation measures are required, these will be determined following the production of the impact assessments and consultation with consenting authorities and appropriate stakeholders.

2.3 Air Quality

The concentration of air pollutants within the WDA is highly variable in time and space with the main source of atmospheric emissions in the area from exhaust emissions from shipping. Currently the main sources of traffic on site are from vessels travelling to and from the Beatrice oil field, fishing vessels and recreational activity. In total, past surveys of the MORL Zone have indicated that and average of 14 vessels per day pass within 10 nm of the MORL Zone during winter and 18 vessels per day during the summer months (MORL, 2012). Commencement of decommissioning activity for the Beatrice oil platforms is anticipated for 2017 which will reduce the number of vessels operating in the area. Converseley, construction and operation of the MORL EDA and the Beatrice Offshore Wind Farm will increase the number of vessels within the vicinity of the proposed development.

The primary pollutants are sulphur dioxide (SO_2), nitrogen oxides (NOx) and carbon dioxide (CO_2). Measures were taken in 2007 to reduce Sulphur emissions through the introduction of a sulphur control area in the North Sea. This has led to a significant reduction in the output of SO_2. Conversley, NOx emissions are falling more slowly with emissions ceiling targets set in 2010 under Directive 2001/81/EC not being met.

Engine exhausts from construction vessels will contribute at a small scale to atmospheric emissions from existing shipping traffic. Given the low levels of vessel traffic recorded in the Moray Firth and the small number of additional vessels likely to be onsite the potential effect is likely to be negligible through all phases of the development. Marine exhaust emissions are limited in line with the provisions MARPOL Annex VI.

In addition, once the WDA is operational emissions of air quality pollutants (including SO_2 and NOx) will be reduced through displacement of fossil fuel use from sources of alternative energy. However, quantification of this will depend on the assumptions used regarding the nature of generating capacity it replaces.

Given the likely negligible increases of air pollutants on site and distance from any shore-based receptors it is proposed that all offshore air quality effects should be scoped out from further consideration within the EIA.

2.4 Airborne Noise

There is potential for increases in airborne noise levels during construction largely from pile driving (should jacket structures of monopile foundations be selected) and also from turbine motion when the wind farm is operational. Furthermore, increased airborne noise levels may arise form the removal of offshore structures during decommissioning. However given the distance of the WDA from shore it is not considered that offshore works would be audible to shore-based receptors. It is proposed that all offshore airborne noise effects should be scoped out from further consideration within the EIA.

3 Biological Environment

3.1 Introduction

This section presents the main characteristics of the offshore physical environment for the WDA. The following topics are covered:

- Designated Sites;
- Benthic Ecology;
- Fish and Shellfish Ecology;
- Marine Mammals; and
- Ornithology.

In each topic the relevant baseline characteristics, identified potential effects from construction, operation and decommissioning of the WDA and the proposed approach for the EIA are set out. Relevant datasets and specific guidance have been listed where appropriate.

3.2 Designated Sites

3.2.1 Designated Sites

The national suite of sites providing statutory protection for flora, fauna, or geological or physiographical features include international sites (e.g. wetlands of international importance, RAMSAR sites); European sites (Special Protection Areas (SPAs) and Special Areas of Conservation (SACs)); national sites (e.g. National Nature Reserves (NNRs), Sites of Special Scientific Interest (SSSIs), Marine Nature Reserves (MNRs) and Marine Protected Areas (MPAs)); and local sites (e.g. Local Nature Reserves (LNRs)). In addition, other non-statutory designated conservation sites that will be considered include Royal Society for the Protection of Birds (RSPB) Reserves, Scottish Wildlife Trust Reserves and Local Nature Conservation Sites.

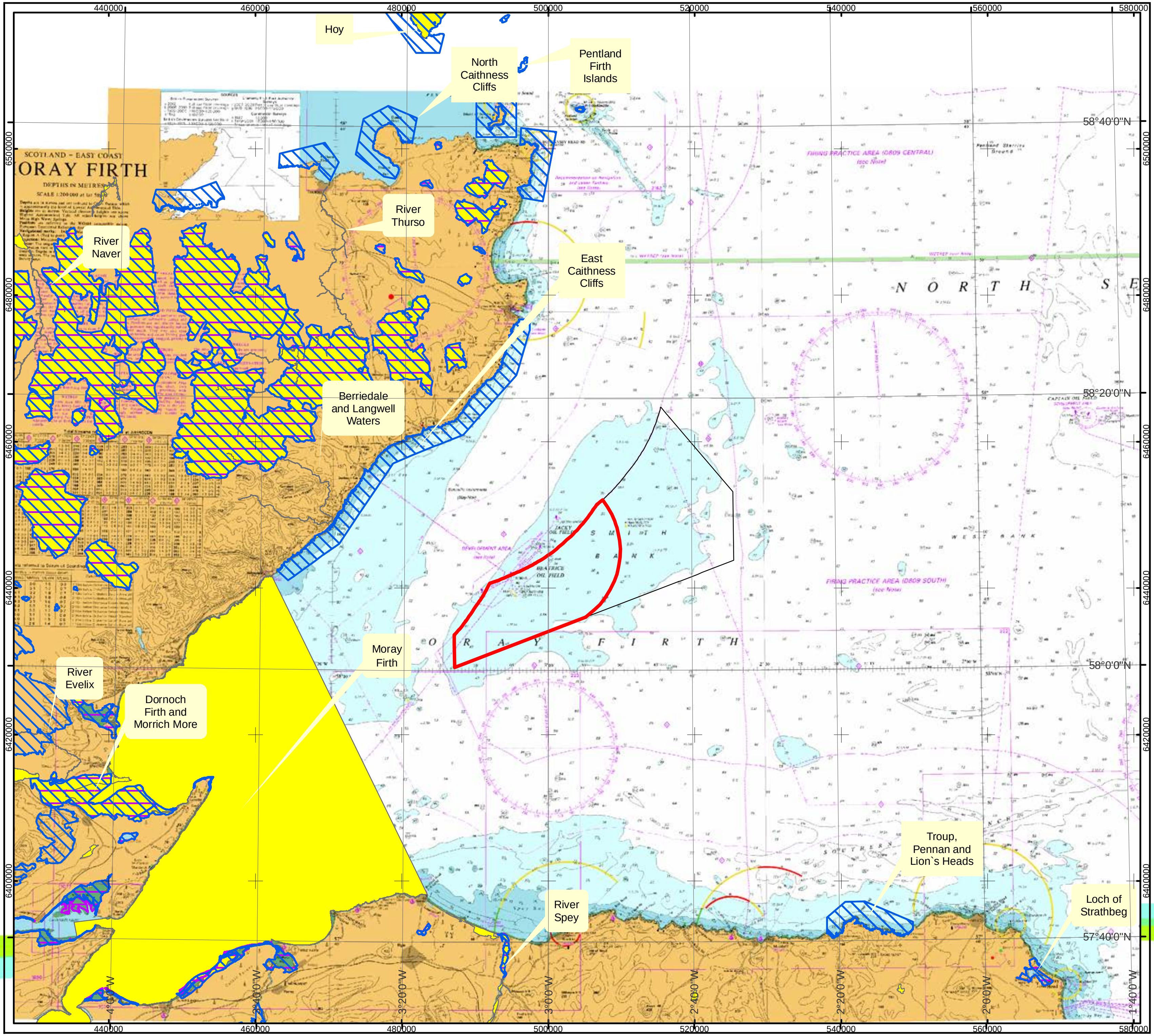
The potential effects of any proposed wind farm upon conservation sites and their interest features need to be considered carefully.

Where sites of international (Ramsar site) or European (SPA, SAC) importance are potentially affected, then the advice of the statutory nature conservation bodies will be required. If there is any indication of a likely significant effect on any of these sites then SNH/JNCC may advise the Competent Authority that an Appropriate Assessment is required.

3.2.2 Baseline Characteristics

The WDA is not located within any site of conservation interest, designated or proposed to be designated. However, the Moray Firth contains many sites of national and international importance for wildlife, with species that may use the WDA for activities such as migration, feeding or resting. A summary of the major nature conservation designations that may be potentially affected by the project are provided in Tables 3.2-1 to 3.2-3 below. Figure 3.2-1 below shows the location of the SACs, SPAs and RAMSAR sites. This list is based on those designated areas assessed for the MORL EDA (MORL, 2012).

The Inner Moray Firth SPA has been scoped out of the list below as the species for which it has been designated are not considered to be at risk from the development of the WDA due to the lack of connectivity. The only seabird species that is a qualifying feature of the SPA is common tern, which has a very short foraging range (mean maximum foraging range of 15.2 km; Thaxter *et al*. 2012), and so there would be no connectivity between breeding birds from the SPA and the WDA, which is 63 km from the SPA. The waterfowl species (for which the SPA has been designated) occur in shallow inshore waters or intertidal habitats in the non-breeding season and do not make use of the pelagic environment. Wintering greylag goose is also included in the Inner Moray Firth SPA qualifying species list however it is extremely unlikely that commuting birds will pass through or close to the WDA because commuting flights occur between foraging locations and roost locations in terrestrial habitats.



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KEY

▨	Special Protection Areas (SPAs)
🟨	Special Areas of Conservation (SACs)
▭	RAMSAR Sites
🟥	Western Development Area
▭	Eastern Development Area

Horizontal Scale: 1:700,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: PL
Approved: SP

Date: 04/05/2016 Revision: B

REF: 8460001-PQW0010-MOR-MAP-006

Figure 3.2-1
Location of SACs, SPAs, and RAMSAR Sites in Moray Firth

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Table 3.2-1 Summary of Major Nature Conservation Designations (with Biological Features) that may Potentially be Affected by the Project by EIA Discipline – Ornithology

Site	Status	Main Conservation Interest
East Caithness Cliffs	SPA SSSIs MPA	The sea cliffs that comprise the East Caithness Cliffs SPA regularly support populations of European importance of a variety of seabird species. Notified interest features: fulmar, shag, cormorant, peregrine, kittiwake, herring gull, great black–backed gull, guillemot, razorbill, puffin, seabird assemblage. MPA designating feature: black guillemot
North Caithness Cliffs	SPA SSSIs RSPB Reserve	The North Caithness Cliffs SPA is of special nature conservation importance for supporting large populations of breeding seabirds. Dunnet Head is an RSPB reserve. Notified interest features: razorbill, peregrine, puffin, fulmar, kittiwake, guillemot, seabird assemblage.
Troup, Pennan and Lion's Heads	SPA, RSPB Reserve	The Troup, Pennan and Lion's Heads Special Protection Area is a 9 km stretch of sea cliffs along the Aberdeenshire coast. The cliffs support large colonies of breeding seabirds. Troup Head is an RSPB Reserve. Notified interest features: razorbill, fulmar, herring gull, kittiwake, guillemot, seabird assemblage.
Pentland Firth Islands	SPA SSSI	The Pentland Firth Islands are located between the Orkney Islands and the mainland coast of north–east Scotland. Notified interest features: Arctic tern.
Hoy	SPA SSSI RSPB Reserve	The Hoy SPA is of special nature conservation importance for supporting large populations of breeding seabirds. Notified interest features: great skua, peregrine, puffin, fulmar, red–throated diver, great black–backed gull, kittiwake, Arctic skua, guillemot, seabird assemblage.
Copinsay	SPA SSSI RSPB Reserve	The Copinsay SPA regularly supports in excess of 20,000 breeding seabirds. Notified interest features: fulmar, great black–backed gull, kittiwake, guillemot, seabird assemblage.
Loch of Strathbeg	SPA SSSI Ramsar RSPB Reserve	The Loch of Strathbeg SPA is a site of international importance comprising a shallow freshwater loch with surrounding wetland, dune and grassland communities. It provides wintering habitat for a number of important wetland bird species, particularly wildfowl. Notified interest features: Eurasian teal, greylag goose, pink–footed goose, whooper swan, sandwich tern, barnacle goose, waterfowl assemblage: breeding bird assemblage, eutrophic loch, fen meadow, open water transition fen, wintering pink–footed goose, whooper swan, greylag goose, goldeneye, goosander, mute swan, pochard, tufted duck, wigeon.
Auskerry	SPA SSSI	Auskerry is a small, uninhabited low–lying island situated 5 km south of Stronsay in the Orkney Islands of northern Scotland. Notified interest features: Arctic tern, storm petrel.

Site	**Status**	**Main Conservation Interest**
Calf of Eday	SPA SSSI	The Calf of Eday SPA supports large colonies of breeding seabirds. Notified interest features: fulmar, great black–backed gull, cormorant, kittiwake, guillemot, seabird assemblage.
Rousay	SPA SSSI	The Rousay SPA consists of areas of maritime heath and grassland, and seacliffs. Notified interest features: fulmar, kittiwake, Arctic tern, Arctic skua, guillemot, seabird assemblage.
West Westray	SPA SSSI	The West Westray SPA is an 8 km stretch of sea cliffs, together with adjacent grassland and heathland, along the west coast of the island of Westray in Orkney. The cliffs support large colonies of breeding auks and kittiwakes while the grassland and heathland areas support breeding colonies of skuas and terns. Notified interest features: razorbill, fulmar, kittiwake, Arctic skua, Arctic tern, guillemot, seabird assemblage.
Papa Westray	SPA SSSI MPA RSPB Reserve	Papa Westray is a small island lying close to Westray in the northern Orkney islands in Scotland. Notified interest features: Arctic tern, Arctic skua. MPA designating feature: black guillemot The SSSI and RSPB Reserve is North Hill.
Sule Skerry and Sule Stack	SPA SSSI	The SPA comprises two uninhabited islands and supports European important populations of seabirds. Notified interest features: gannet, guillemot, Leach's petrel, puffin, shag, storm petrel, seabird assemblage.
Fair Isle	SPA SSSI	Fair Isle SPA supports internationally important populations of breeding seabirds on its cliffs and maritime heath and grassland. Notified interest features: gannet, Arctic skua, Arctic tern, Fair Isle wren, fulmar, great skua, guillemot, kittiwake, puffin, razorbill, shag, seabird assemblage.
North Rona and Sula Sgeir	SPA SSSI	The uninhabited islands of North Rona and Sula Sgeir, together with several outlying rocky islets and adjacent waters, lie 65 km north of Lewis. The coastlines of both islands consist mainly of cliffs except for two low–lying peninsulas on North Rona. Notified interest features: gannet, fulmar, great black–backed gull, guillemot, kittiwake, Leach's petrel, puffin, razorbill, storm petrel, seabird assemblage.
Sumburgh Head	SPA SSSI RSPB Reserve	Sumburgh Head is located at the most southern tip of the Shetland mainland in northern Scotland. Notified interest feature: Arctic tern
Mousa	SPA SSSI RSPB Reserve	Mousa is a small island located off the east coast of the south part of the Shetland mainland in northern Scotland. Notified interest feature: Arctic tern

Site	**Status**	**Main Conservation Interest**
Noss	SPA SSSI	Noss is an offshore island lying 5 km east of Lerwick, Shetland. It supports breeding seabirds on cliffs and also on inland heathlands and grasslands. Notified interest features: gannet, fulmar, great skua, guillemot, kittiwake, puffin, seabird assemblage.
Foula	SPA SSSI	Foula is the most westerly of the Shetland Islands, which are situated to the north of the Scottish mainland and Orkney. Notified interest feature: Arctic tern
Papa Stour	SPA SSSI	Papa Stour lies on the west coast of mainland Shetland in northern Scotland. Notified interest feature: Arctic tern
Fetlar	SPA SSSI RSPB Reserve	Fetlar is one of the northernmost of the Shetland Islands in northern Scotland. Notified interest feature: Arctic tern
Forth Islands	SPA SSSI	Forth Islands SPA consists of a series of islands supporting the main seabird colonies in the Firth of Forth. The islands of Inchmickery, Isle of May, Fidra, The Lamb, Craigleith and Bass Rock were classified on 25 April 1990. The extension to the site, classified on the 13th February 2004 consists of the island of Long Craig, which supports the largest colony of roseate tern in Scotland. It is the most northerly of only six regular British colonies. Notified interest features: gannet, Arctic tern, common tern, cormorant, fulmar, guillemot, herring gull, kittiwake, lesser black–backed gull, puffin, razor bill, roseate tern, Sandwich tern, shag, seabird assemblage.
Hermaness, Saxa Vord and Valla Field	SPA SSSI	The Hermaness, Saxa Vord and Valla Field SPA lies in the north–west corner of the island of Unst, Shetland, at the northernmost tip of Britain. It consists of 100 to 200 m high sea cliffs and adjoining areas of grassland, heath and blanket bog. Notified interest features: gannet, fulmar, great skua, guillemot, kittiwake, puffin, red–throated diver, shag, seabird assemblage.
Rum	SPA SSSI	The Rum SPA includes the Inner Hebridean Island of Rum, which has a largely rocky coast with cliffs rising to 210 m, and adjacent coastal waters. Notified interest features: Manx shearwater, golden eagle, guillemot, kittiwake, red–throated diver, seabird assemblage.

Table 3.2-2 Summary of Major Nature Conservation Designations (with Biological Features) that may Potentially be Affected by the Project by EIA Discipline – Marine Mammals

Site	Status	Main Conservation Interest
Moray Firth	SAC	Notified interest features: subtidal sandbanks, bottlenose dolphin.
Dornoch Firth and Morrich More	SAC	Notified interest features: reefs, subtidal sandbanks, glasswort and other annuals colonising mud and sand, Atlantic salt meadows, estuaries, intertidal mudflats and sandflats, otter, harbour seal, coastal dune heathland, dunes with juniper thickets, lime–deficient dune heathland with crowberry, shifting dunes, dune grassland, humid dune slacks, shiftings dunes with marram grass.

Table 3.2-3 Summary of Major Nature Conservation Designations (with Biological Features) that may Potentially be Affected by the Project by EIA Discipline – Fish and Shellfish Ecology

Site	Status	Main Conservation Interest
Berriedale and Langwell Waters	SAC	Notified interest features: Atlantic salmon
River Borgie	SAC	Notified interest features: freshwater pearl mussel, Atlantic salmon and otter
River Dee	SAC	Notified interest features: freshwater pearl mussel, Atlantic salmon and otter
River Naver	SAC	Notified interest features: freshwater pearl mussel, Atlantic salmon
River Thurso	SAC	Notified interest features: Atlantic salmon
River Oykel	SAC	Notified interest features: Atlantic salmon, freshwater pearl mussel
River Thurso	SAC	Notified interest features: Atlantic salmon
River Evelix	SAC	Notified interest features: freshwater pearl mussel
River Moriston	SAC	Notified interest features: Atlantic salmon, freshwater pearl mussel
River Spey	SAC SWT Reserve	Notified interest features: sea lamprey, Atlantic salmon, otter, freshwater pearl mussel Spey Bay Wildlife Reserve is located at the mouth of the River Spey.

3.2.3 *Data Gaps*

Data for nature conservation designating species is available from SNH, JNCC or the party responsible for the designated site. However, some site specific surveys are likely to be required to determine the frequency and density of potential receptors within the WDA. The need for surveys will be identified on a receptor-by-receptor basis and will be dependent on the level of information required for the EIA and to inform the Habitats Regulations Appraisal. Data on species presence within the MORL EDA and connectivity with the MORL Zone is also available from MORL ES 2012. Specific data gaps associated with species are discussed within Sections 3.4 (Fish and Shellfish Ecology), 3.5 (Marine Mammals) and 3.6 (Ornithology).

In addition, data on the distribution of Annex I habitats and UK Biodiversity Action Plan species and habitats within the proposed development area will also be required.

3.2.4 Potential Effects and EIA

Potential effects to, and the EIA approach for, species and habitats of nature conservation significance will be addressed in Section 3.3 (Benthic Ecology), Section 3.4 (Fish and Shellfish Ecology), Section 3.5 (Marine Mammals) and Section 3.6 (Ornithology).

3.3 Benthic Ecology

3.3.1 Baseline Characteristics

This section describes the Benthic Ecology baseline environment and potential effects associated with the WDA. Information on the WDA baseline characteristics have been derived mostly from the MORL ES 2012. The Benthic Ecology ES Chapter and Technical Appendices can be accessed via the following links – Chapter 4.2 Benthic Ecology and Technical Appendix 4.2 A Benthic Ecology Characterisation Survey (Wind Farm). Table 3.3-1 below lists the proposed datasets that will inform the assessment. For a full list of wave, stratification, sea level and wind data see Physical Processes – Section 2.2 above.

Table 3.3-1 Datasets for the Benthic Ecology EIA

Dataset	**Coverage**	**Date**
Benthic Surveys - seabed sampling, video surveillance and scientific trawling (EMU Ltd)	MORL EDA	October 2010
Benthic Surveys - seabed video surveillance and seabed sampling (EMU Ltd)	MORL 2012 export cable route	July 2011
Benthic Surveys - seabed video surveillance and seabed sampling (EMU Ltd)	MORL 2014 modified export cable route	May 2014
Geophysical survey (Osiris Projects)	WDA (coarse grid across the area with approximately 20% coverage)	May –July 2010
Benthic Surveys - seabed sampling, video surveillance and scientific trawling (CMACS Ltd)	BOWL site	October – November 2010
Benthic Surveys - seabed video surveillance and seabed sampling (CMACS Ltd)	BOWL offshore transmission works route	June 2011

It is proposed that the following guidance will inform the Benthic Ecology assessment:

- Institute for Ecology and Environmental Management (IEEM) Guidelines for Ecological Impact Assessment in Britain and Ireland (Marine and Coastal) (IEEM, 2010).

- Scottish Natural Heritage, Advice on Marine Planning, including management of Marine Protected Areas (Available on-line at: http://www.snh.gov.uk/planning-and-development/marine-planning/. Accessed March 2015).
- European Commission (2013) Interpretation Manual of European Union Habitats EUR 28 (European Commission, 2013b) (Available on-line at: http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf. Accessed March 2015).
- EU Biodiversity Strategy (Available on-line at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0244. Accessed March 2015).
- GB Non-Native Species Secretariat (NNSS) (Available on-line at: http://www.nonnativespecies.org/index.cfm?sectionid=22. Accessed March 2015).
- Alien Invasive Species and the Oil and Gas Industry - Guidance for prevention and management, OGP/IPIECA, 2010 (Available on line at: http://www.ogp.org.uk/pubs/436.pdf. Accessed March 2015).
- Scottish Natural Heritage advice on marine non-native species (Available on-line at: http://www.snh.gov.uk/land-and-sea/managing-coasts-and-sea/marine-nonnatives/. Accessed March 2015).

The MORL ES 2012 provides a description of the regional benthic environment of the Moray Firth and presents survey information to provide a detailed picture of the benthic characteristics of the MORL EDA (Chapter 4.2 of MORL ES 2012). Given the comparative depth conditions (see Section 2.2.1 Bathymetry), the WDA is expected to support habitat conditions and associated communities that are similar to those already identified and described in the MORL EDA and at the BOWL site, subject to survey.

A summary of the baseline information provided within the MORL ES 2012 is provided below.

Desktop Studies

The Moray Firth is described as an “open system” being an integral part of the wider North Sea, thus having common environmental factors. Seabed sediments, considered as moderately to well sorted, fine to medium grained, with some shell, are described as relatively homogeneous. Predicted distributions of seabed habitats derived from the Mapping European Seabed Habitat (MESH) project[1] (Figure 3.3-1 below) identifies five principal habitat types in the area:

- Circalittoral and deep coarse sediments;
- Circalittoral fine sand or circalittoral muddy sand;
- Deep circalittoral sand;
- Deep circalittoral mud; and
- Infralittoral coarse sediment.

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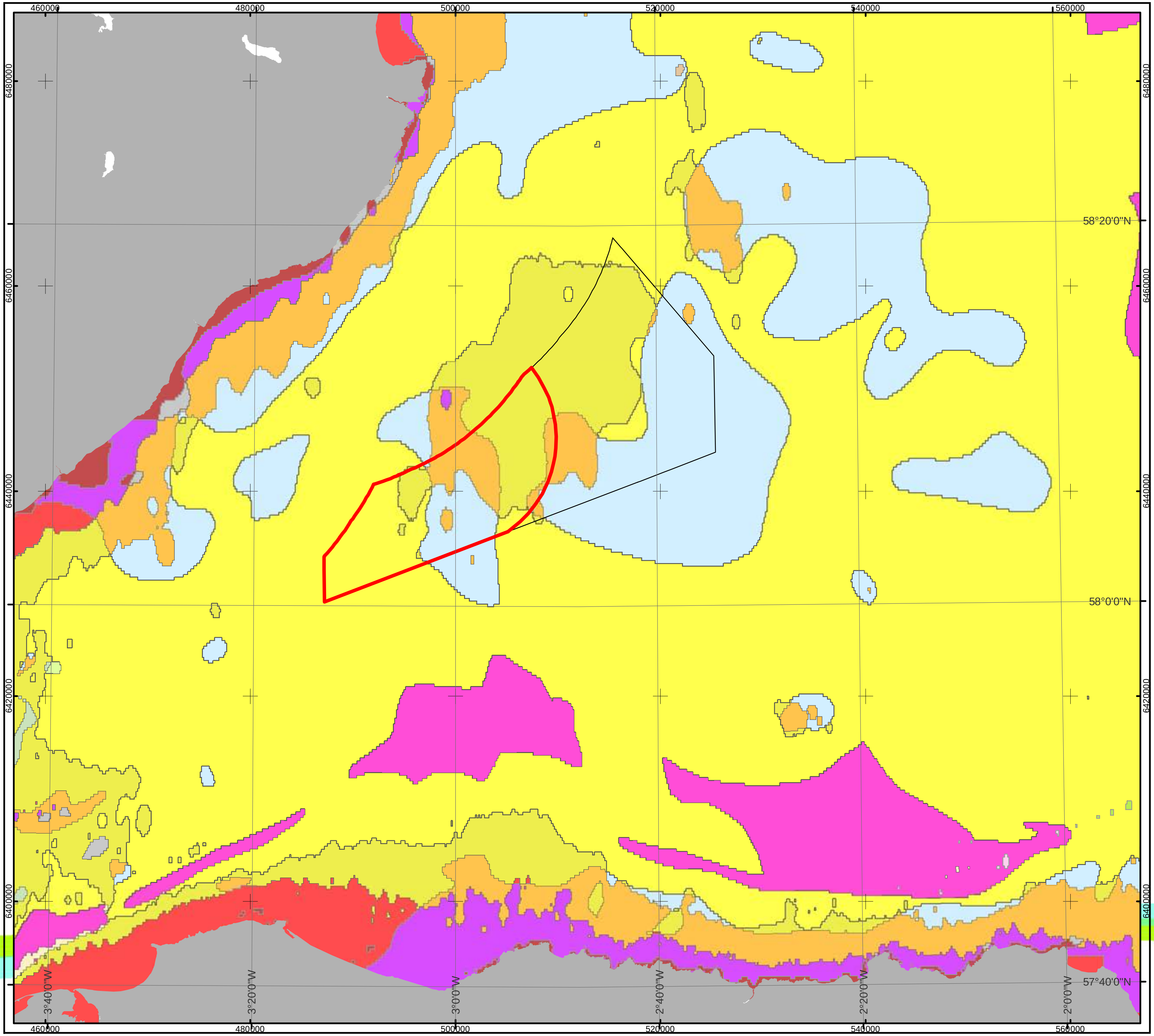
[1] www.searchmesh.net



renewables

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KEY

Predicted EUNIS Habitats (Source: MESH)

- 🟧 Circalittoral coarse sediment
- 🟨 Circalittoral fine sand or circalittoral muddy sand
- 🟩 Circalittoral mixed sediments
- ⬜ Circalittoral sandy mud or circalittoral fine mud
- 🟦 Deep circalittoral coarse sediment
- 🟩 Deep circalittoral mixed sediments
- 🟪 Deep circalittoral mud
- 🟨 Deep circalittoral sand
- ⬜ Deep-sea mud
- 🟩 Deep-sea sand or deep-sea muddy sand
- 🟫 Faunal communities on deep low energy circalittoral rock
- 🟪 Infralittoral coarse sediment
- 🟥 Infralittoral fine sand or infralittoral muddy sand
- 🟥 Infralittoral mixed sediments
- ⬜ Low energy circalittoral rock
- 🟥 Low energy infralittoral rock
- 🟥 Western Development Area
- ☐ Eastern Development Area

Horizontal Scale: 1:500,000 A4 Chart

0 5,000 10,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

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Figure 3.3-1
Moray Firth MESH Habitats

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Figure 3.3-1 above indicates that the sediments of the Smith Bank comprise mainly of coarse and fine sands. Coarser sediments are generally associated with shallower areas whilst finer grained sediments occur in deeper water areas. Further information on the geology and sediments of the WDA is provided in Section 2.2.3.1 above.

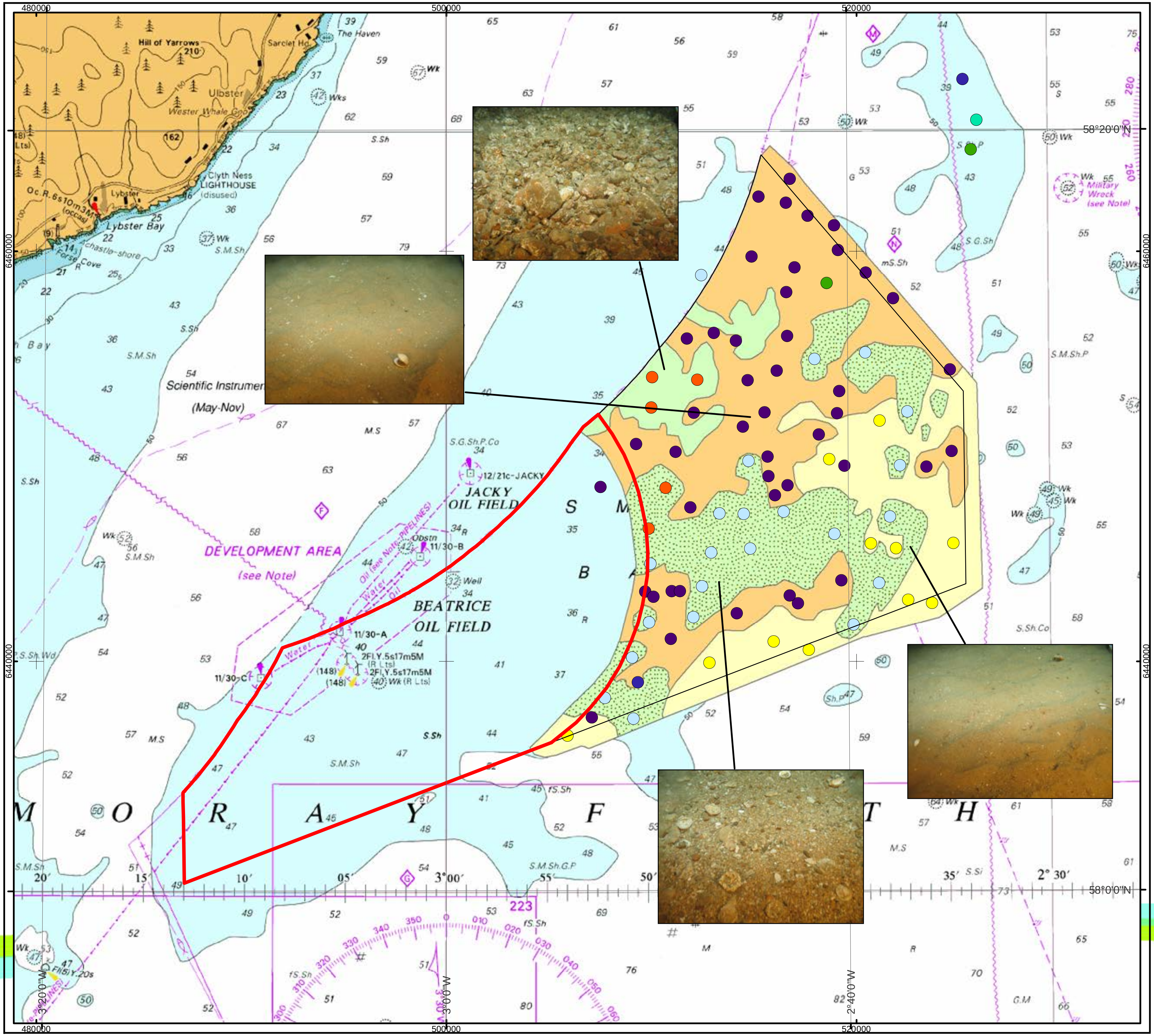
Annelida (segmented worms) dominate the benthic communities on the Smith Bank, comprising approximately 40% of total species diversity. Molluscs are also typically well represented (approximately 30% of total diversity) together with crustaceans (approximately 20%), miscellaneous taxa (approximately 10%) and echinoderms (approximately 5%). There is a rich and diverse faunal community characterised by polychaetes (*Spiophanes bombyx*, *Pholoe baltica, Cirratulids spp., Scoloplos armiger, Nephtys spp., Spio filicornis, Lumbrineris spp., Diplocirrus glaucus* and *Goniada maculata*), bivalves (*Cochlodesma praetenue, Tellina (Fabulina) fabula, Abra prismatica, Crenella decussata, Gari fervensis*) and amphipods (*Bathyporeia spp.* and *Urothoe elegans)*. Talisman similarly identified a rich and diverse community within an area of the WDA following investigations supporting the Beatrice Demonstrator Project (located within the WDA). Conspicuous sediment species observed during the Talisman study included the polychaetes *Chaetozone setosa, L. gracilis* and *Exogone hebes* together with the amphipods *U. elegans, Ampelisca tenuicornis* and *Bathyporeia spp.*, the bivalve *T. fabula* and the pea urchin *Echinocyamus pusillus.* Sessile epibenthic communities (i.e. groups of animals attaching to the surface of seabed substrata) were characterised by sponges, the erect bryozoan *Flustra foliacea*, the anemone *Bolocera tuediae* and the crab *Hyas coarctatus*.

Assemblages of more mobile epifauna, such as crab, fish, shrimps and starfish include the common starfish *Asterias rubens*, burrowing starfish *Astropecten irregularis* and sea urchins *Echinus spp.*, crustaceans (e.g. *Crangon allmanni, Pagurus bernhardus, Anapagurus laevis* and *H. coarctatus*) and the gastropod *Neptunea antiqua*. Historic scientific and commercial trawls also identified a typical regional assemblage of demersal fish comprising whiting (*Merlangius merlangus*), dab (*Limanda limanda*), haddock (*Melanogrammus aeglefinus*), lemon sole (*Microstomus kitt*), plaice (*Pleuronectes platessa*), grey gurnard (*Eutrigla gurnardus*), herring (*Clupea harengus*) and long rough dab (*Hippoglossoides platessoides*).

MORL EDA Site Specific Studies

Baseline benthic ecological data was collected during a site specific seabed sampling survey employing seabed video, sediment grab and trawl sampling techniques.

The results of the sampling and analyses were consistent with those of previous studies and showed that dominant seabed sediment habitat type was slightly gravelly sand with patches of shelly gravelly sand, sandy gravel and gravel. Levels of silt and clay in seabed sediments were generally low (<3%) across the MORL EDA with slight increases (up to 4 to 5%) in deeper water areas. Levels of sediment contaminants were below relevant guideline values. The distribution of the seabed habitat classifications is shown in Figure 3.3-2 below.



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KEY

- 🟥 Western Development Area
- ☐ Eastern Development Area

Biotopes

- ● SS.SCS.CCS
- ● SS.SCS.CCS.MedLumVen
- ● SS.SCS.ICS.Glap
- ● SS.SCS.ICS.MoeVen
- ● SS.SMx.OMx.PoVen
- ● SS.SSa.CFiSa.EpusOborApri
- ● SS.SSa.OSa.OfusAfil or SS.SSa.IMuSa.FfabMag

Biotope Habitats

- 🟩 SS.SCS.CCS
- ▨ SS.SCS.CCS.MedLumVen
- ▨ SS.SCS.ICS.MoeVen
- ▨ SS.SCS.ICS.MoeVen (Glycera dominated)
- 🟧 SS.SSa.CFiSa.EpusOborApri
- 🟨 SS.SSa.OSa.OfusAfil or SS.SSa.IMuSa.FfabMag

Horizontal Scale: 1:250,000 A4 Chart

0 2,500 5,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

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Figure 3.3-2
MORL EDA Subtital Biotopes

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The benthic communities associated with these seabed habitat types were found to be rich and diverse and were characterised by polychaete worms (e.g. *S. bombyx, Notomastus spp. Lumbrineris gracilis* and *Chone sp.*), the burrowing urchin (*E. pusillus*) and the bivalve *Cochlodesma praetenue*. Other commonly recorded species included the calcareous tube dwelling keel worm (*Pomatoceros triqueter*), soft corals, barnacles, sea firs (hydroids) and sea mats (bryozoans) which were found attached to the surfaces of gravel, stones and shell fragments. Correlation with measured physical parameters, via the BIOENV statistical procedure, showed that benthic communities were most influenced by depth and sediment types.

Multivariate statistical classification and sorting techniques organised the grab faunal sample data into seven groups representing seven distinct communities. These faunal community groups and their associated sediment types were then compared with the Marine Habitat Classification using the BioScribe database to attribute each a biotope classification as summarised in Table 3.3-2 below.

Table 3.3-2 Summary of Biotopes Identified Within and Around the Boundaries of the MORL EDA

Group (No. Samples)	Biotope Classification	Description of Habitat and Community (Biotope)
a (2 samples) ●	SS.SMx.OMx.PoVen	Coarse sand and gravelly sand characterised by the polychaete *Glycera lapidum*, and the bivalve *C. decussata*.
b (5 samples) ●	SS.SCS.CC	Coarse gravel sediments supporting calcareous tube worms, and urchins.
c (22 samples) ●	SS.SCS.CCS.MedLumVen	Mixed sand and gravel sediments characterised by the polychaetes *Chone sp., Notomastus sp., L. gracilis, Aonides paucibranchiata* and *G. lapidum,* the pea urchin *E. pusillus,* the amphipod *Atylus vedlomensis* and ribbon worms Nemertea.
d (2 samples) ●	SS.SCS.ICS.Glap	Coarser sand and sandy gravel sediments characterised by the polychaete *G. lapidum*, and the bivalve *C. decussata*.
e (11 samples) ●	SS.SSa.OSa.OfusAfil or SS.SSa.IMuSa.FfabMag	Slightly deeper water sand and slightly gravelly sand sediments with some silt / clay supporting polychaetes, acorn worms, ribbon worms and brittlestars.
f (1 sample) ●	SS.SCS.ICS.MoeVen	Comparatively shallower coarse sand supporting the bivalve *Moerella spp*. with venerid bivalves.
g (45 samples) ●	SS.SSa.CFiSa.EpusOborApri	Fine sand sediments characterised by polychaetes (*Ophelia borealis*), molluscs (*C. praetenue* and *C. decussata)* and the urchin *E. pusillus*.

The biotopes found included closely related circalittoral (deep water) and offshore sand biotopes typical of central and northern North Sea areas. Classifications matched well with the distribution of the broad-scale MESH habitats shown in Figure 3.3-1 above and with previous sample data. None of the habitats were considered to be geographically restricted or rare and were well represented within and around the MORL EDA area.

The trawl and video data identified assemblages of larger and more mobile benthic species not normally collected using grab techniques. These included scallops (*Aequipecten opercularis*), common starfish (*A. rubens*), pogge (*Agonus cataphractus*), harbour crab (*Liocarcinus depurator*), hermit crabs (*Pagurus spp.*), dragonet (*Callionymus lyra*), whiting (*M. merlangus*), dab (*L. limanda*), plaice (*P. platessa*), thick back sole (*Microchirus variegatus*) and lemon sole (*M. kitt*).

No rare or protected species with respect to the (the Habitats Directive) and / or the Wildlife and Countryside Act 1981, were found within the boundaries of the MORL EDA. The following features of potential nature conservation interest were however, noted:

- The Icelandic cyprine or Ocean quahog (*Arctica islandica*) is on the OSPAR List of Threatened and / or Declining Species and Habitats (Region II – Greater North Sea) and the list of Scottish Priority Marine Features (PMF) but was only found singly as juveniles at nine of the 88 stations sampled. No adult *A. islandica* specimens were recorded during the survey;
- "Subtidal sands and gravels" is a UK Biodiversity Action Plan (UK BAP) priority habitat as a result of its importance for the conservation of biodiversity. It encompasses a range of near-shore and offshore habitats including a number of shallow and deeper water sand and fine sand biotopes corresponding to the classifications SS.SCS.ICS, SS.SCS.CCS, SS.SSa.IFiSa, SS.SSa.CFiSa and SS.SSa.OSa. These biotope types were recorded during the MORL EDA site investigation;
- The coarse sand biotope MoeVen is listed as a PMF on the Scottish PMF list. This biotope was however, only found within the boundaries of the BOWL wind farm site at one reference location and outside of the boundaries of the MORL Zone; and
- Sandeels (as sandeel complex *Ammodytes marinus, A. tobianus*) are also included within the Scottish PMF list. These species have an important functional role supporting many types of larger fish, seabirds and marine mammals as a food source.

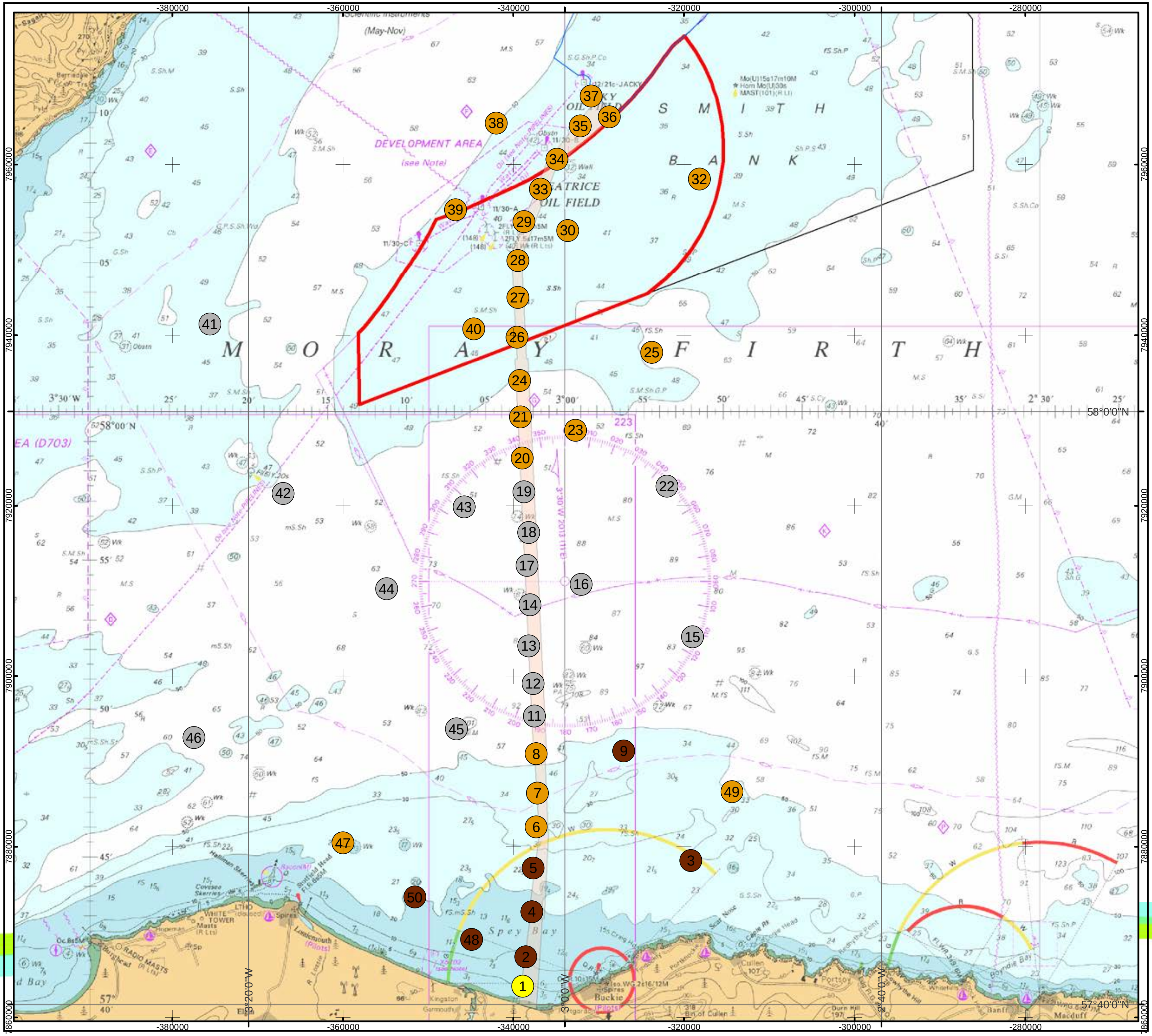
Finally, levels of sediment contaminants were below guideline levels at all locations sampled. Sediment total organic carbon content was generally low ranging between 0.20% and 0.39%.

Other studies

BOWL carried out benthic surveys in June 2011 within its Offshore Transmission Works Corridor. Part of the survey was undertaken within the WDA which the BOWL export cable route transects. The survey comprised of drop down camera survey and benthic grabs (eight of which were located within the WDA boundary as shown in Figure 3.3-3 below). Four different habitats were classified within the survey area with 'fine sand and shell fragments' the only habitat found within the WDA. A summary of this habitat description is provided below:

The sediment description for this habitat type is fine sand with shell fragments and a silt veneer with either no or very sparse visible epifauna. Small amounts of bivalve and gastropod shell fragments are visible with occasional large dead shells e.g. *Ensis spp.* Epifaunal species recorded from these sites were very low in numbers and were; common starfish, *A. rubens*, *Ophiura spp*., and *P. triqueter* encrusting empty bivalve shell with very small amounts of hydroids and bryozoa. Occasional sand mason worms, *Lanice conchilega* were also noted.

Detailed information is provided within Annex 22A of the BOWL ES (BOWL, 2012).



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KEY

Habitat Classification

- ● Burrowed Mud
- ● Encrusted Cobble, Pebble and Coarse Gravel
- ● Fine Sand with Shell Fragments
- ● Very Fine Sand with Ripples
- ▭ Western Development Area
- ▭ Eastern Development Area
- ▭ BOWL
- ▭ BOWL OfTW Corridor

Horizontal Scale: 1:600,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

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Figure 3.3-3
Existing WDA Benthic Data 2011
BOWL OfTW Sample Locations

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3.3.2 *Data Gaps*

Apart from the localised surveys from the Beatrice Demonstrator site investigations and BOWL's Offshore Transmission Works survey as highlighted in Section 3.3.1 above there is no additional detailed benthic survey data of the WDA. Site specific surveys to identify the benthic characteristics across the WDA are therefore proposed. The surveys will include seabed sampling, video surveillance and scientific trawling. The survey sampling will be designed to supplement the existing data and will be based on the existing geophysical survey data available for the WDA. The modelled geophysical data (from the coarse grid surveys undertaken in 2010) will be used to identify target areas for benthic surveys to provide a good representation of the likely extent of benthic habitats throughout the WDA.

3.3.3 *Potential Effects*

3.3.3.1 Summary of Potential Effects

Based on the EIA for benthic ecology for the MORL EDA wind farms (MORL, 2012) the following are perceived to be the potential effects of development in the WDA on benthic features:

Potential Effect	**Construction**	**Operation**	**Decommissioning**	**Scoped Out**
Temporary Direct Seabed Disturbances	✓	✓	✓	×
Temporary Indirect (Sediment) Disturbances	✓	×	✓	×
Seabed Deposition of Sediment Arisings from Drilling of Jacket Piles and Dredge Material from Seabed Preparation	✓	×	×	×
Seabed Contamination as a Result of Accidental Spillage of Chemicals	✓	✓	✓	×
Net Reduction of Area of Seabed Habitat	×	✓	×	×
Habitat and Associated Community Change	×	✓	×	×
Effects on Physical Processes and Related Biological Changes	×	✓	×	×

Whilst a specific assessment will be carried out in relation to the WDA, given the proximity of the MORL EDA and WDA and the potential similarities in relation to potential effects, the findings of the MORL EDA benthic ecology assessment have been included below for context.

3.3.3.2 Potential Effects During the Construction Phase

Temporary Direct Seabed Disturbances

Seabed habitats will be temporarily directly disturbed as a result of placement of the feet of construction vessels (jack–up barges) and the installation of inter–array cables. In addition, cable laying barges will typically deploy up to six heavy anchors in an array around the vessel to enable accurate positioning for cable installation. These anchors will leave a series of scars on the seabed. Berms of sediment may also be deposited on the seabed as a result of displacement and side casting of material from trenches constructed during cable installation. Small mounds of sediment may also be created at each anchor site as a result of the anchor being pulled through the sediment on initial deployment or recovery. Whilst much of this prepared seabed will be subsequently occupied by the foundation and scour protection material, other areas of prepared seabed will remain exposed.

These temporary direct seabed disturbances are of potential interest as they will result in a series of seabed depressions, including holes left by the feet of spud legs and linear scars where inter–array cables have been buried, resulting in a change in the benthic ecology relative to baseline conditions. In addition, there is the potential for damage to benthic fauna as a result of crushing, compaction and abrasion effects causing loss of species diversity, abundance and biomass within the footprint of the effect. Sessile and sedentary fauna will be most susceptible due to their limited ability to move away from affected areas. Dredging (e.g. for installation of gravity base foundations) will remove the sediment and the animals which live within it.

Experience from the marine aggregates industry (e.g. van Moorsel & Waardenburg, 1991; Kenny & Rees, 1996; Sardá et al., 2000; Boyd *et al*., 2005; Desprez 2010; Barrio–Frojan, 2008; Hill *et al*., 2011) shows that recovery of the benthic ecology follows a general pattern of succession of colonisation once seabed disturbances abate, but that the rate at which this is achieved typically depends upon a number of factors including the prevailing hydrodynamic and sediment transport regime, the severity of the original effect and the nature of the baseline community and surrounding populations.

It is highlighted that the assessments for the MORL EDA identified the potential effects of temporary direct seabed disturbances to be of minor significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, this was not considered to be a significant effect.

Temporary Indirect (sediment) Disturbances

Seabed preparatory work including dredger over–spill, placement of turbines and installation of inter–array cables are likely to suspend fine sediments into the water column increasing suspended sediment concentrations (SSCs) in the locale. Suspended sediments from these sources will be transported via tidal currents for re-settlement over adjacent seabed areas. This effect is of potential interest as the re-settlement of sediment back to the seafloor may have negative indirect effects on benthic ecology including smothering and scour of seabed communities causing a loss of species diversity, abundance and biomass where effects are significant. Sessile epifaunal species may be particularly affected by increases in SSCs as a result of potential clogging or abrasion of sensitive feeding and respiratory apparatus. Larger, more mobile animals, such as crabs, fish, shrimps and prawns are expected to be able to avoid any adverse SSCs and areas of deposition.

It is highlighted that the assessments for the MORL EDA identified the potential effects of temporary direct seabed disturbances to be of minor significance (temporary, negative and of short duration). Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, this was not considered to be a significant effect.

Seabed Deposition of Sediment Arisings from Drilling of Jacket Piles and Dredge Material from Seabed Preparation

The deposition of sediment arisings from drilling activities will not occur under the gravity base scenario but is worth considering nonetheless ensuring all realistic worst case effects on benthic ecology are assessed (see Section 1.2 above for WDA project design information). This effect is specific to the jacket foundation option and it is therefore appropriate that related effects are assessed in the event that this alternative is eventually selected. Effects relate to the deposition of drill arisings onto the seabed and are of potential interest as a result of associated smothering and scour effects on benthic communities.

Deposition of sediment and boulders will also occur with disposal of dredge material/re-distribution of boulders from seabed preparation (e.g. for placement of foundations). Community change at a local scale and smothering effects on benthic communities as suspended sediments settle out will need to be considered. The scale of the effects will depend on the nature and volume of the dredge/boulder material.

It is highlighted that the assessments for the MORL EDA assessed the potential effects of deposition of sediment arisings from drilling activities to be of minor significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, this was not considered to be a significant effect.

Sediment Contamination as a Result of Accidental Spillage of Chemicals (construction, operation and decommissioning)

Accidental spillages or release of chemicals such as grouting, fuel and oil during the construction, operation and decommissioning phases of the wind farm may potentially contaminate seabed sediments. The severity of this effect on benthic ecology depends upon the quantities and nature of the spillage / release, the dilution and dispersal properties of the receiving waters and the bio–availability of the contaminant to benthic species.

It is highlighted that the assessments for the MORL EDA identified the pre-mitigation potential effects of accidental spillages to be of up to major significance (worst case scenario) as the scale and magnitude of the effects were unquantifiable at the time. The uncertainty associated with the effects was classed as high. Adherence to the EMP reduced the significance of the effect to minor. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, this was not considered to be a significant effect (post-mitigation).

3.3.3.3 Potential Effects During the Operational Phase

Net Reduction of Area of Seabed Habitat

It is considered that there will be a direct loss of habitat due to the placement of infrastructure in the seabed (turbine foundations) as well as due to associated scour protection and cable protection material onto the seabed. The effect is of potential concern as it will result in a reduction in the total area of original seabed habitat.

The effect of the reduction of seabed habitats for the MORL EDA was assessed as being long term lasting for the duration of the development after which the total area of habitat would be restored following decommissioning and removal of turbine foundations and scour material. However, in view of the very small spatial extent of the effect, the magnitude of the effect was considered to be low. Ecosystem functioning of component habitats was not predicted to be significantly affected and so the sensitivity of the receptor was regarded to be low. Accordingly the effect of the direct placement of turbines on the seabed was judged to be of minor significance for the MORL EDA. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, this was not considered to be a significant effect.

Habitat and Associated Community Change

New habitat will be created through the introduction of hard substances, including turbine foundations, scour, dredge disposal from seabed preparation for foundations during construction and cable protection material, which will be available for colonisation by attaching and encrusting species such as barnacles, hydroids and bryozoans. This will create a habitat that will be different from baseline conditions. There will also be an increase in the risk of enhancing the spread of marine invasive non–native species (MINNS). The effects will be long term lasting for the duration of the operation of the wind farm. Effects associated with the spread of MINNS may last beyond decommissioning. The placement of scour and cable protection material on the seabed will also change the ambient sedimentary habitats to a more heterogeneous coarse, hard substrate habitat.

Disposal of dredge material/boulder movement as part of seabed preparation can also result in a change in benthic communities and it will depend on the nature and volume of the dredge/boulder material.

It is highlighted that the assessments for the MORL EDA identified the potential effects on habitats and associated community change through the introduction of hard substances to be of moderate significance, in recognition of the potential for *C. mutica* and other MINNS to colonise the turbines. Adherence to the EMP (including the MINNS protocol) reduced the significance of the effect to minor. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, this was not considered to be a significant effect (post-mitigation).

Effects on Physical Processes and Related Biological Changes

Benthic habitats and associated communities are strongly influenced by seabed sediment type and stability which are themselves typically functions of prevailing hydrodynamic and wave regimes. Effects of the wind farm on physical processes are therefore of potential interest as they may lead to changes in baseline benthic ecological conditions. Depending on the extent of the effects on the hydrodynamic and wave regimes, the effects on the benthic community could be long term, lasting for the duration of the operation of the wind farm but reversible upon decommissioning.

At the local (individual turbine) level, secondary scour of the seabed (i.e. scour around the edges of scour protection material) may occur as a result of locally accelerated near bottom currents. Associated effects on benthic ecology could include increased habitat instability and modification as a result of winnowing and erosion of finer grained particles from the affected seabed sediments. This may change the composition of affected benthic communities including exclusion of species with particular sensitivity to disturbance although complete defaunation is highly unlikely. The extent of the influence of secondary scour is broadly related to the nature of the scour material itself and is therefore not considered to extend beyond a few tens of metres from its outer edge (as observed at Thornton Bank where gravity bases and associated scour protection already exist (ABPmer, 2010)).

At the wider (array) scale, the presence of a maximum of 90 turbines (as defined in the Project Description in Section 1.2 above) has the potential to influence tidal flow speeds and prevailing wave climate which may influence sediment transport pathways, which may have associated effects on benthic ecology.

It is highlighted that the assessments for the MORL EDA assessed the potential on physical processes and related biological changes as minor based on the results of the hydrodynamics, wave climate and tidal regime assessment and the benthic environment within the MORL EDA. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, this was not considered to be a significant effect.

Temporary Direct Seabed Disturbances

Ongoing operations and maintenance, major interventions and overhauls of turbines can cause temporary direct seabed disturbance. The significance of this effect will depend on the predicted number of interventions throughout the operational phase of the wind farm.

It is highlighted that the assessments for the MORL EDA assessed the potential spatial extent and duration of this effect as negligible. Biotopes within the MORL EDA were considered to have high recoverability and were expected to recover within a few months to five years. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, this was not considered to be a significant effect.

3.3.3.4 Potential Effects During the Decommissioning Phase

At this stage, decommissioning effects are envisaged to be similar to those described for the construction phase, or will be less in the event that buried cables are left in-situ.

3.3.4 Approach to EIA

For each of the potential effects identified above a survey or study and method of impact assessment is described in the tables below.

3.3.4.1 Construction Phase

Potential Effect	**Temporary Direct Seabed Disturbances,** **Temporary Indirect (Sediment) Disturbance, and** **Seabed Deposition of Sediment Arisings from Drilling of Jacket Piles and Dredge Material from Seabed Preparation**
Study / Survey Proposed	Data on benthic habitat will be collected through seabed sampling, video surveillance and scientific trawling (the survey sampling will be designed to supplement the existing benthic data and will be based on the existing modelled geophysical survey data available for the WDA). A benthic characterisation survey is proposed across the WDA area and adjacent areas within the potential influence of sediment plumes, to identify the biotopes and habitats present (including Annex 1 and Scottish PMF habitats). Desk based study to assess the predicted recovery of benthic communities present within the WDA to seabed disturbance and increased SSCs. The MORL Zone numerical model for physical processes will be updated (see Section 2.2 Physical Processes above) to determine the potential for increased suspended sediment concentrations and associated redeposition.
EIA Methodology	Potential effects on sensitive receptors will be assessed using the outputs of the physical processes model assessment and published data on the sensitivity of benthic communities associated with the WDA. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**Seabed Contamination as a Result of Accidental Spillage of Chemicals**
Study / Survey Proposed	Chemical analysis of sediments (from subsamples of the benthic grab survey) will be undertaken to understand the existing sediment contaminants in the seabed.
EIA Methodology	The data collected will be used to assess the likelihood of sediment contamination through comparison with Marine Scotland Action Level I values for dredged materials. Contaminants to be tested will be agreed with MS-LOT following consultation with MSS, but are expected to include organic carbon, Ba, Ca, Cu, Ni, Cr, Pb, Zn, As, Sn, Hg, PAHs (EPA 16) and TPH. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

3.3.4.2 Operation Phase

Potential Effect	**Net Reduction of Area of Seabed Habitat**
Study / Survey Proposed	Data on the benthic habitat will be collected through seabed sampling, video surveillance and scientific trawling. A benthic characterisation survey is proposed across the WDA area to identify and map the biotopes and habitats present (including Annex 1 and Scottish PMF habitats).
EIA Methodology	Potential effects through direct habitat loss will be assessed via quantifying any losses in terms of % of loss of certain biotopes/habitats within the WDA. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**Habitat and Associated Community Change**
Study / Survey Proposed	Data on benthic habitat will be collected through seabed sampling, video surveillance and scientific trawling. A benthic characterisation survey is proposed across the WDA area to identify the biotopes and habitats present (including Annex 1 and Scottish PMF habitats).
EIA Methodology	This characterisation biotope data will be used to assess the impact of increased hard substrate area on the surrounding marine ecology. Reference will also be made to the results of monitoring programmes for other offshore wind farms and other relevant literature in order to determine the communities likely to become established on the turbines. Standard EIA methodologies will be used to determine significance. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**Effects on Physical Processes and Related Biological Changes, and Temporary Direct Seabed Disturbances**
Study / Survey Proposed	Data on benthic habitat will be collected through seabed sampling, video surveillance and scientific trawling. A benthic characterisation survey is proposed across the WDA area to identify the biotopes and habitats present (including Annex 1 and Scottish PMF habitats). Desk based study to assess the predicted recovery of benthic communities present within the WDA to seabed disturbance and increased SSCs. The MORL Zone numerical model for physical processes will be updated (see Section 2.2 Physical Processes above) to determine the potential for increased suspended sediment concentrations and associated redeposition.
EIA Methodology	Potential effects on the benthic environment through scour/sediment transport changes and temporary direct seabed disturbances will be assessed by applying the findings of the physical processes assessment to the characterisation of the benthic datasets, including published data on the sensitivity of benthic communities associated with the WDA, and previous experience gained during the assessment of previous offshore wind farms and standard EIA methodologies. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**Seabed Contamination as a Result of Accidental Spillage of Chemicals**
Study / Survey Proposed	Data on the benthic habitat will be collected through seabed sampling, video surveillance and scientific trawling. A benthic characterisation survey is proposed across the WDA area to identify the biotopes and habitats present (including Annex 1 and Scottish PMF habitats). Chemical analysis of sediments (from subsamples of the benthic grab survey) will also be undertaken to understand the existing sediment contaminants in the seabed.
EIA Methodology	The data collected will be used to assess the likelihood of sediment contamination through comparison with Marine Scotland Action Level I values for dredged materials and the presence and responses of particularly vulnerable species and communities which will be protected through the development of, and adherence to, relevant management plans. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

3.3.5 Site Specific Survey Methodology

The benthic ecology survey will be conducted following Cefas Guidelines (Cefas, 2004) and in accordance with Cefas guidance on the conduct of benthic surveys at marine aggregate sites (Ware & Kenny, 2011).

The benthic surveys will include the following techniques:

- Seabed imagery via drop down video for habitat assessment;
- Single 0.1m^2 mini-Hamon grab sample at each station for quantitative sampling of sediment fauna and particle size distribution;
- Stainless steel Day grab or Shipek grab sampling for seabed sediment chemical analyses; and
- 2 m scientific beam trawling for assessment of mobile epibenthic assemblages (crabs, fish, prawns etc).

Proposed methodologies will be agreed with MS-LOT following consultation with MSS prior to mobilisation.

Seabed sampling

A random stratified seabed sampling array will be developed on the basis of pre-acquired geophysical (side scan sonar and bathymetry) data.

At each station, a single quantitative seabed sample will be collected by a 0.1 m^2 Day or Hamon grab for macrofaunal content and particle size distribution analysis (PSD). In addition, a single sample for contaminants analysis shall be collected by a 0.04 m^2 Shipek grab at selected stations.

At each sampling location acceptable samples will be retained for faunal and sediment analysis and for physico-chemical analyses. The analyses tested will include:

- Particle Size Distribution (PSD) with sieve and laser sizer;
- Total Organic Carbon (TOC);
- Hydrocarbon analysis;
- Heavy metal concentration (Ba, As, Cd, Cr, Cu, Pb, Hg, Ni, Sn);
- PAH (Polycyclic Aromatic Hydrocarbons); and
- Macrofaunal and epifaunal analysis with phylum biomass analysis.

Video Surveillance

Prior to the grab sampling at each station, seabed video surveillance will be collected for assessment of habitats, conspicuous epifauna and presence of any sensitive features, such as reefs. The video camera will also be deployed to ground truth any topographically distinct features that may have been identified from the review of the geophysical data. Photographic stills will also be collected for subsequent analysis and to enhance the species record for each station.

Seabed video and photography data will be acquired using a drop-down transect methodology at each station. Digital stills will be acquired throughout each transect. Parallel lasers will also be attached to the camera system to allow quantification and assessment of scale of all observed fauna. In addition, laser scaling is important in determining sediment size classes, especially for assessment of geogenic or biogenic reef, if found. From previous experience, visibility conditions are expected to be adequate for video surveillance purposes.

Once the data is returned to the office it will be analysed to record the fauna and flora and sediment conditions observed.

Scientific Trawling

A series of 2 m scientific beam trawl samples shall also be collected for assessment of larger, more mobile fauna such as crabs, fish and shrimps. Survey logs will be kept detailing the sample name / number, fix number / geographical location of start and end position, speed of trawl, distance of trawl, length of winch wire deployed, time in the water, volume of sample recovered, sediment and other materials present in trawl and conspicuous fauna.

Trawl sampling will be conducted using a 2 m Scientific Beam Trawl based on the industry standard Lowestoft design. The trawls are fitted with a 10 mm net with a 5 mm cod end liner.

At each site, the trawl will be orientated into the most appropriate direction to enable the trawl to be undertaken into the tide (which enables low survey speeds coupled with manoeuvrability). Tow length will be no more than 1000 m with a speed not exceeding 2 knots. Vessel track will be recorded along with start and end points of the trawl.

Contents of each trawl will be photographed and sorted and epibenthos identified. The total length of commercial fish will be measured to the nearest centimetre, rounded down. The sex of elasmobranchs and other adult fish will be recorded where possible. The sex, carapace length and shell softness of macro-crustaceans will be recorded, including the presence of any berried females. Large conspicuous sessile colonial fauna will be weighed to illustrate relative abundance at each location.

Species will be identified and enumerated on site. Problematic species will be preserved on-site and returned for subsequent analysis.

Following analysis, data will undergo univariate and multivariate analyses to derive community metrics and will contribute to the habitat classification and mapping outputs.

3.3.6 Cumulative and In-combination Effects

There is foreseeable potential for the extent or magnitude of any effects identified in Section 3.3.3 above to be cumulatively increased by the simultaneous presence of other existing or proposed activities or developments. The extent to which these cumulative effects may arise will depend upon the design and extent of the infrastructure or the frequency and intensity of the activities.

As discussed in Section 1.3.2.6 above, the method for cumulative impact assessment will be carried out in accordance with the methods outlined within the MFOWDG discussion document "Moray Firth Offshore Wind Developers Group Cumulative Impact Assessment Discussion Document" (MORL, 2012) unless otherwise agreed with MS-LOT and appropriate stakeholders. This document has been included as Annex 1 to this Scoping Report.

3.3.7 Potential Mitigation Measures

If in light of the conclusions of the EIA, potential mitigation measures are required, these will be determined following the production of the impact assessments and consultation with consenting authorities and appropriate stakeholders.

It is highlighted that mitigation put forward for the MORL EDA (MORL, 2012), included:

- Adherence to EMP; and
- Adoption of a protocol to minimise risk in relation to spread MINNS.

3.4 Fish and Shellfish Ecology

3.4.1 Baseline Characteristics

This section describes the Fish and Shellfish Ecology baseline environment and potential effects associated with the WDA. Information on the WDA baseline characteristics have been derived mostly from the MORL ES 2012. The Fish and Shellfish ES Chapter and Technical Appendix can be accessed via the following links – Chapter 4.3 Fish and Shellfish Ecology and Technical Appendix 4.3 A Fish and Shellfish Ecology. Table 3.4-1 below lists the proposed datasets that will inform the assessment.

Table 3.4-1 Datasets for the fish and shellfish ecology EIA

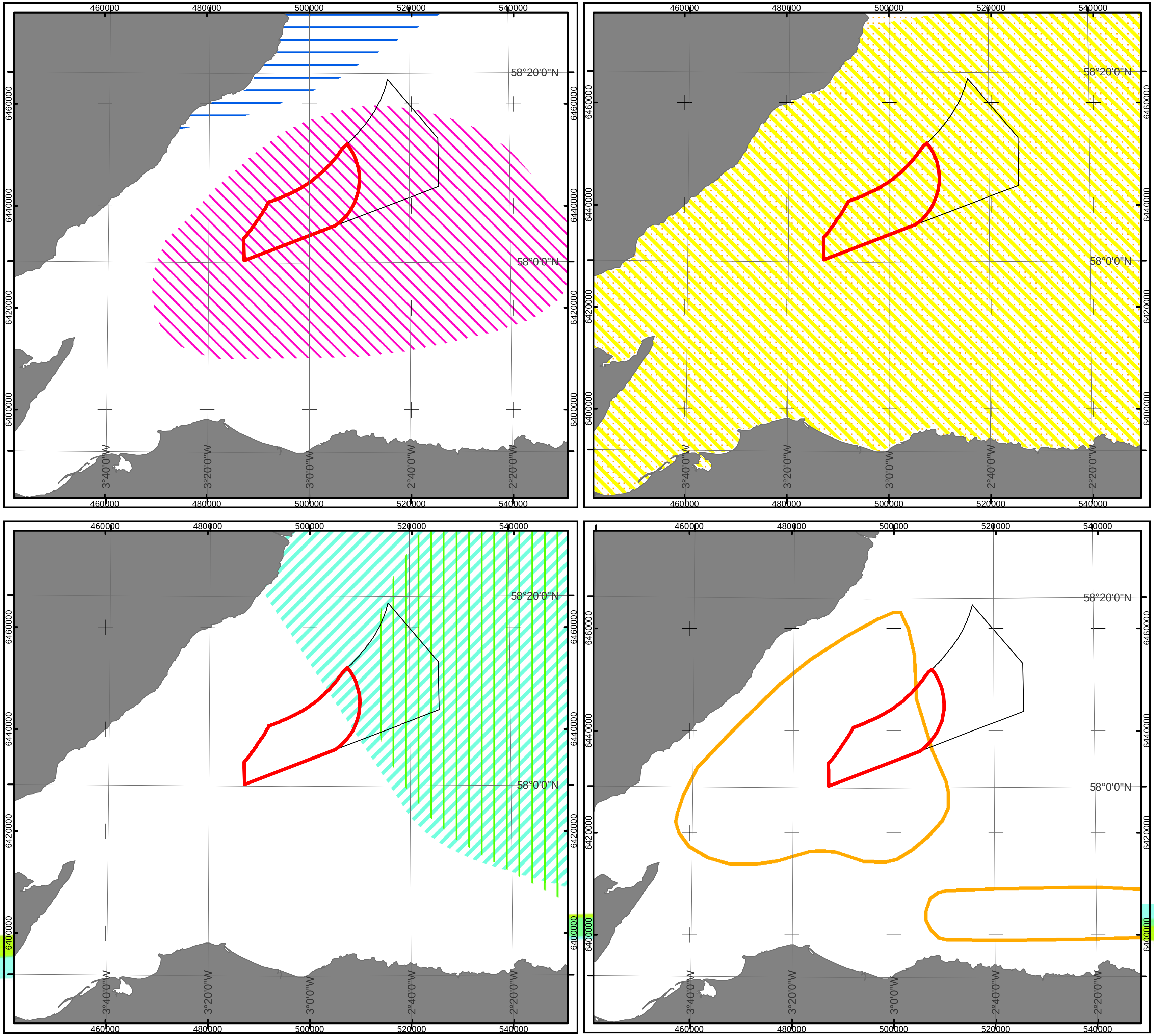
Dataset	**Coverage**	**Date**
Hydrodynamic modelling	MORL EDA and Zone	2012
Benthic Surveys (grabs trawls and video, EMU Ltd)	MORL EDA	October 2010
Sandeel surveys	MORL Zone	Jan – Mar 2012
Cod survey report (MORL, 2013a)	MORL Zone	Feb-Mar 2013
Pre-construction baseline cod spawning survey – Technical Report	BOWL site	Feb 2015
BOWL herring larval surveys	BOWL site	2014-2015
BOWL cable route benthic surveys	BOWL cable route	2012
Cod Spawning Grounds - González-Irusta & Wright – ICES Journal of Marine Science	North Sea	2015
International Council for the Exploration of the Sea (ICES) publications (e.g. International Bottom Trawl Survey and International Herring Larval Survey)	UK	n/a
Marine Management Organisation (MMO) landings data by ICES rectangle	UK	To be confirmed
Fisheries Sensitivity Maps in Brisith Waters e.g. Coull *et al*. (1998) Ellis *et al*. (2012) Scottish Marine and Freshwater Science Volume 5 Number 10: Updating Fisheries Sensitivity Maps in British Waters (2014)	UK	1998
Mapping spawning and nursery areas of species to be considered in Marine Protected Areas (Marine Conservation Zones)	UK	2010

The guidance documents to be used in the preparation of the EIA include:

- Cefas (2004). Offshore Wind Farms: Guidance Note for Environmental Impact Assessment in Respect of Food and Environmental Protection Act (FEPA) and Coast Protection Act (CPA) Requirements: Version 2.
- IEEM (Institute of Ecology and Environmental Management) (2010). Guidelines for Ecological Impact Assessment in Britain and Ireland. Marine and Coastal. Final Document, August 2010.

3.4.1.1 Spawning and nursery areas

Spawning and nursery grounds have been defined for a number of species within and in the immediate vicinity of the WDA (see Figures 3.4-1 and 3.4-2 below). These are shown in Table 3.4-2 below, together with spawning times and intensity of spawning / nursery areas. Spawning times are given as provided in Coull *et al*., (1998) and spawning / nursery grounds intensity as described in Ellis *et al*., (2010). Detailed information on the ecology and spawning behaviour of the species is given in the MORL ES 2012 (Appendix 4.3 A, Section 4) and further detail on cod spawning behaviour on the Smith Bank is provided in MORL Modified ES 2014 and BOWL (2015).



Moray Offshore Renewables Ltd

KEY

🟥 Western Development Area

☐ Eastern Development Area

Spawning Grounds (Coull et al., 1998)

Species

▨ Cod

— Herring

⋯ Lemon Sole

▨ Nephrops

▨ Sprat

| | | Whiting

☐ Plaice

Horizontal Scale: 1:1,000,000

A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: PL
Approved: SP

Date: 04/05/2016

Revision: C

REF: 8460001-PQW0010-MOR-MAP-009

Figure 3.4-1
Spawning Grounds in the Moray Firth

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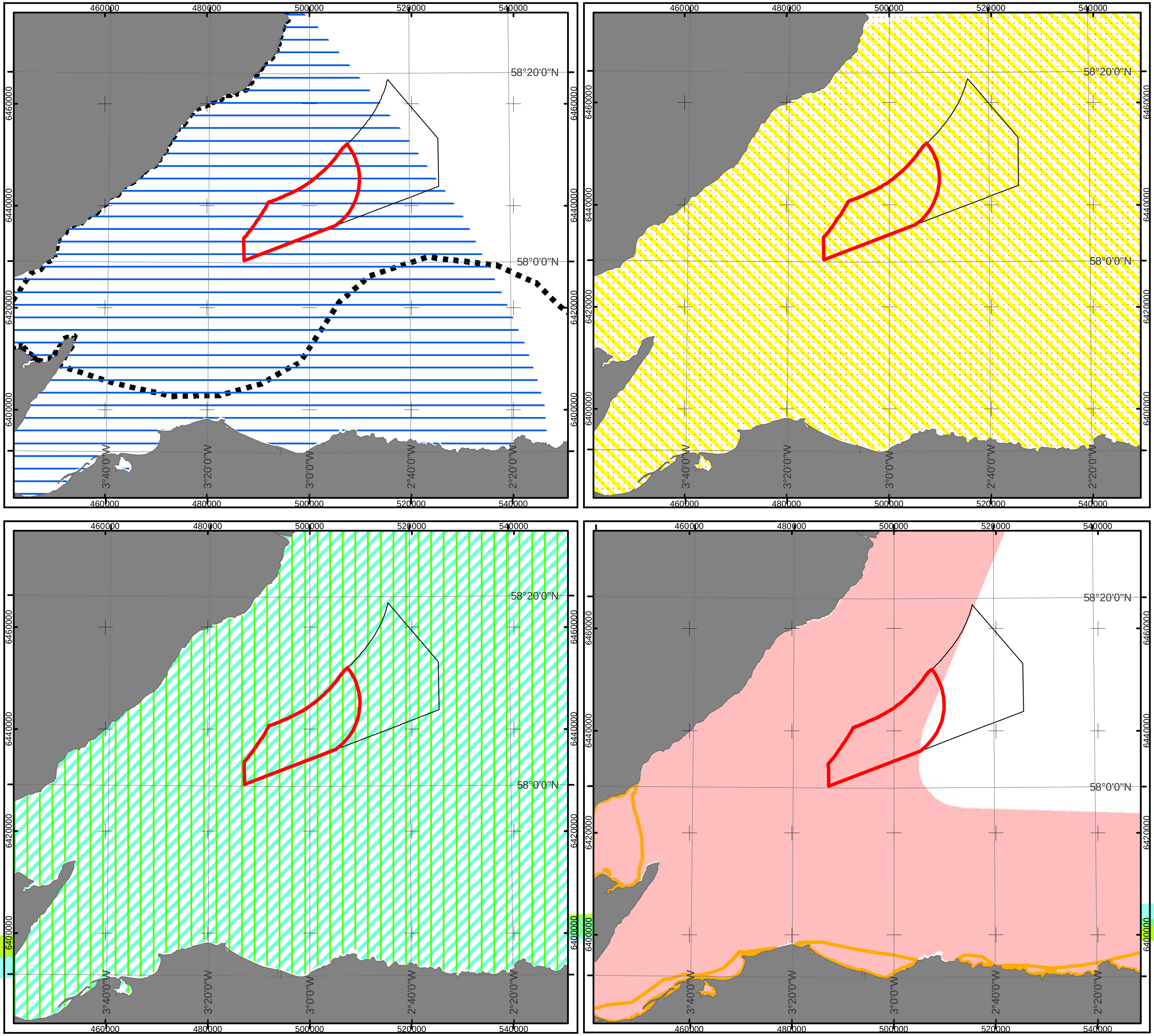

Moray Offshore Renewables Ltd

KEY

- 🟥 Western Development Area
- ☐ Eastern Development Area

Nursery Grounds (Coull et al,. 1998)

Species

- ▪▪▪ Haddock
- ═ Herring
- ⋯ Lemon Sole
- ▨ Nephrops
- ▨ Sprat
- ||| Whiting
- ☐ Plaice
- ■ Saithe

Horizontal Scale: 1:1,000,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
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Date: 04/05/2016 Revision: C

REF: 8460001-PQW0010-MOR-MAP-010

Figure 3.4-2
Nursery Grounds in the Moray Firth

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Table 3.4-2 Species with Spawning and Nursery Areas within / in Close Proximity to the MORL EDA and Export Cable(s), and Spawning Times and Intensity (Coull *et al.*, 1998, Ellis *et al.*, 2010)

Species	Seasonality of Spawning (Intensity and Peak Spawning*)												Nursery (Intensity)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Cod	🟨	🟨 *	🟨 *	🟨									🟥
Herring								🟩	🟩				🟥
Lemon Sole				🟩	🟩	🟩	🟩	🟩	🟩				🟩
Nephrops	🟩	🟩	🟩	🟩 *	🟩 *	🟩 *	🟩	🟩	🟩	🟩	🟩	🟩	🟩
Plaice	🟨 *	🟨 *	🟨									🟨	🟨
Sandeel	🟥	🟥									🟥	🟥	🟨
Sprat					🟩 *	🟩 *	🟩	🟩					🟩
Whiting		🟨	🟨	🟨	🟨	🟨							🟥
Anglerfish	n/a												🟥
Blue Whiting	n/a												🟨
Haddock	n/a												🟩
Hake	n/a												🟨
Ling	n/a												🟨
Mackerel	n/a												🟨
Saithe	n/a												🟩
Spotted Ray	n/a												🟨
Spurdog	n/a												🟨
Thornback Ray	n/a												🟨
Colour key: Red – high intensity spawning/nursery ground. Yellow – low intensity spawning / nursery ground. Green – unknown intensity. * - Peak spawning.													

It should be noted that, in addition to the species listed above, king scallops may use areas within the WDA as a spawning and nursery ground. As suggested by fisheries data, scallops are widely distributed in the Moray Firth, including the area of the WDA. Similarly squid, a species also supporting important commercial fisheries, is known to spawn in the Moray Firth in inshore areas. Some degree of squid spawning may therefore also occur in the area of the WDA.

Spawning and nursery grounds are dynamic features of fish life history and are rarely fixed in one location from year to year. In addition, fish may spawn earlier or later in the season in response to environmental change. Therefore, the information provided in Figures 3.4-1 and 3.4-2 above represents the widest known distribution of spawning and nursery grounds.

3.4.1.2 Key prey species

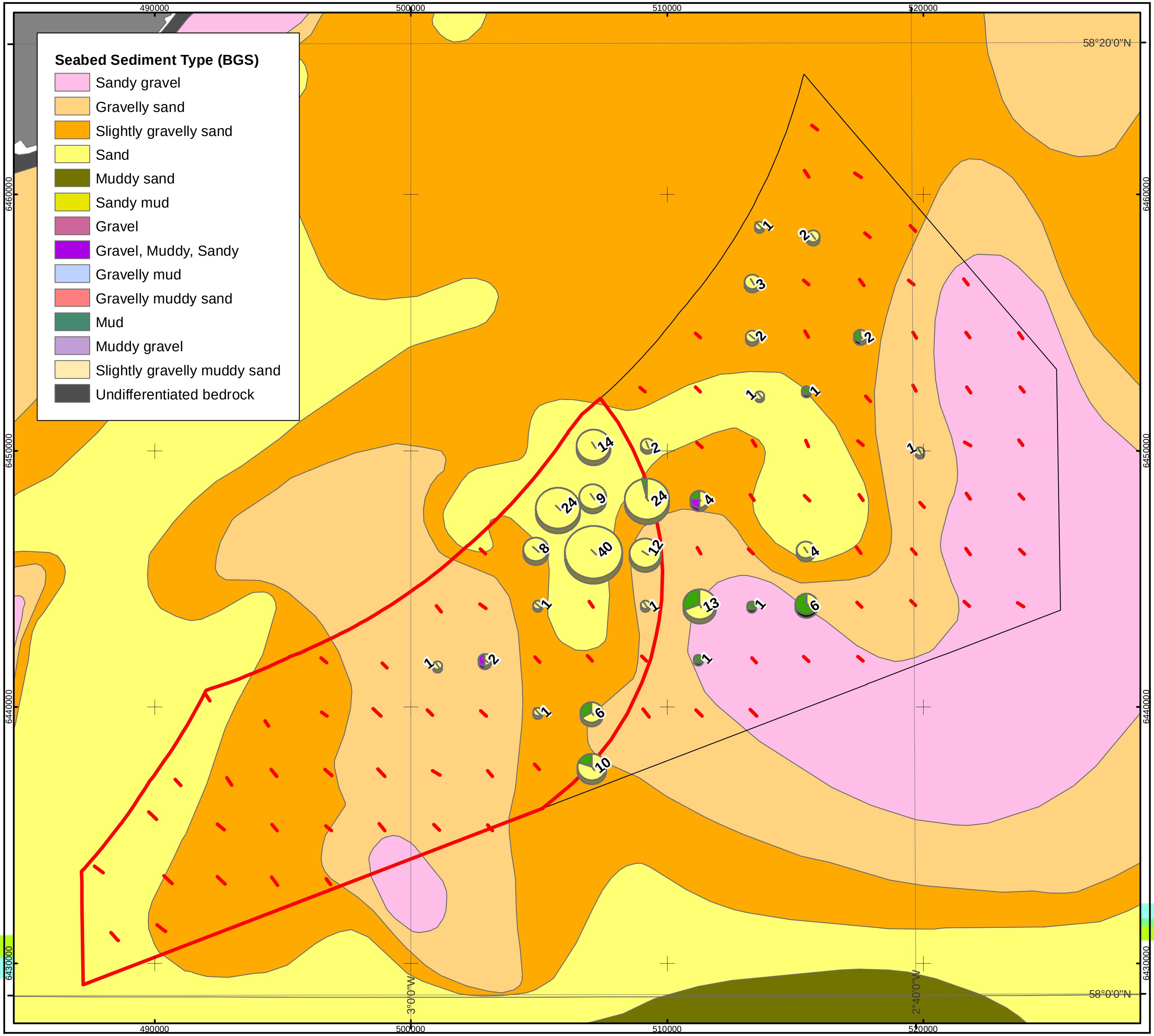
Sandeels, herring and sprat play a key role in the North Sea's food–web, being situated in a mid–trophic position. They are major predators of zooplankton and the principal prey of many top predators such as birds, marine mammals and piscivorous fish.

Herring is fed upon by a number of fish species (i.e. salmon, sea trout, whiting and cod), seabirds and a number of marine mammals such as harbour porpoises, bottlenose dolphins, grey seals and common seals. Similarly, sprat is also fed upon by a number of fish species, sea birds and marine mammals.

Sandeels are most commonly preyed upon when they are in transit to, or feeding in the water column. They are a key component of the diet of many birds (e.g. kittiwakes, razorbills, puffins and common terns), piscean predators such as herring, salmon, sea trout, cod, haddock and marine mammals such as grey seals, harbour porpoises and minke whales.

A sandeel survey was undertaken between January to March 2012 for the purposes of investigating the distribution of sandeels across the MORL Zone. The greatest abundance of sandeels were found in the eastern section of the WDA (Figure 3.4-3 below). The majority of individuals caught were Rait's sandeel (*Ammodytes marinus*) with a small proportion of Smooth sandeel (*Gymnammodytes semisquamatus*) recorded from sample sites on slightly gravelly sand and gravelly sand.

Overall, the distribution of sandeels was considered to be patchy, with the majority being caught in areas characterised by a sandy substrate (sand, sandy gravel, gravelly sand). It was commented in the MORL ES 2012 that zero catch rates should not be taken as an indication of unsuitable sandeel habitat. Sandeel distribution is extremely patchy and even the most suitable habitats often render zero–catch samples. If it is assumed that the population is below the area's carrying capacity, it is unlikely that all of the most suitable habitat will be fully occupied by sandeels (Greenstreet, 2007).



Moray Offshore Renewables Ltd

KEY

Type of sandeel caught

Total Catch (number sandeel per dredge)

🟨 Raitt's sandeel
🟪 Greater sandeel
🟩 Smooth sandeel
Dredge locations
Western Development Area
Eastern Development Area

Horizontal Scale: 1:200,000 A4 Chart
0 2,500 5,000 Meters
N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: PL
Approved: SP

Date: 06/05/2016 Revision: A

REF: 8460001-PQW0010-MOR-MAP-011

Figure 3.4-3
Sandeel distribution & diversity in MORL Zone (Jan-Feb 2012)

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Contains data from Brown & May, 2012. Sandeel Survey

3.4.1.3 Conservation species

A number of species of conservation importance have been identified as potentially present in the WDA. These include diadromous migratory species, (those using the marine and freshwater environments during their life cycle) elasmobranchs (sharks and rays) and commercial fish species.

Diadromous migratory species potentially present in the Moray Firth area are given in Table 3.4-3 below, together with their conservation status. The qualifying status of species considered for selection of river SACs in the Moray Firth and the wider area is given in Section 3.2 – Designated Sites above. A description of the ecology and distribution of diadromous species of conservation importance is provided in the MORL ES 2012 (Appendix 4.3 A, Section 6).

Table 3.4-3 Diadromous Migratory Species of Conservation Importance

Common name	**Latin Name**	**Conservation Status**								
		OSPAR	**IUCN Red List**	**Bern Convention**	**Habitats Directive**	**The Wildlife & Coountryside Act 1981**	**The Conservation (Natural Habitats &c) Regulations 1994**	**UK BAP Species**	**Scottish PMF**	**The Nature Conservation (Scotland) Act 2004**
European Eel	*Anguilla anguilla*	Y	Critically endangered	n	n	n	n	y	y	N
Allis Shad	*Alosa alosa*	Y	Least concern	y	y	y	y	y	n	N
Twaite Shad	*Alosa fallax*	N	Least concern	y	y	y	y	y	n	N
Sea Lamprey	*Petromyzon marinus*	Y	Least concern	y	y	n	n	y	y	N
River Lamprey	*Lampetra fluviatilis*	N	Least concern	y	y	n	y	y	y	N
Smelt	*Osmerus eperlanus*	N	Least concern	n	n	n	n	y	y	N
Atlantic Salmon	*Salmo salar*	Y	Lower risk / least concern	y	y	n	y	y	y	N
Sea Trout	*Salmo trutta*	n	Least concern	n	n	n	n	y	y	N

It should be noted that Atlantic salmon and sea lamprey are primary reasons and qualifying features for selection of a number of SAC rivers in the Moray Firth area. In addition, the freshwater pearl mussel is also a primary reason for selection of a number of SAC rivers in the Moray Firth area. The life cycle of this species is closely linked to that of Atlantic salmon and concerns have been raised that impacts on Atlantic salmon may result in indirect effects on this species.

Elasmobranch species (sharks and rays) with conservation status and / or declining stocks potentially using the WDA are given in Table 3.4-4 below. Their distribution and ecology in the Moray Firth are described in the MORL ES 2012 (Appendix 4.3 A, Section 6.2). Sharks and rays have slow growth rates and low reproductive output compared to other species groups. This results in slow rates of stock increase and low resilience to fishing mortality. Directed fisheries have caused stock collapse for many species, although at present, mortality in mixed–species and by–catch fisheries seems to be a more important threat.

Table 3.4-4 Principal Elasmobranch Species with Conservation Status Recorded in the Moray Firth

Common name	**Latin name**	**MMO Landings Data Records**	**Recorded in the Moray Firth (Ellis *et al.*, 2005)**	**Conservation Status**						
				OSPAR	**IUCN Red List**	**The Wildlife & Countryside Act 1981**	**The Conservation (Natural Habitats &c.) Regulations 1994**	**UK BAP Species**	**Scottish PMF**	**The Nature Conservation (Scotland) Act 2004 and Bern Convention**
Sharks										
Basking shark	*Cetorhinus maximus*	N	N	Y	Vulnerable	Y	N	Y	Y	Y
Blue shark	*Prionace glauca*	N	N	N	Near threatened	N	N	Y	N	N
Gulper shark	*Centrophorus granulosus*	Y	N	Y	Vulnerable	N	N	Y	N	N
Leafscale gulper shark	*Centrphorus squamosus*	Y	N	Y	Vulnerable	N	N	Y	N	N
Porbeagle	*Lamna nasus*	N	N	Y	Vulnerable	N	N	Y	N	N
Portuguese dogfish	*Centroscymunus coelolepis*	Y	N	Y	Near threatened	N	N	Y	N	N
Sailfin roughshark	*Oxynotus paradoxus*	Y	N	N	Data deficient	N	N	N	N	N

Spurdog (spiny dogfish)	*Squalus acanthias*	Y	Y	Y	Vulnerable	N	N	Y	Y	N
Tope	*Galeorhinus galeus*	Y	N	N	Vulnerable	N	N	Y	N	N
Skates and Rays										
Common skate	*Dipturus batis*	Y	Y	Y	Critically endangered	N	N	Y	Y	N
Long-nosed skate	*Dipturus oxyrinchus*	Y	N	N	Near threatened	N	N	N	N	N
Sandy ray	*Leucoraja circularis*	N	N	N	Vulnerable	N	N	Y	N	N
Spotted ray	*Raja montagui*	N	Y	Y	Least concern	N	N	N	N	N
Thornback ray	*Raja clavata*	Y	Y	Y	Near threatened	N	N	N	N	N
While skate	*Rostroraja alba*	Y	N	Y	Endangered	N	N	Y	N	N

Further to the above, there are a number of other fish species with conservation status in the Moray Firth area. The majority of these are commercially exploited in the Moray Firth having been recorded in landings data (2000 to 2009) within the regional study area. These are given in Table 3.4-5 below. In addition, the Ocean Quahog (*Arctica islandica*) a Scottish PMF and listed on the OSPAR list of threatened / declining species is also known to be present in the Moray Firth. A small number of juveniles of this species have been recorded in the MORL EDA but no adult specimens (MORL, 2012).

Table 3.4-5 Conservation Status of Fish Species Recorded in Landings Data (2000 to 2009) Within the Regional Study Area

Common Name	**Latin Name**	**Scottish PMF**	**UK BAP Species**	**OSPAR**	**IUCN Red List**
Anglerfish	*Lophius piscatorius*	Y	Y	N	N
Atlantic halibut	*Hippoglossus hippoglossus*	N	Y	N	Y
Atlantic mackerel	*Scomber scomber*	Y	Y	N	N
Black scabbardfish	*Aphanopus carbo*	N	Y	N	N
Blue ling	*Molva dypterygia*	Y	Y	N	N
Cod	*Gadus morhua*	Y	Y	Y	Y
Greenland hablibut	*Reinhardtius hippoglossoides*	N	Y	Y	Y

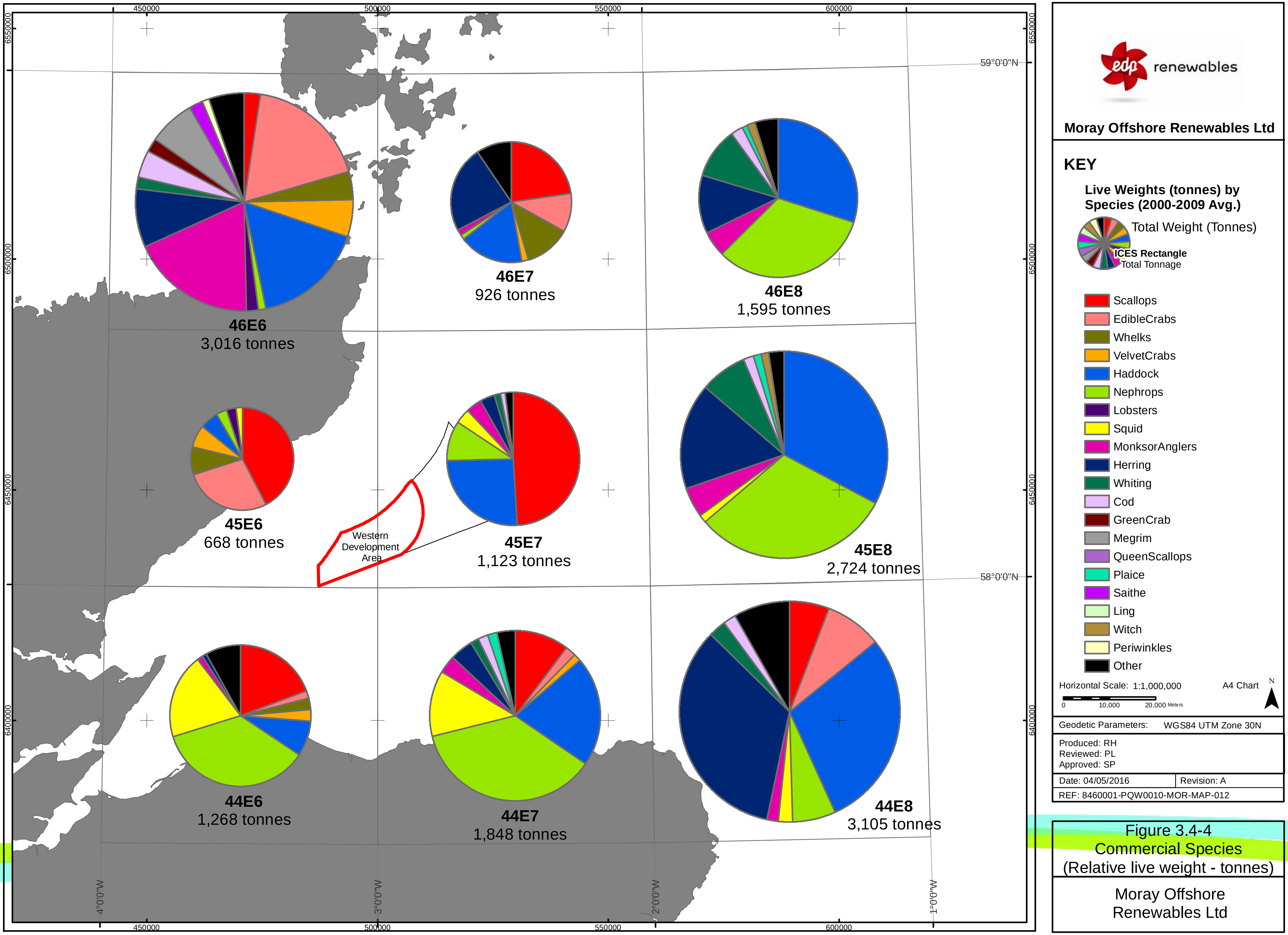
Common Name	**Latin Name**	**Scottish PMF**	**UK BAP Species**	**OSPAR**	**IUCN Red List**
Hake	*Merluccius merluccius*	N	Y	N	N
Herring	*Clupea harengus*	Y	N	N	Y
Horse mackerel	*Trachurus trachurus*	N	Y	N	N
Ling	*Molva molva*	Y	Y	N	N
Norway pout	*Trisopterus esmarki*	Y	N	N	N
Plaice	*Pleuronectes platessa*	N	Y	N	Y
Saithe	*Pollachius virens*	Y (juveniles)	N	N	N
Sandeels	*Ammodytes marinus*	Y	Y	N	N
	Ammodytes tobianus	Y	Y	N	N
Sand goby	*Pomatoschistus minutus*	Y	N	N	N
Whiting	*Merlanguis merlangus*	Y (juveniles)	Y	N	N

3.4.1.4 Commercial Species

Landings data for commercial fish species is available through units called ICES rectangles (see Figure 3.4-4 below). These units can be used to infer the potential commercial fish species within an area. The relevant units for the WDA are 45E7 and 45E6. However, it is difficult to use these units to infer which commercial species may be present within the study area because unit 45E6 also covers the coastal zone, which is targeted by different fishery gear types compared to the offshore area of the Smith Bank. However, the data from 2000 - 2009 do suggest that king scallops form a significant proportion of the commercial catch from the WDA area and haddock are also likely to be a key commercial species.

Seasonal squid fisheries are also known to be of relative importance to local fishermen in the Moray Firth area, although squid do not constitute a significant proportion of the total weight landed.

Elasmobranch species (sharks and rays) constitute a small percentage of the landings weights in both rectangles, being included under the category "other" in Figure 3.4-4 below.



Moray Offshore Renewables Ltd

Horizontal Scale: 1:1,000,000

A4 Chart

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: PL
Approved: SP

Date: 04/05/2016
Revision: A

REF: 8460001-PQW0010-MOR-MAP-012

Figure 3.4-4
Commercial Species
(Relative live weight - tonnes)

Moray Offshore
Renewables Ltd

Contains information supplied by the Marine Management Organisation (2010). Landings data (2000-2009)

Landings data for commercial fish species is available through units called ICES rectangles (see Figure 3.4-4 above). These units can be used to infer the potential commercial fish species within an area. The relevant units for the WDA are 45E7 and 45E6. However, it is difficult to use these units to infer which commercial species may be present within the study area because unit 45E6 also covers the coastal zone, which is targeted by different fishery gear types compared to the offshore area of the Smith Bank. However, the data from 2000-2009 do suggest that king scallops form a significant proportion of the commercial catch from the WDA area and haddock are also likely to be a key commercial species.

Seasonal squid fisheries are also known to be of relative importance to local fishermen in the Moray Firth area, although squid do not constitute a significant proportion of the total weight landed.

Elasmobranch species (sharks and rays) constitute a small percentage of the landings weights in both rectangles, being included under the category "other" in Figure 3.4-4 above.

3.4.2 Data Gaps

The quality and resolution of the available data is considered to be suitable for the EIA for fish and shellfish.

3.4.3 Potential Effects

3.4.3.1 Summary of Potential Effects

Based on the EIA for fish and shellfish ecology for the MORL EDA (MORL, 2012), the following are perceived to be the potential effects of development in the WDA on fish and shellfish ecology:

Potential Effect	Construction	Operation	Decommissioning	Scoped Out
Temporary disturbance to the seabed (including smothering)	✓	×	✓	×
Underwater noise from piling activity	✓	×	✓	×
Loss/ damage/ change of habitat	✓	✓	✓	×
Introduction of new habitats / habitat creation	×	✓	×	×
Electromagnetic Fields	×	✓	×	×
Operational noise	×	✓	×	×
Changes to fishing activity	×	✓	×	×

Whilst a specific assessment will be carried out in relation to the WDA, given the proximity of the MORL EDA and WDA and the potential for similarities in relation to potential effects, the findings of the MORL EDA fish and shellfish ecology assessment have been included below for context.

3.4.3.2 Potential Effects During the Construction Phase

Loss / damage / change of habitat

Seabed preparation, such as dredging or boulder redistribution for installation of foundations or cables, will result in a change and/or loss of habitat and potential damage to habitat available to fish and shellfish in general. Sandeels, which are substrate specific and spawning herring, which lay their eggs on the seabed, are likely to be particularly sensitive.

Temporary Disturbance to the Seabed (including smothering)

The physical disturbance of the seabed associated with construction works (e.g. dredging for foundations or drilling activites for piles) may result in an increase in suspended sediment concentrations and subsequent sediment re-deposition. This could result in effects on fish and shellfish species including smothering, impairment to feeding behaviour, displacement and mortality. Sensitive receptors are expected to include eggs and larvae of fish and shellfish, including seabed laid eggs of herring and sandeels, mobile and sedentary or sessile juvenile and adult fish and shellfish.

It is highlighted that the assessments for the MORL EDA identified that effects of suspended sediment concentration increases on eggs and larvae were probable. Given the sensivity of eggs and larvae to turbidity, the receptors were considered to be of medium sensitivity and the effects would be negative but of minor significance. For seabed laid eggs, such as those of sandeel and herring, the effect of the redeposition of increased levels of suspsended sediment concentrations were considered to be probable. These effects were also considered to be negative but of minor significance.

The potential for increased levels of suspended sediment concentrations were expected to cause the displacement of mobile juvenile and adult fish. Given their mobility, this group was considered to be of low sensitivity but the effect was considered probable and negative but of minor significance.

With the exception of squid, the shellfish in the area have limited mobility and increased levels of suspended sediments and its redeposition could affect the shellfish through displacement, smothering and impaired feeding from redeposition. Effects on shellfish were considered probable and negative but of minor significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Underwater noise from piling activity

A number of wind farm construction related activities generate underwater noise and vibration. These include suction dredging, drilling, operational noise, impact piling, cable laying, rock placement, seismics, trenching and vessel noise. Effects from noise could include displacement and potentially hearing damage or mortality of fish, both with and without swim bladders. Sensitive receptors include herring and cod.

It is highlighted that the assessments for the MORL EDA assessed the potential for effects of underwater piling noise on the following species: plaice, salmon, sea trout, cod, whiting, herring, larvae and glass eels and shellfish. Effects on the fish species were considered to be probable and negative and with mitigation, the significance of the effects was minor. Effects on larvae and glass eels were considered to be probable and negative but of minor significance. The effects on shellfish were considered to be unlikely but if they did occur would be negative and of minor significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

3.4.3.3 Potential Effects During the Operational Phase

Loss / damage / change of habitat

The footprint of the wind farm will result in a loss of habitat to fish and shellfish in general and in particular sandeels, as these species are substrate specific, and spawning herring, which lay their eggs on the seabed.

It is highlighted that the assessments for the MORL EDA identified that fish and shellfish were likely to have a low sensitivity to any effects of loss of habitat and that although the effects were probable, the effects would not be significant. Sandeels and spawning herring were both considered to have medium sensitivity to habitat loss. The potential for effects to spawning herring were considered unlikely but if they did occur would be negative but of minor significance. The effects on sandeels were considered probable, negative and of minor significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Introduction of new habitat / habitat creation

The introduction of structures and on-site dredge disposal material will increase the area of new habitat available for colonization. Fish and shellfish, in general, are expected to be affected by such an introduction. Edible crab, a commercial species, is expected to be an early colonizer of operational offshore wind farms (Linley *et al.*, 2007). The potential for non-native species to colonise the new habitat is also a possibility.

It is highlighted that the assessments for the introduction of new structures for the MORL EDA identified that potential effects on fish and shellfish were probable and of minor significance. Whether the effects were positive or negative would depend on the species in question. For edible crab, a positive effect was considered probable but this would be of minor significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

EMFs

The inter-array cables for the WDA will potentially create electromagnetic fields, which may affect the behaviour of species sensitive to such fields. Sensitive receptors are likely to include elasmobranchs (and in particular common skate and spiny dogfish), river and sea lamprey, Atlantic salmon and sea trout, European eel, which are all expected to have medium sensitivity to electromagnetic fields and other fish and shellfish species, which are expected to have low sensitivity.

It is highlighted that the assessments for the MORL EDA identified that potential effects on elasmobranchs, Atlantic salmon, sea trout and European eel were considered to be negative and probable but of minor significance. Effects on lampreys and other species of fish and shellfish were considered to be unlikely but if they did occur would be negative and of minor significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Research on the likely effects of electromagnetic fields from generators and associated cabling on salmon has recently been done by MSS. Recent studies of EMF on fish and shellfish species in America has also been done (e.g. Bull & Nishimoto, 2016; Nishimoto *et al*., 2016; and Wyman *et al*., 2016). Reference to these works will made when assessing this potential effect.

Operational noise

During the operational phase of a wind farm, noise is principally generated by the turbine's gear boxes and transferred into the water and sediment through the towers and foundations (Lindell, 2003). Sound emissions during this period are expected to be in the low-frequency range (Westerberg, 1994; Degn, 2000; Lindell, 2003). Detailed information on the likely effects of operational noise on fish and shellfish is limited to date, it is however generally accepted that the effects of operational noise are restricted to masking of communication and orientation signals, rather than causing damage or consistent avoidance reactions (Wahlberg and Westerberg, 2005). The implication of these effects will depend on the ecology and use that particular species makes of the WDA and its vicinity and on the hearing ability of different species. All fish species are potential receptors. Gadoids (e.g. cod) are expected to have a greater sensitivity to operational noise due to their use of sound during spawning.

It is highlighted that the assessments for MORL EDA identified that potential effects on fish and shellfish species, in general, were unlikely but would be negative and of minor significance if they were to occur. Effects on cod and haddock were considered to be probable, negative and of minor significance. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Changes to fishing activity

Changes to fishing activity as a result of the installation of the WDA could potentially affect fish and shellfish species. Primarily this would be species commercially targeted and / or caught as by-catch, although a wider range of organisms may also be affected due to changes in seabed communities associated with seabed disturbance.

It is highlighted that the assessments for the MORL EDA considered that whilst the potential for changes to fishing activity to have an effect on fish and shellfish receptors was recognised, given the numerous uncertainties (e.g. actual degree of fishing reduction and areas to which where fishing effort may be displaced) it was not possible for a meaningful assessment to be made. However, on the basis that fishing would continue to be possible within the wind farms during the operational phases, it was not expected that a significant effect (above minor) would occur. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

3.4.3.4 Potential Effects During the Decommissioning Phase

At this stage, decommissioning effects are envisaged to be similar to those described for the constrction phase.

3.4.4 Approach to EIA

For each of the potential effects identified above a study and method of impact assessment is described in the tables below. MORL will seek to agree with key stakeholders including MSS and SNH the key parameters and detailed methodologies to be used in the assessments following receipt of the responses to this scoping report.

3.4.4.1 Construction Phase

Potential Effect	**Loss/Damage/Change of Habitat**
Study / Survey Proposed	Desk based research, results of surveys done within the MORL Zone and BOWL site to date and interviews with Moray Firth fishermen will be used to determine the fish assemblage of the area.
EIA Methodology	The available geophysical and geotechnical survey data available for the WDA will be used to determine the available habitat. The potential for losses / damage/ or change to habitats through boulder movement or on-site dredge disposal will be assessed. The assessment will follow best practice at the time of assessment along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**Temporary Disturbance to the Seabed**
Study / Survey Proposed	Desk based research, results of surveys done within the MORL Zone and BOWL site to date and interviews with Moray Firth fishermen will be used to determine the fish assemblage of the area. To determine the potential for increased suspended sediment concentrations and associated redeposition, the MORL Zone numerical model for physical processes will be updated (see Section 2.2 above).
EIA Methodology	Potential effects on sensitive receptors will be assessed using the outputs of the metocean model assessment and published data on the sensitivity of fish and shellfish species associated with the WDA. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**Underwater noise from piling activity**
Study / Survey Proposed	Desk based research, results of surveys done within the MORL Zone and BOWL site to date and interviews with Moray Firth fishermen will be used to determine the fish assemblage of the area. Underwater noise modelling will be done to identify the geographical range of potential effects.
EIA Methodology	Potential effects during the construction phase on sensitive receptors will be assessed using specific noise modelling for the area. This will draw on contemporary research on species sensitivity to underwater noise and the assessment will follow best practice at the time of assessment along with previous experience gained from the MORL EDA EIAs.

3.4.4.2 Operation Phase

Potential Effect	**Loss of Habitat**
Study / Survey Proposed	Desk based research, results of surveys done within the MORL Zone and BOWL site to date and interviews with Moray Firth fishermen will be used to determine the fish assemblage of the area.
EIA Methodology	The available geophysical and geotechnical survey data available for the WDA will be used to determine the available habitat. The potential losses of habitats through substructure/foundation placement and temporary losses during the inter-array and export cabling will be quantified. Potential effects from areas from which fishing is excluded (i.e. 50 m around operational turbines) will also be highlighted. The assessment will follow best practice at the time of assessment along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**Introduction of New Habitat**
Study / Survey Proposed	Desk based research and interviews with Moray Firth fishermen will be used to determine the fish assemblage of the area and the potential for species to colonise infrastructure.
EIA Methodology	A review of the potential colonisation of new structures (piles, scour protection etc) and potential effects afforded by this will be undertaken. The assessment will follow best practice at the time of assessment along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**EMFs**
Study / Survey Proposed	Desk based research, results of surveys done within the MORL Zone and BOWL site to date and interviews with Moray Firth fishermen will be used to determine the fish assemblage of the area.
EIA Methodology	The findings of recent and ongoing projects investigating the effects of EMF on sensitive fish species will be used to determine the significance of any impacts on fish species from EMF associated with the wind farm cables. The assessment will follow best practice at the time of assessment along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**Operational noise**
Study / Survey Proposed	Desk based research, results of surveys done within the MORL Zone and BOWL site to date and interviews with Moray Firth fishermen will be used to determine the fish assemblage of the area.
EIA Methodology	Potential effects during the operational phase on sensitive receptors will be assessed using specific noise modelling for the area. This will draw on contemporary research on species sensitivity to underwater noise and the assessment will follow best practice at the time of assessment along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**Changes to fishing activity**
Study / Survey Proposed	Desk based research, results of surveys done within the MORL Zone and BOWL site to date and interviews with Moray Firth fishermen will be used to determine the fish assemblage of the area.
EIA Methodology	Impact assessment will include a consideration of potential effects from a change/reduction/cessation in commercial fishing within the proposed development area and the displacement of commercial fisheries to other areas which previously were not used as intensively. The assessment will follow best practice at the time of assessment along with previous experience gained from the MORL EDA EIA's.

3.4.5 *Cumulative and In-combination Effects*

There is foreseeable potential for the extent or magnitude of any effects identified in Section 3.4.3 above to be cumulatively increased by the simultaneous presence of other existing or proposed activities or developments. The extent to which these cumulative effects may arise will depend upon the design and extent of the infrastructure or the frequency and intensity of the activities.

As discussed in Section 1.3.2.6 above, the method for cumulative impact assessment will be carried out in accordance with the methods outlined within the MFOWDG discussion document 'Moray Firth Offshore Wind Developers Group Cumulative Impact Assessment Discussion Document' (MORL, 2012) unless otherwise agreed with MS-LOT and appropriate stakeholders. This document has been included as Annex 1 to this Scoping Report.

3.4.6 *Potential Mitigation Measures*

If in light of the conclusions of the EIA potential mitigation measures are required, these will be determined following the production of the impact assessments and consultation with MS-LOT and appropriate stakeholders.

It is highlighted that mitigation put forward for the MORL EDA offshore wind farms (MORL, 2012), included:

- Soft start piling;
- Monitoring of noise or appropriate surveys to increase confidence in the assessment of construction and operational noise and / or mitigation measures where required;
- Cable burial and/or protection to minimize potential electromagnetic fields;
- The adoption of a protocol to minimize risk in relation to the spread of non-indigenous species; and
- Further surveys to determine any requirement for further mitigation.

Engineering techniques/methods that generate low levels of noise during installation and 'at source' noise mitigation options to reduce potential noise effects on the marine environment will be considered for the WDA EIA.

3.4.7 Habitats Regulations Appraisal

As discussed in Section 3.2 above, Atlantic salmon and lamprey are protected species under the Habitats Directive and Atlantic salmon are also linked to the life-cycle of the protected freshwater pearl mussel. These species are designating features of SACs in the Moray Firth region and therefore effects to these species may affect the integrity of related SACs. This will require the WDA proposal to undergo a Habitats Regulations Appraisal (see Section 3.2.1 above).

Identification of the SACs likely to be affected will be done in consultation with SNH, JNCC and MS-LOT. Potential SACs that may be included are listed in Table 3.2-3 above.

For the SACs identified as relevant for assessment, the effects on the relevant fish and shellfish qualifying species will be assessed (taking account of their conservation objectives) using the following criteria:

- Deterioration of the habitats of the qualifying species;
- Significant disturbance to the qualifying species;
- Changes in the distribution of the species within the site; and
- Changes in the distribution and extent of habitats supporting the species.

In addition, in the particular case of Atlantic salmon and freshwater pearl mussel SAC populations, the following criteria will also been taken into account for assessment:

- Changes to the population of the species, including range of genetic types of salmon as a viable component of the site; and
- Changes to the distribution of freshwater pearl mussel host species and to the structure, function and supporting processes of habitats supporting fresh water pearl mussel host species.

3.5 Marine Mammals

3.5.1 Baseline Characteristics

This section describes the Marine Mammals baseline environment and potential effects associated with the WDA. Information on the WDA baseline characteristics have been derived mostly from the MORL ES 2012. The Marine Mammals ES Chapter and Technical Appendices can be accessed via the following links – Chapter 4.4 Marine Mammals and Technical Appendix 4.4 A Marine Mammal Baseline. Table 3.5- 1 below lists the proposed datasets that will inform the assessment.

Table 3.5-1 Datasets for the Marine Mammals EIA

Dataset	**Coverage**	**Date**
MORL boat-based surveys	MORL EDA plus 4 km buffer	Apr 2010 – Mar 2012
Harbour seal abundance at haul-out sites and at sea (University of Aberdeen, Moray Firth MMMP)	Moray Firth	Late 1980s - present
Harbour seal telemetry (University of Aberdeen and Sea Mammal Research Unit (SMRU) Ltd, Moray Firth MMMP)	East Scotland	1989 - 2009 and 2014 - 2015
Grey seal telemetry (University of Aberdeen and SMRU Ltd)	UK	1993 - 2002
Broad scale 'at sea' harbour and grey seal estimated density surfaces provided by SMRU (Jones *et al.*, 2013)	UK	2013 (using data from 1988 – 2013)
Passive acoustic monitoring data to inform bottlenose dolphin usage, especially of the southern region of Moray Firth (University of Aberdeen)	Moray Firth	2005 - present
Bottlenose dolphin visual surveys (various sources including University of Aberdeen and Moray Firth MMMP)	Moray Firth	1982 - present
Aerial and passive acoustic survey data (MSS)	East Scotland	2014 - 2015

It is proposed that the following guidance and published literature will inform the Marine Mammal assessment:

- IEEM. (2010). Guidelines for Ecological Impact Assessment in Britain and Ireland, Marine and Coastal. Institute of Ecology and Environmental Management.
- Thompson *et al.* (2013). Framework for assessing impact of pile-driving noise from offshore wind farm construction on a harbour seal population.
- Harwood *et al.* (2013). A Protocol for Implementing the Interim Population Consequences of Disturbance (PCoD) Approach: Quantifying and Assessing the Effects of UK Offshore Renewable Energy Developments on Marine Mammal Populations.
- Intergovernmental panel on climate change (2010). Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties.
- Fracas *et al.* (2016). Underwater noise modelling for environmental impact assessment.
- Russell *et al.* (2016). Avoidance of windfarms by harbour seals is limited to pile driving activities. Journal of Applied Ecology D01:10.1111/1365-2664.12678
- Hastie *et al.* (2015). Sound exposure in harbour seals during the installation of an offshore wind farm: predictions of auditory damage.
- National Oceanic and Atmospheric Administration (2015). Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing.

There is an extensive amount of marine mammal data available for the Moray Firth as highlighted in the table above. Much of that available up until 2012 was used to characterise the baseline of the MORL EDA as detailed in the MORL ES 2012. The data used to generate predicted population densities across the Moray Firth (density surfaces) presented in the MORL ES 2012 can now be supplemented by data available from bottlenose dolphin SAC monitoring undertaken by University of Aberdeen, through seal counts reported through Special Committee on Seals (SCOS) and the 'at-sea' density estimates available from SMRU (Jones *et al.*, 2013).

In addition, data has been collected since May 2014 as part of the strategic regional Pre-Construction Marine Mammal Monitoring Programme (MMMP) in respect of the MORL EDA and BOWL Wind Farm Developments. The programme has been operational since the summer of 2014 and the first Annual report (Graham *et al.*, 2015) provides additional baseline data that will be utilised to characterise the baseline use of the Moray Firth by harbour seal and bottlenose dolphins.

To date, a total of 14 cetacean species and two pinnipeds have been recorded alive within the Moray Firth (Table 3.5-2 below). Other species have been found stranded within the firth area but are not included in this review due to the uncertainty in the animals' location before death.

Table 3.5-2 Frequency of marine mammal recordings within the outer Moray Firth

Common Name	**Latin Name**	**Frequency of recordings**
Pinnipeds		
Harbour seal	*Phoca vitulina*	Common, all year
Grey seal	*Halichoerus grypus*	Common, seasonal
Cetaceans		
Harbour porpoise	*Phocoena phocoena*	Common, all year
Bottlenose dolphin	*Tursiops truncatus*	Common, all year
Common dolphin	*Delphinus delphis*	Common, seasonal
White-beaked dolphin	*Lagenorhynchus albirostris*	Common, seasonal
Minke whale	*Balaenoptera acutorostrata*	Common, seasonal
Risso dolphin	*Grampus griseus*	Occasional
White-sided dolphin	*Lagenorhynchus acutus*	Occasional
Killer whale	*Orcinus orca*	Occasional
Pilot whale	*Globicephala melas*	Rare

Common Name	Latin Name	Frequency of recordings
Humpbacked whale	*Megaptera novaengliae*	Rare
Fin whale	*Balaenoptera physalus*	Rare
Sperm whale	*Physeter macrocephalus*	Rare
Northern bottlenose whale	*Hyperoodon ampullatus*	Rare
Beluga whale	*Delphinapterus leucas*	Rare

Two SACs have been designated within the Moray Firth, one for the bottlenose dolphin and another for harbour seal (see Section 3.2 above).

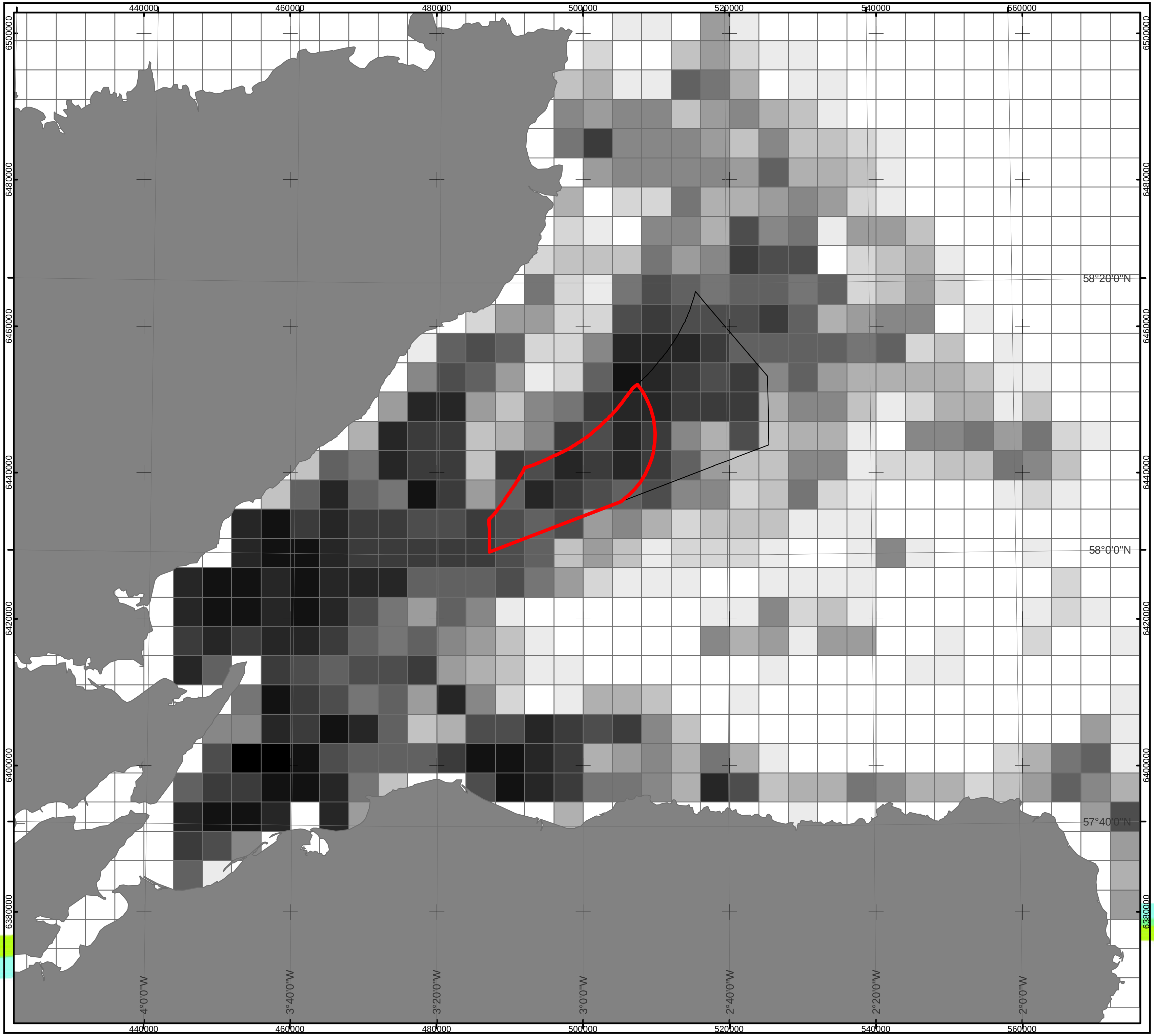
3.5.1.1 Summary of key species in the Moray Firth

Below is a summary of the key species in the Moray Firth taking into account the information provided in the MORL ES 2012 and information made available since then (as detailed above).

Harbour Seal

The work undertaken to develop an estimated density surface for harbour seals at sea for the MORL EDA impact assessment is described in detail in Appendix 4.4, Section 4.4.6 of the MORL ES 2012. Based upon the highest levels of abundance seen over the preceding two decades, the results of the presence-absence Generalised Additive Model (GAM) indicated that seals from the Moray Firth population were likely to be dispersed widely across the Moray Firth, particularly over offshore sandbanks (Figure 3.5-1 below). These data suggest that there was variability in the importance of different parts of the Round 3 Zone and adjacent waters, but that some grid squares in this region might be expected to hold up to eight seals, representing a density approaching 0.5 individuals per km^2.

Results of the 2014-2015 harbour seal tagging studies confirm that the areas of preferred habitat are located within the inner Moray Firth (see Figure 3.5-2 below reproduced from Graham *et al.*, 2015).



Moray Offshore Renewables Ltd

KEY

🟥 Western Development Area
☐ Eastern Development Area

Predicted Harbour Seal

▨ 0 - 0.5
▨ 0.51 - 1.00
▨ 1.01 - 1.50
▨ 1.51 - 2.00
▨ 2.01 - 2.50
▨ 2.51 - 3.00
▨ 3.01 - 3.50
▨ 3.51 - 4.00
▨ 4.01 - 4.50
▨ 4.51 - 5.00
▨ 5.01 - 5.50
▨ 5.51 - 6.00
▨ 6.01 - 6.50
▨ 6.51 - 7.00

Horizontal Scale: 1:700,000
A4 Chart
0 10,000 20,000 Meters
N

Geodetic Parameters: WGS84 UTM Zone 30N

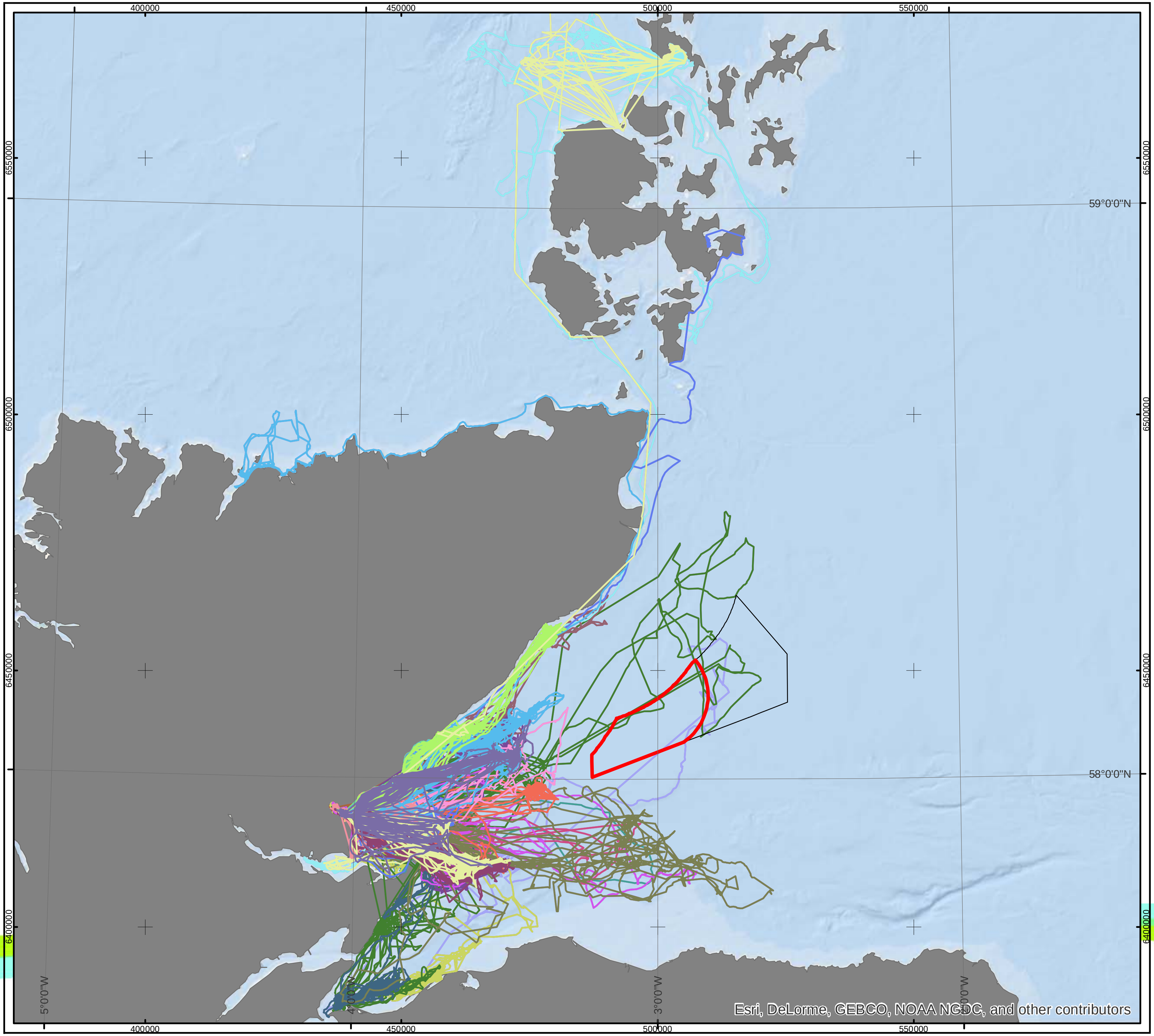
Produced: RH
Reviewed: CR
Approved: SP

Date: 15/04/2016
Revision: A

REF: 8460001-PQW0010-MOR-MAP-013

Figure 3.5-1
Predicted Harbour Seal Occurence

Moray Offshore Renewables Ltd



Moray Offshore Renewables Ltd

KEY

🟥	Western Development Area
☐	Eastern Development Area
—	Seal GPS/GSM Tracks (colour per track)

Horizontal Scale: 1:1,000,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: CR
Approved: SP

Date: 15/04/2016 Revision: A

REF: 8460001-PQW0010-MOR-MAP-014

Figure 3.5-2
Harbour Seal GPS Tracks
28 Sept 2014 to 30 Apr 2015

Moray Offshore
Renewables Ltd

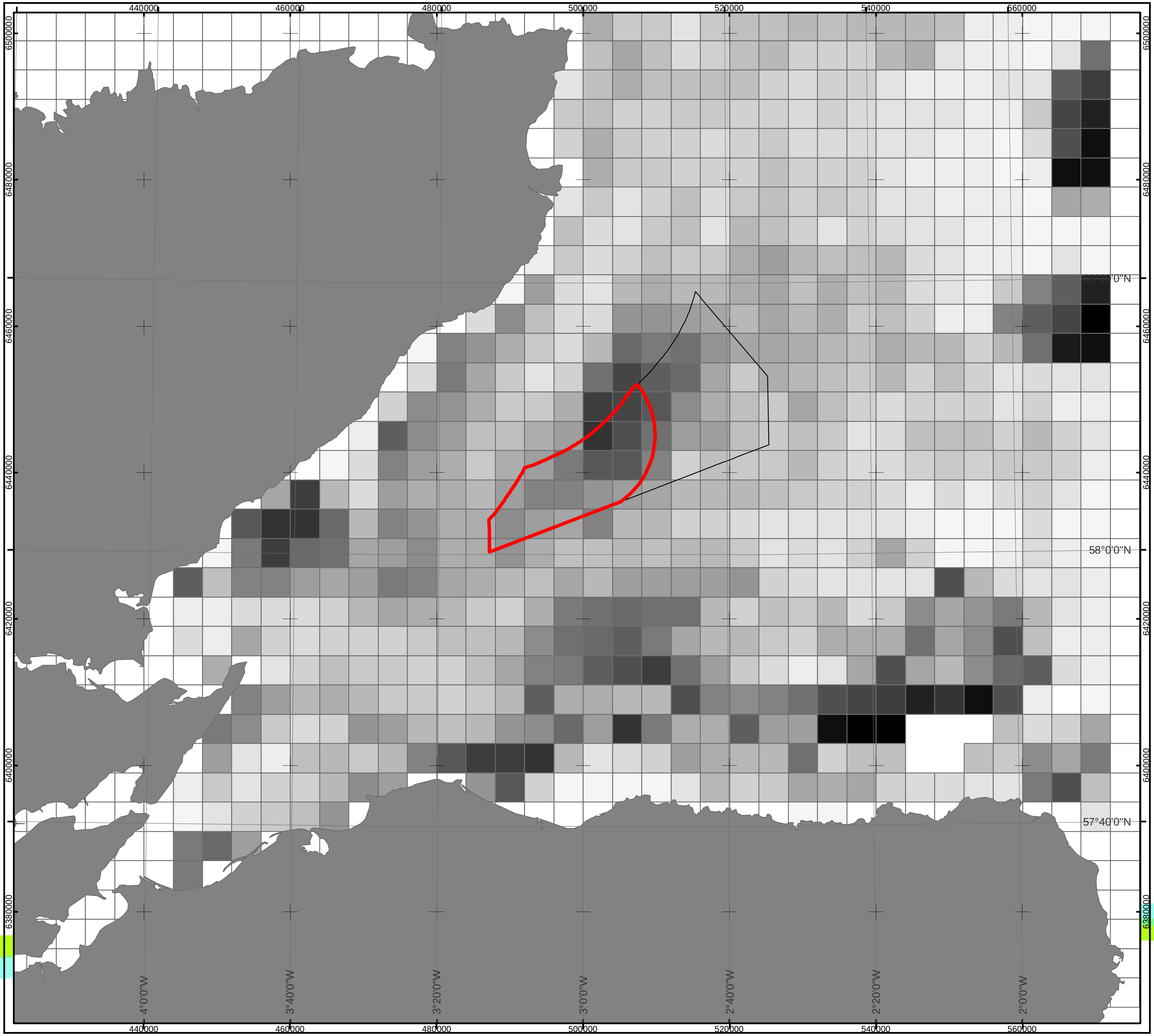
Grey Seal

Data presented within the MORL ES 2012 from telemetry and haul-out studies undertaken to that time, showed that grey seals regularly travel between the Moray Firth and haul-out sites in other parts of Scotland. Estimated at sea density for grey seals were presented in Figure 4.10 of Appendix 4.4 A within the MORL ES 2012. Areas with the highest usage within the Moray Firth included the Dornoch and Pentland Firths.

Since the publication of the MORL ES in 2012 updated at sea grey seal usage maps have been published by SMRU under contract to the Scottish Government (Jones *et al.,* 2013). These usage maps along with any up-dates available will be used in addition to local data available from Moray Firth specific studies to inform the baseline characterisation of the Moray Firth for grey seals.

Harbour Porpoise

Passive acoustic monitoring indicates that harbour porpoise can be found throughout the Moray Firth. Harbour porpoise habitat models utilising a number of survey data (presented in Section 5 of Appendix 4.4 A of the MORL ES 2012), showed a preference for intermediate depths with increasing levels of sand and gravel, such as the Smith Bank. Numbers predicted in the models for coastal areas were low as illustrated in Figure 3.5-3 below.



Moray Offshore Renewables Ltd

KEY

☐ Western Development Area
☐ Eastern Development Area

Predicted Harbour Porpoise (Population Number)

1	16
2	17
3	18
4	19
5	20
6	21
7	22
8	23
9	24
10	25
11	26
12	27
13	28
14	29
15	30

Horizontal Scale: 1:700,000 A4 Chart
0 10,000 20,000 Meters
N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: CR
Approved: SP

Date: 15/04/2016 Revision: A

REF: 8460001-PQW0010-MOR-MAP-015

Figure 3.5-3
Predicted Harbour Porpoise Occurence

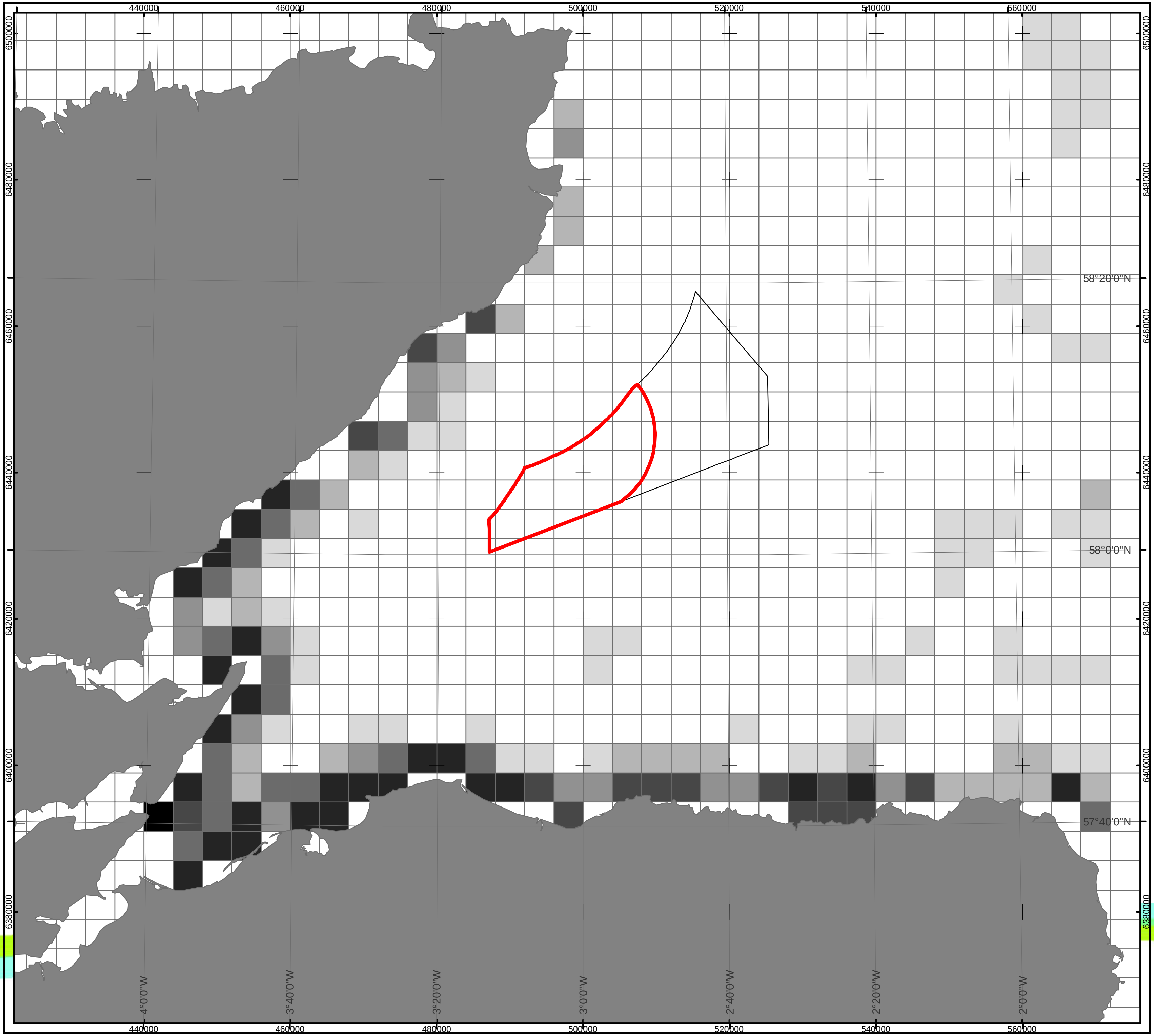
Moray Offshore Renewables Ltd

Bottlenose Dolphins

A resident population of bottlenose dolphins can be found within the Moray Firth, for which a SAC has been designated. Passive acoustic monitoring (which cannot differentiate between dolphin species) indicates that dolphins can be found throughout the Moray Firth. The EARs (Ecological Acoustic Reader) data (which does allow differentiation between species) suggest that those dolphins recorded in the vicinity of the MORL EDA and WDA are unlikely to be bottlenose dolphins, with this species being restricted to coastal waters.

The most recent estimate of the abundance of bottlenose dolphins along the whole of the east coast of Scotland is based on co-ordinated photo-identification studies in 2006 and 2007, which produced an estimate of 195 individuals (95% highest posterior density intervals (HPDI): 162 to 253) (Cheney *et al*., 2013). More detailed annual surveys within the Moray Firth SAC between 2002 and 2010, indicate that around 50% of these animals use the SAC in each year, with estimates ranging from 68 to 114 individuals; (mean = 93.3) but with overlapping confidence limits (Cheney *et al*., 2012).

The University of Aberdeen provided a robust estimation of the spatial variation of bottlenose dolphins within the Moray Firth in order to provide a baseline distribution to inform the MORL EDA EIA. The spatial variation was calculated using all data available at the time (through a process described in Section 5, Appendix 4.4A of the MORL ES 2012) and used in combination with independent estimates of population size to provide average densities of bottlenose dolphins across the Moray Firth area. The resulting density surface is presented in Figure 3.5-4 below and it shows that the bottlenose dolphin abundance in the vicinity of the MORL EDA and WDA are predicted to be low.



edp renewables

Moray Offshore Renewables Ltd

KEY

🟥 Western Development Area
□ Eastern Development Area

Predicted Bottlenose Dolphin
(Predicted Probability)

- 0.00 - 0.100
- 0.101 - 0.200
- 0.201 - 0.300
- 0.301 - 0.400
- 0.4001 - 0.500
- 0.5001 - 0.600
- 0.6001 - 0.700
- 0.7001 - 0.800

Horizontal Scale: 1:700,000 A4 Chart

0 10,000 20,000 Meters N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: CR
Approved: SP

Date: 15/04/2016 Revision: A

REF: 8460001-PQW0010-MOR-MAP-016

Figure 3.5-4
Predicted Bottlenose Dolphin
Occurence

Moray Offshore
Renewables Ltd

Other Cetacean Species

Of the other cetacean species observed within the Moray Firth, the minke whale is the most abundant. The Small Cetaceans in the European Atlantic and North Sea (SCANS) II surveys estimated 0.022 animals per km^2 for the Moray Firth, Orkney and Shetland combined, higher than the 0.01 animals per km^2 calculated from the boat-based surveys for the MORL EDA although the small sample size needs to be taken into account when interpreting these results.

White-beaked and common dolphins have been recorded within the Moray Firth but detailed information on their abundance is lacking. Both species were recorded within the MORL EDA during the boat-based surveys but in low numbers.

3.5.2 Data Gaps

There is an extensive amount of marine mammal data for the Moray Firth, and there is not considered to be a significant information gap on the abundance of this receptor group within the Moray Firth. Despite this, additional marine mammal abundance data will be collected for the WDA through aerial surveys. Data collected as part the Moray Firth MMMP will also be taken into account in the context of the WDA EIA.

Rather than information on the abundance of marine mammals, MORL consider the information gap to be concentrated upon the degree of impact (Permanent Threshold Shift (PTS) and displacement), along with the consequences of these effects to individual animals and the populations concerned. The assessment methodology developed for the MORL EDA EIA was necessarily precautionary, using conservative assumptions for both the degree of effect and the consequences of these effects upon individuals and so populations of marine mammals. Since publication of the MORL ES 2012, some of the precaution inherent in the MORL assessment has been removed through peer review (Thompson *et al.,* 2013) and further development of the methodology. The assessment methodology for the WDA will follow the principles outlined in Section 3.5.4 below.

3.5.3 Potential Effects

3.5.3.1 Summary of Potential Effects

Based on the EIA for marine mammals for the MORL EDA wind farms (MORL, 2012) and data collected since the submission of the MORL ES 2012, the following are perceived to be the potential effects of development in the WDA on marine mammals:

Potential Effect	**Construction**	**Operation**	**Decommissioning**	**Scoped Out**
Hearing Damage	✓	×	✓	×
Disturbance / Displacement	✓	×	✓	×
Collision risk from vessels	✓	✓	✓	×
Reduction in Prey Availability	✓	✓	✓	×
Reduction in Foraging Ability	✓	×	✓	×
Toxic Contamination	×	×	×	✓
Long Term Avoidance as a result of Operational Noise	×	×	×	✓
Stranding Due to Electromagnetic Fields	×	×	×	✓

Whilst a specific assessment will be carried out in relation to the WDA, given the proximity of the MORL EDA and WDA and the potential similarities in relation to potential effects, the findings of the MORL EDA marine mammal assessment have been included below for context.

3.5.3.2 Potential Effects During the Construction Phase

Hearing Damage (Permanent Threshold Shift, PTS) and Disturbance / Displacement

It is considered that the greatest effect on marine mammals during construction will be from increased levels of underwater anthropogenic noise. A number of activities during construction generate underwater noise and vibration, including suction dredging, cable laying, rock placement, trenching, vessel noise and impact piling. Impact piling is considered the primary source of noise during construction (and therefore exerting the greatest potential effect on marine mammals).

Effects from increased noise levels can be divided into two broad categories: disturbance /displacement and physical injury. Permanent hearing damage can reduce the animal's ability to find prey, avoid predators and socially interact. Temporary disturbance / displacement can result in restricted access to food sources, breeding grounds or migration routes leading to reduced fitness.

It is highlighted that the assessments for the MORL EDA assessed the potential for effects of underwater piling noise on the following species: harbour seal, grey seal, harbour porpoise, bottlenose dolphin and minke whale. Despite the precaution inherent in the assessment methodology developed to perform these assessments (and so high magnitude impacts predicted for the construction phase), long term effects were considered to be of minor significance for harbour seal, grey seal, harbour porpoise and minke whale. For bottlenose dolphins the effects were assessed as medium significance for individuals during the construction phase, with minor significance for long term effects at the population level. Since effects were considered to be significant within the MORL ES 2012 if they were above medium significance, this was not considered to be a significant effect.

Collision Risk

Collision risk associated with increased vessel movement during construction can result in physical injury and reduced viability in marine mammals. This effect will take into account the outputs of the Shipping and Navigation assessment (see Section 4.3 below). Following consideration of recent guidance provided by Scottish Nature Conservation Bodies (SNCBs) (Interim advice of seal corkscrew injury, February 2015), the potential for corkscrew injury on seals resulting from the use of ducted propellers will not be considered.

It is highlighted that the assessments for the MORL EDA assessed the potential for effects from collision as being of low magnitude, medium duration and minor significance during construction. Since effects were considered to be significant within the MORL ES 2012 if they were above medium significance, this was not considered to be a significant effect.

Reduction in Prey Availability

Reduction in prey is considered a secondary effect on marine mammal species which can result from increased noise and / or vibration during construction. This in turn has the potential to result in a reduction in fitness in marine mammals. The consequence of this potential effect will therefore be assessed utilising the conclusions of the Fish and Shellfish Ecology assessment (see Section 3.4 above).

It is highlighted that the assessments for the MORL EDA identified this effect as being of low magnitude for a medium duration and therefore of minor significance during construction. Since effects were considered to be significant within the MORL ES 2012 if they were above medium significance, this was not considered to be a significant effect.

Reduction in Foraging Ability

It is considered that an increase in suspended sediment as a result of foundation installation and cable laying activities may result in a reduction in marine mammal foraging or social interactions in marine mammals during the construction phase of the WDA. The consequence of this potential effect will therefore be assessed utilising the conclusions of the Physical Processes assessment (see Section 2.2 above).

It is highlighted that the assessments for the MORL EDA identified this effect as being of low magnitude for a short duration and therefore of minor significance during construction. Since effects were considered to be significant within the MORL ES 2012 if they were above medium significance, this was not considered to be a significant effect.

3.5.3.3 Potential Effects During the Operational Phase

Collision Risk

There is a risk of collision with maintenance vessels, however when compared with the increased vessel traffic associated with construction activities it is likely that this risk will be significantly lower. This assessment of the likely magnitude of this effect will take into account the outputs of the Shipping and Navigation assessment (see Section 4.3 below).

It is highlighted that the assessments for the MORL EDA identified this effect as being of low (negligible) magnitude, long duration and minor significance. Since effects were considered to be significant within the MORL ES 2012 if they were above medium significance, this was not considered to be a significant effect.

Reduction in Prey Availability

Reduction in prey can occur due to habitat loss from the footprint of the foundations of installed wind turbines. The assessment of the magnitude of this effect will therefore be considered utilising the conclusions of the Fish and Shellfish Ecology assessment (Section 3.4 above).

It is highlighted that the assessments for the MORL EDA identified this effect as being of low magnitude, long duration and minor significance. Since effects were considered to be significant within the MORL ES 2012 if they were above medium significance, this was not considered to be a significant effect.

3.5.3.4 Potential Effects During the Decommissioning Phase

At this stage, decommissioning effects are envisaged to be similar to those described for the construction phase.

3.5.3.5 Scoped Out Effects

Toxic Contamination

Marine mammals can be exposed to contaminants directly through their skin and indirectly through the consumption of contaminated prey, potentially causing illness and/or death. As apex predators, marine mammals are particularly at risk from bio-accumulation of contaminants in the food chain.

During construction, accidental incidents involving the release of chemicals into the marine environment may include vessel collisions and accidental spillages. In order to mitigate collision risk, vessels will use predefined routes and will travel at slow speeds. As a consequence, the probability of such an event occurring is deemed highly unlikely. As the greatest increase in vessel movements will be during the construction and decommissioning phases, the increased risk of toxic contamination will predominantly be of a temporary nature.

Once a wind farm is operational, there is the potential for leaching of toxic compounds from sacrificial anodes, leaking of corrosion inhibitors, antifouling paints, vessel fuel or the loss of hydraulic fluids, which may result in toxic contamination of the water column. All materials used in the construction, operation and maintenance and decommissioning of the WDA Project will be certified as safe for use within the marine environment. It is likely that antifouling paints, amongst other potential contaminants, are widely used by existing marine infrastructure and vessels in the Moray Firth, and therefore detectable increases in potential contaminants resulting from the WDA are considered unlikely.

As a consequence of the mitigation described above, the probability of such a release of toxic compounds to cause contamination of either marine mammal species directly or indirectly through the food chain is deemed highly unlikely. It is therefore proposed to scope out further consideration of toxic contamination impact upon marine mammals from the EIA for the WDA.

Long Term Avoidance as a Result of Operational Noise

Displacement or disturbance due to operating noise was assessed in the MORL ES 2012. The effects were predicted to be of very local nature (based on underwater noise modelling) and given that it is predicted that marine mammals will quickly habituate to the presence of turbines in the water and that there will be sufficient distance between turbines to allow movement between foundations it is unlikely that this effect would be significant.

Since the submission of the MORL ES, a Marine Scotland funded review (2012) concluded after review of all available data at the time, that operational turbine noise is unlikely to cause displacement of marine mammals from the offshore wind farm footprint. A subsequent Marine Scotland funded noise modelling study (Marmo *et al.*, 2013) concluded that '*…seal species (harbour and grey) and bottlenose dolphins were not considered to be at risk of displacement from the operational (6MW+ sized) turbines…*', and that '*..the limited data available suggest that where porpoise activity was reduced during windfarm construction it returned to normal levels during the operational phase…*' and '*it is also unlikely that the low frequency of tonal noise would mask the high frequency signals of porpoise vocalisation*'. Although the paper also concluded that operational wind turbine noise would likely be audible to minke whale up to 18 km from the wind farm, MORL note that the WDA is in excess of 18 km from the Southern Trench, an area recognised as holding higher densities of minke whale. The sightings of minke whale during the boat based surveys of the MORL EDA provided density estimates lower than those provided by SCANS II for the Moray Firth, Orkney and Shetland combined, suggesting that the Smith Bank is not an attractive habitat for minke whale.

It is therefore proposed to scope further consideration of operational noise effects upon marine mammals out of the EIA for the WDA.

Stranding Due to Electromagnetic Fields (Operation)

Electromagnetic fields from operational cables have been identified as a potential factor affecting the marine mammals navigation mechanism, possibly resulting in stranding (and death). A review of publicly available information was undertaken for the MORL EDA EIA (see Section 5.4 of Technical Appendix 7.3 A of the MORL ES 2012 for details) which highlighted that the potential effects of electromagnetic fields generated by inter-array cabling on marine mammals is uncertain and suggests effects would be unlikely. Several more recent studies reported at the American

Geophysical Union's Ocean Sciences Meeting[2] (2016), support the conclusion that EMF is also unlikely to cause significant effects upon the food chain of marine mammals (Nishimoto *et al.*, 2016; Wyman *et al.*, 2016; and Bull and Nishimoto, 2016). It is therefore proposed to scope out further consideration of electromagnetic field effects upon marine mammals from the EIA for the WDA.

3.5.4 Approach to EIA

For each of the potential effects identified above that have not been scoped out a survey or study and method of impact assessment is described in the tables below. MORL will seek to agree with relevant stakeholders including MSS, SNH and JNCC the key parameters and detailed methodologies to be used in the assessments following receipt of the responses to this scoping report.

3.5.4.1 Construction Phase

Potential Effect	**Hearing Damage; and Disturbance / Displacement**
Study / Survey Proposed	Aerial surveys and desk-based studies will be used to confirm and/or up-date predicted marine mammal distribution/densities within the WDA. Underwater noise modelling will be carried out based on the WDA project information (including number of turbines, pile design information and predicted piling campaign duration should a piled foundation be selected) and seabed conditions.
EIA Methodology	The results of the underwater noise modelling will be used to predict potential effects on key marine mammal receptors. The assessment methodology will follow the principles as described in the MORL EDA EIA (namely assessment of short, medium and long term impacts across the suite of marine mammal species commonly present in the Moray Firth). Population modelling will be utilised to explore the consequences of predicted effects on the viability of Natura designated species. This assessment will take into account any additional information on marine mammal responses to underwater noise that have become available since 2012. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**Collision Risk**
Study / Survey Proposed	AIS surveys will also be undertaken to assess vessel traffic within the WDA (see Section 4.3 below).
EIA Methodology	The results from the Shipping & Navigation assessment will be used to inform the predicted collision risk to marine mammals from vessels during the construction phase of the WDA. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

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[2] Conference summary available at https://www.sciencenews.org/article/magnetism-underwater-power-cables-doesnt-deter-sea-life

Potential Effect	**Reduction in Prey Availability**
Study / Survey Proposed	Desk based research and interviews with fishermen will be used to determine the fish assemblage of the area as described above in Section 3.4 Fish and Shellfish Ecology. Additional noise modelling will be carried out for key fish species taking into account the WDA project information and seabed conditions.
EIA Methodology	The results of the Fish and Shellfish Ecology assessment will be used in the context of prey availability for marine mammals. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**Reduction in Foraging Ability**
Study / Survey Proposed	To determine the potential for increased SSCs and associated redeposition, the MORL Zone numerical model for Physical Processes will be updated (see Section 2.2 above).
EIA Methodology	The results of the Physical Processes assessment will be used in the context of how it could affect the marine mammal foraging or social interactions. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

3.5.4.2 Operation Phase

Potential Effect	**Collision risk**
Study / Survey Proposed	AIS surveys will also be undertaken to assess vessel traffic within the WDA (see Section 4.3 Shipping and Navigation below).
EIA Methodology	The results from the Shipping & Navigation assessment will be used to inform the predicted collision risk to marine mammals from vessels during the operational phase of the WDA. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**Reduction in Prey Availability**
Study / Survey Proposed	Desk based research and interviews with fishermen will be used to determine the fish assemblage of the area and the available geophysical and geotechnical survey data available, as well as existing BGS data, for the WDA will be used to determine the available habitat as described above in Section 3.4 Fish and Shellfish Ecology above.
EIA Methodology	The potential losses of habitats through substructure/foundation placement and temporary losses during the inter-array and export cabling will be quantified. Potential habitat loss will be assessed for prey fish species and how it could affect marine mammals. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

3.5.5 *Site Specific Survey Methodology*

As mentioned above there is extensive data available on the marine mammal distribution and densities within the Moray Firth. The only surveys MORL proposes to undertake to support the WDA EIA are aerial surveys.

Digital aerial video surveys will be undertaken monthly for a period of 12 months between April 2016 and March 2017. The surveys will consist of a series of parallel transects, each spacing approximately 2.5 km apart, aligned in a south-east to north-west orientation within the WDA boundary and 4 km buffer (please see Section 3.6 Ornithology below for more details on aerial survey design). Marine mammal data will be collected, identified and included within the baseline description section of the marine mammal chapter of the WDA EIA.

3.5.6 *Cumulative and In-combination Effects*

There is foreseeable potential for the extent or magnitude of any effects identified in Section 3.5.3 above to be cumulatively increased by the simultaneous presence of other existing or proposed activities or developments. The extent to which these cumulative effects may arise will depend upon the design and extent of the infrastructure or the frequency and intensity of the activities.

As discussed in Section 1.3.2.6 above, the method for cumulative impact assessment will be carried out in accordance with the methods outlined within the MFOWDG discussion document 'Moray Firth Offshore Wind Developers Group Cumulative Impact Assessment Discussion Document' (MORL, 2012) unless otherwise agreed with MS-LOT and appropriate stakeholders. This document has been included as Annex 1 to this Scoping Report.

3.5.7 *Potential Mitigation Measures*

In light of the conclusions of the EIA, potential mitigation measures are required, these will be determined following the production of the impact assessments and consultation with consenting authorities and appropriate stakeholders.

It is highlighted that mitigation put forward for the MORL EDA (MORL, 2012) included:

- Soft start piling;
- Appropriate pre-piling mitigation measures as agreed with stakeholders – the MORL EDA EIA considered the existing JNCC guidelines, however during recent discussions with stakeholders for the construction of the first phase of the project within the MORL EDA the use of acoustic deterrent devices (ADDs) was considered the most appropriate mitigation measure for marine mammals alongside piling soft start (see Thompson and McGarry, 2015);
- Monitoring of piling noise and associated marine mammal responses to increase confidence in the assessment; and
- Designated vessel routes during construction and operation (to reduce potential collision risk effects).

Engineering techniques/methods that generate low levels of noise during installation and 'at source' noise mitigation options to reduce potential noise effects on the marine environment will be considered for the WDA EIA.

3.5.8 Habitats Regulations Appraisal

As discussed in Section 3.2 above there are two SACs in the Moray Firth designated for marine mammals (the Moray Firth SAC designated for bottlenose dolphin and the Dornoch Firth and Morrich More SAC for harbour seal) and therefore effects on these species may affect the integrity of related SACs. This will require the WDA proposal to undergo a Habitats Regulations Appraisal (see Section 3.2.1 above).

SACs likely to be affected will be identified in consultation with SNH, JNCC, MSS and MS-LOT. Potential SACs that may be included are listed in Table 3.2-2 above.

For the SACs identified as relevant for assessment, the effects on the relevant marine mammal qualifying species will be assessed (taking account of their conservation objectives) using the following criteria:

- Changes in the distribution or extent of the habitats supporting the species;
- Changes in the structure, function and supporting processes of habitats supporting the species;
- Significant disturbance to the qualifying species;
- Changes in the distribution of the species within the site; and
- The species being maintained as a viable component of the site in the long term, and therefore the integrity of the site.

3.6 Ornithology

3.6.1 Baseline Characteristics

This section describes the Ornithology baseline environment and potential effects associated with the WDA. Information on the WDA baseline characteristics have been derived mostly from the MORL ES 2012. The Ornithology ES Chapter and Technical Appendices can be accessed via the following links – Chapter 4.5 Ornithology and Technical Appendix 4.5 A Ornithology Baseline and Impact Assessment, Technical Appendix 4.5 B Aerial Ornithology Surveys for the Moray Firth Zone and Technical Appendix 4.5 C Seabird Tracking and Modelling Report. Table 3.6-1 below lists the proposed datasets that will inform the assessment.

Table 3.6-1 Datasets for the Ornithology EIA

Dataset	**Coverage**	**Date**
MORL boat-based surveys	MORL EDA plus 4 km buffer	Apr 2010 – Mar 2012
MORL aerial surveys	Wide strip from the East Caithness Cliffs (ECC) and North Caithness Cliffs (NCC) SPAs to the Moray Coast	May – July 2011
Tracking data for fulmar, kittiwake, guillemot and razorbill from southern part of the ECC SPA	Moray Firth	2011 breeding season
Migration surveys (during MORL and BOWL boat-based surveys and at four coastal vantage points)	Moray Firth	Autumn 2010 and Spring 2011

Dataset	**Coverage**	**Date**
BOWL boat based surveys	BOWL site plus 4 km buffer	Oct 2009 – Sep 2011
Beatrice Demonstrator monthly vantage point watches (Talisman)	Moray Firth	2005 - 2008
Aerial surveys (HiDef, WWT)	Wide area in Moray Firth including the entire MORL Zone plus 4 km buffer	Breeding season 2009 and winter 2009/2010
Tracking of large gulls (great black-backed gull and herring gull) at ECC SPA	Moray Firth	May – Jun 2014
Marine Scotland seabirds strategic surveys	East coast Scotland	2014 – 2015
BOWL pre-construction aerial surveys	Area between the ECC SPA and the BOWL site plus 10 km buffer	May – Aug 2015
Seabird 2000 census	UK	1998-2002
East Caithness Cliffs SPA colony monitoring (Scottish Natural Heritage)	East caithness Cliffs SPA	2015

It is proposed that the following guidance and published work will inform the Ornithology assessment:

- SNH (2013). A handbook on environmental impact assessment: Guidance for Competent Authorities, Consultees and others involved in the Environmental Impact Assessment Process in Scotland. Scottish Natural HeritageIEEM. (2010) Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal. Winchester, UK.
- Maclean I.M.D, Wright L.J., Showler D.A. and Rehfisch M.M. (2009). A Review of Assessment Methodologies for Offshore Windfarms. BTO Report commissioned by Cowrie Ltd. COWRIE METH-08-08.
- Masden, E. A., Haydon, D. T., Fox, A. D. & Furness, R. W. (2010). Barriers to movement: Modelling energetic costs of avoiding marine wind farms amongst breeding seabirds. Marine Pollution Bulletin, 60: 1085-1091.
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- Speakman, J., Gray, H. & Furness, L. (2009). University of Aberdeen report on effects of offshore wind farms on the energy demands on seabirds. DECC. URN 09D/800.
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- SOSS-05: Assessing the risk of offshore wind farm development to migratory birds designated as features of UK Special Protection Areas (and other Annex 1 species).
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There is an extensive amount of ornithology data for the Moray Firth, as highlighted in the table bove and further detailed in the MORL ES 2012. Additional data has been collected since the submission of the MORL ES 2012, including great back-backed gull and herring gull tagging as well as through regional strategic monitoring (commissioned by MSS).

The MORL ES 2012 provided an overall description of the seabird assemblage of the Moray Firth based on literature review and surveys carried out to inform the EDA EIA.

A number of SPAs were considered in the assessment presented in the MORL ES 2012 for the EIA and to inform a HRA. Two key SPAs were considered in detail given their proximity to the MORL EDA ECC and NCC SPA, however a significantly larger number of SPAs were taken into account (as detailed in Chapter 12.2 of the MORL ES 2012). These are also the SPAs considered relevant for the WDA assessment and are detailed in Section 3.2 above.

A summary of the baseline description based on the information provided within the MORL ES 2012 as well as an overview of the results of the great black-backed gull and herring gull tracking study in 2014 is provided below.

Boat-based surveys

A total of 28 boat-based surveys were carried out between April 2010 and March 2012. The survey area covered the MORL EDA plus a 4 km buffer (part of which overlaps with the WDA) (see Technical Appendix 4.5 A of the MORL ES 2012 for full details on the boat-based survey methodology). A summary of the seasonal abundance of the key species recorded, are presented in Table 3.6-2 below and density maps for some of these species are included in the MORL ES 2012 (Figures 4.5-2 to 4.5-7).

Table 3.6-2 Abundance Estimates (Birds Using the Sea) for key species in the MORL EDA, taken from 2010 to 2012 NPC Boat–Based Survey Data. Figures refer to MORL ES 2012, Volume 6b

Species	Breeding Season		Non-Breading season		Figure
	Site	Buffer	Site	Buffer	
Fulmar	782	750	197	189	Figure 4.5-2
Gannet	100	86	23	20	Figure 4.5-3
Great Skua	101	62	N/A	N/A	n/a
Kittiwake	1,963	1,532	261	204	Figure 4.5-4
Herring Gull	7	18	41	47	n/a
Great Black-Backed Gull	271	526	106	77	n/a
Arctic Tern	229	1,903	N/A	N/A	n/a
Guillemot	6,732	6,943	990	1,021	Figure 4.5-5
Razorbill	1,661	1,674	892	899	Figure 4.5-6
Guillemot & Razorbill Combined	2,732	1,815	711	989	n/a
Little Auk	N/A	N/A	151	136	n/a
Puffin	1,916	1,971	450	463	Figure 4.5-7

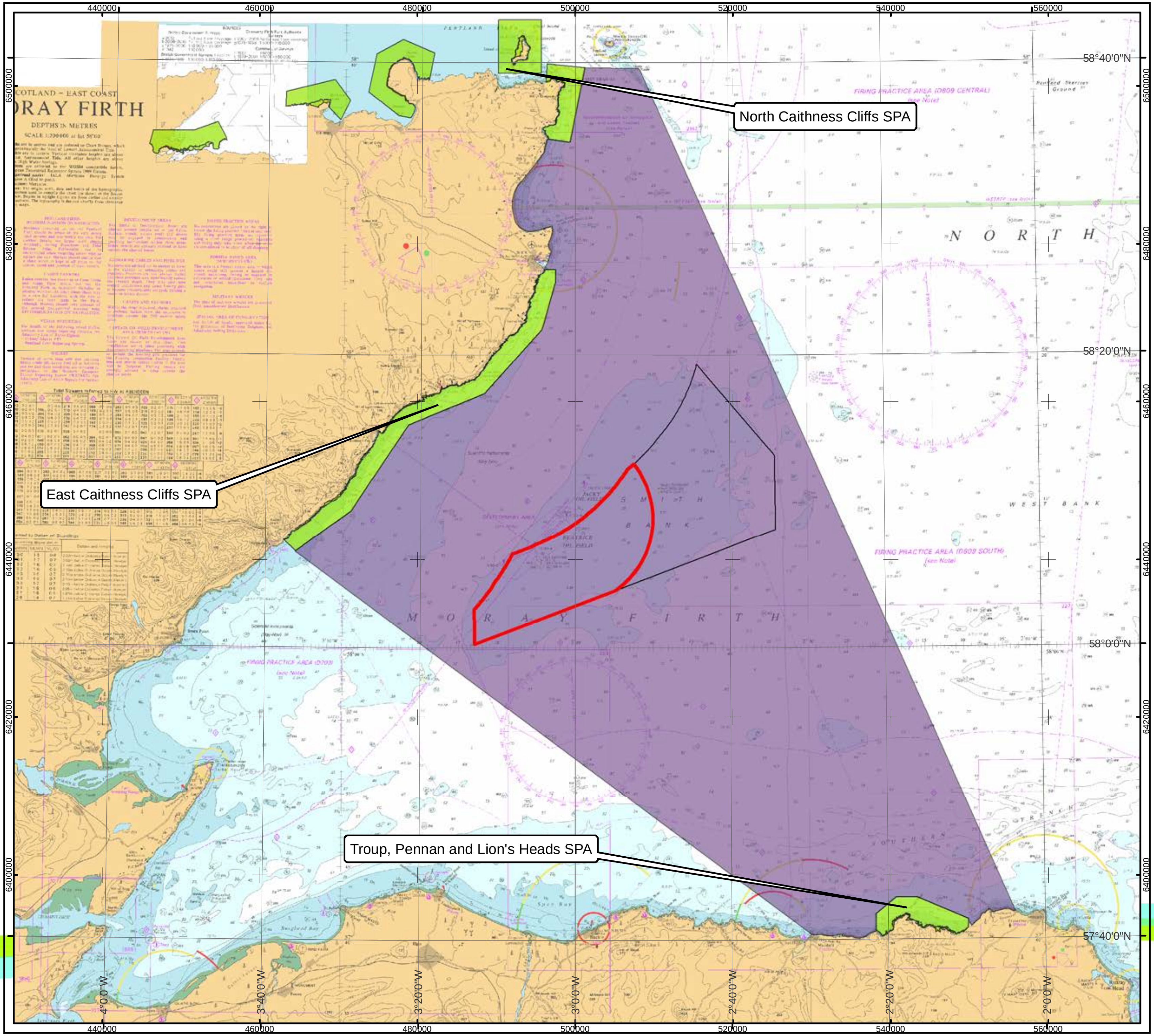
Aerial surveys

A total of six digital aerial surveys were carried out by APEM between May and July 2011. The survey area covered a strip between the ECC and NCC SPAs in the north, to the Troup, Pennan and Lion's Head SPA in the Moray Coast in the south (the survey area covered the entire MORL Zone, i.e. including the WDA – see Figure 3.6-1 below). The survey aircraft was flown along transects 2 km apart from each other, aligned in a north-northeast to south-southeast direction, and images were captured every 250 m along each transect line, at a resolution of 2 cm ground sample distance (GSD).

Relative abundance estimates from the aerial surveys are included in Table 3.6-3 below and smoothed density surface distribution maps for the surveyed area are shown in Figures 3.6-2 to 3.6-7 below. These data describe the relative abundance of birds across the survey area. These data were collected to aid the identification of connectivity between the MORL EDA and breeding colonies of key seabirds. No availability bias correction was made for diving birds being underwater when the image was taken, so for diving species the values in Table 3.6-3 below will underestimate the absolute abundance of birds present.

Table 3.6-3 Relative abundance estimates from the APEM digital imaging surveys

Species	Relative Abundance Estimate		Confidence Interval	% of the MORL EDA Compared with the Whole Survey Area
Guillemot	Survey Area	69,485	(68,801 to 70,247)	9.8
	MORL EDA	6,832	(6,774 to 6,893)	
Razorbill	Survey Area	59,846	(58,936 to 60,861)	4.2
	MORL EDA	2,517	(2,495 to 2,538)	
Guillemot & Razorbill Combined	Survey Area	149,353	(147,161 to 151,610)	4.6
	MORL EDA	6,832	(6,774 to 6,893)	
Puffin	Survey Area	11,780	(11,686 to 11,874)	4.6
	MORL EDA	541	(537 to 544)	
Fulmar	Survey Area	21,241	(20,973 to 21,541)	4.1
	MORL EDA	880	(872 to 887)	
Great Black-Backed Gull	Survey Area	950	(903 to 1,000)	0.5
	MORL EDA	5	(5 to 5)	
Kittiwake	Survey Area	47,765	(46,484 to 48,993)	2.6
	MORL EDA	1,225	(1,197 to 1,256)	



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KEY

🟪	Aerial survey area
🟩	Special Protection Areas (SPAs)
🟥	Western Development Area
☐	Eastern Development Area

Horizontal Scale: 1:650,000
A4 Chart
0 10,000 20,000 Meters
N

Geodetic Parameters: WGS84 UTM Zone 30N

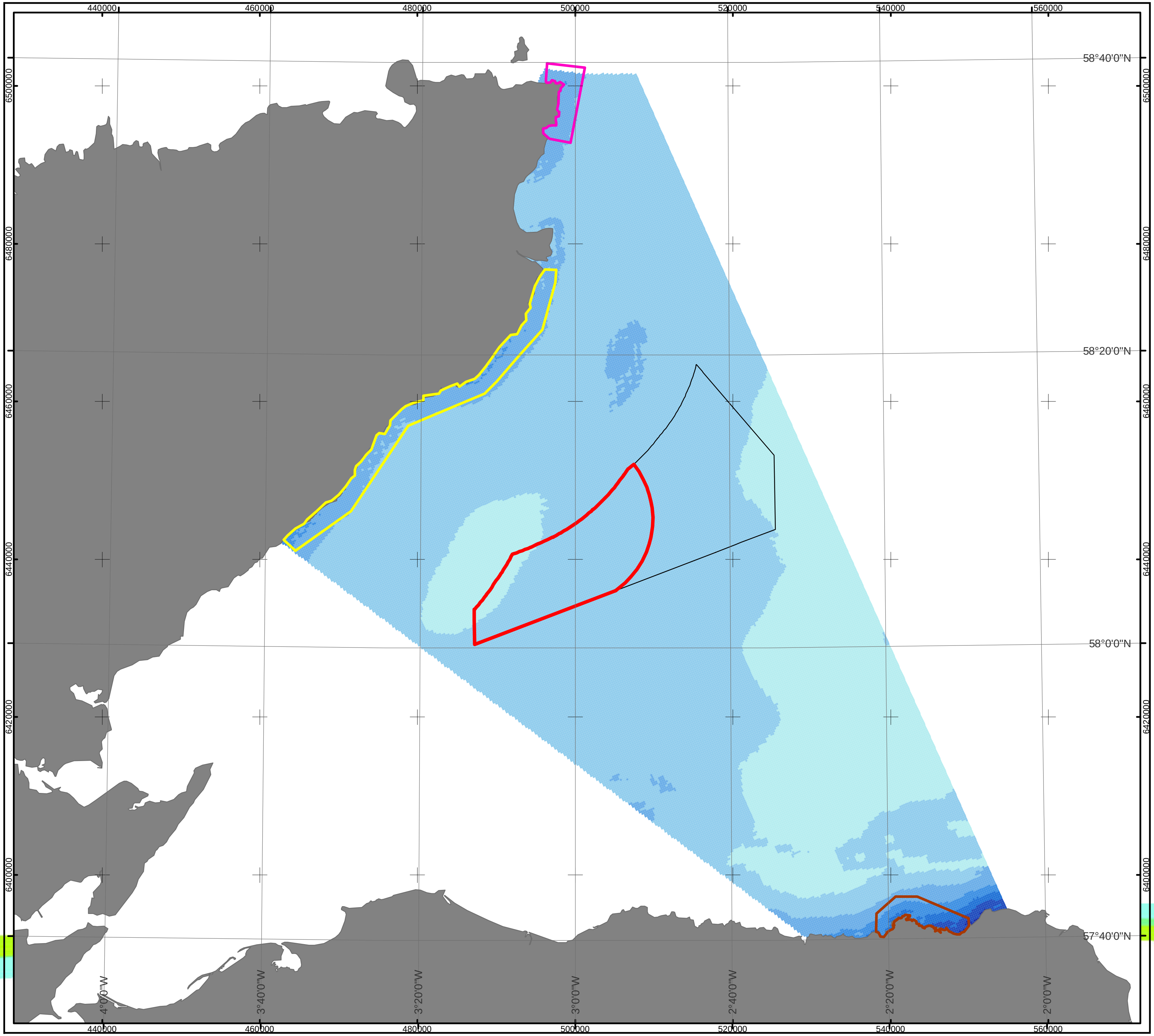
Produced: RH
Reviewed: CR
Approved: SP

Date: 04/05/2016
Revision: A

REF: 8460001-PQW0010-MOR-MAP-017

Figure 3.6-1
APEM Digital Aerial Survey
(May - July 2011)

Moray Offshore Renewables Ltd



Moray Offshore Renewables Ltd

KEY

🟥 Western Development Area
☐ Eastern Development Area

Guillemot Density per 250m2

- 0.00 - 0.46
- 0.47 - 1.76
- 1.77 - 4.31
- 4.32 - 8.10
- 8.11 - 14.02
- 14.03 - 22.36
- 22.37 - 34.44
- 34.45 - 49.50

Special Protection Areas

☐ East Caithness Cliffs
☐ North Caithness Cliffs
☐ Troup Pennan and Lions Head

Horizontal Scale: 1:650,000 A4 Chart
0 10,000 20,000 Meters
N

Geodetic Parameters: WGS84 UTM Zone 30N

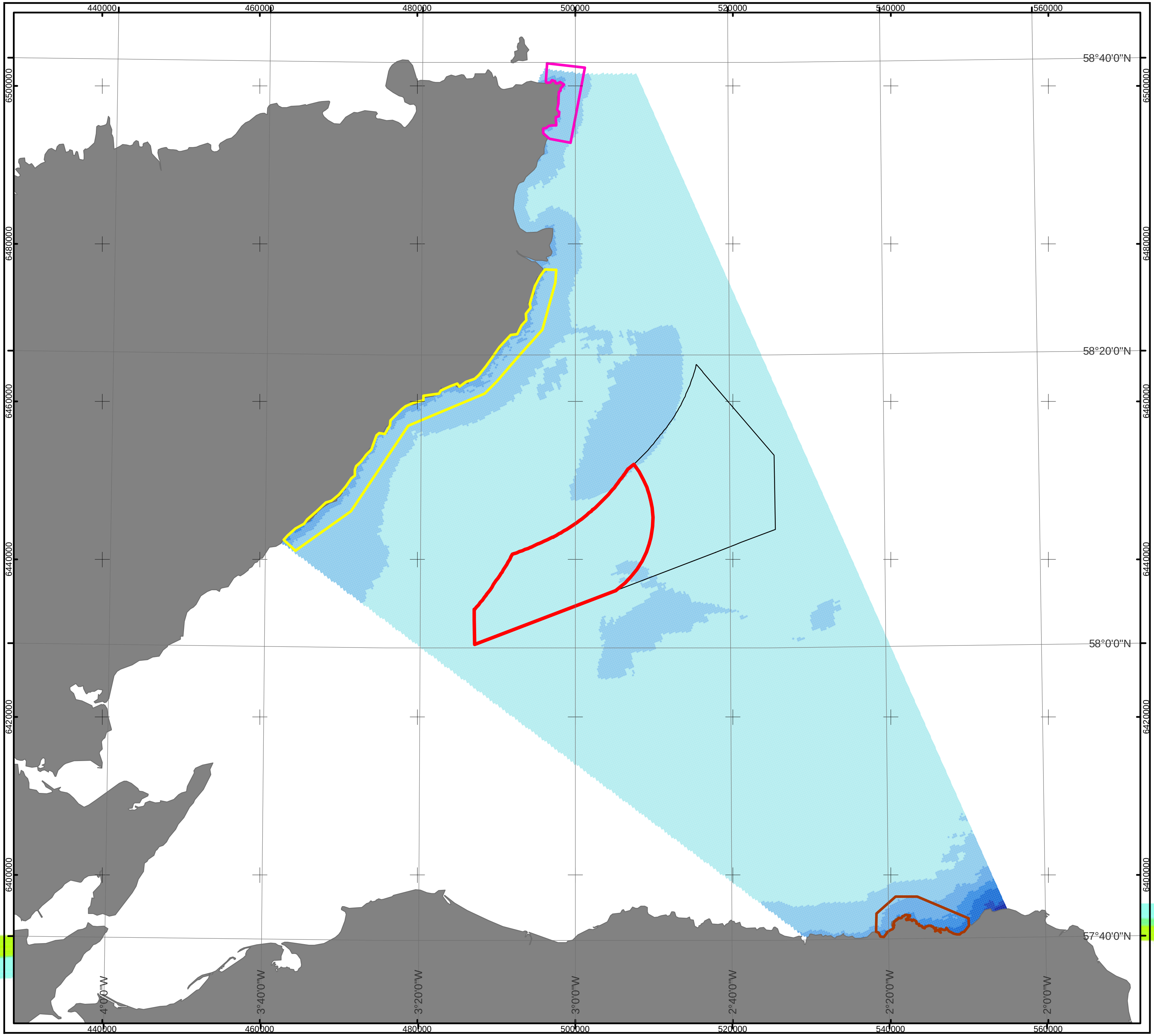
Produced: RH
Reviewed: CR
Approved: SP

Date: 15/04/2016	Revision: A

REF: 8460001-PQW0010-MOR-MAP-018

Figure 3.6-2
Density Surface Model Outputs
Guillemot (APEM 2011 Surveys)

Moray Offshore
Renewables Ltd



edp renewables

Moray Offshore Renewables Ltd

KEY

□ Western Development Area
□ Eastern Development Area

Razorbill Density per 250m2

■ 0.00 - 0.88
■ 0.89 - 3.07
■ 3.08 - 6.82
■ 6.83 - 13.63
■ 13.64 - 27.12
■ 27.13 - 55.56
■ 55.57 - 169.19
■ 169.20 - 286.77

Special Protection Areas

□ East Caithness Cliffs
□ North Caithness Cliffs
□ Troup Pennan and Lions Head

Horizontal Scale: 1:650,000
A4 Chart
0 10,000 20,000 Meters
N

Geodetic Parameters: WGS84 UTM Zone 30N

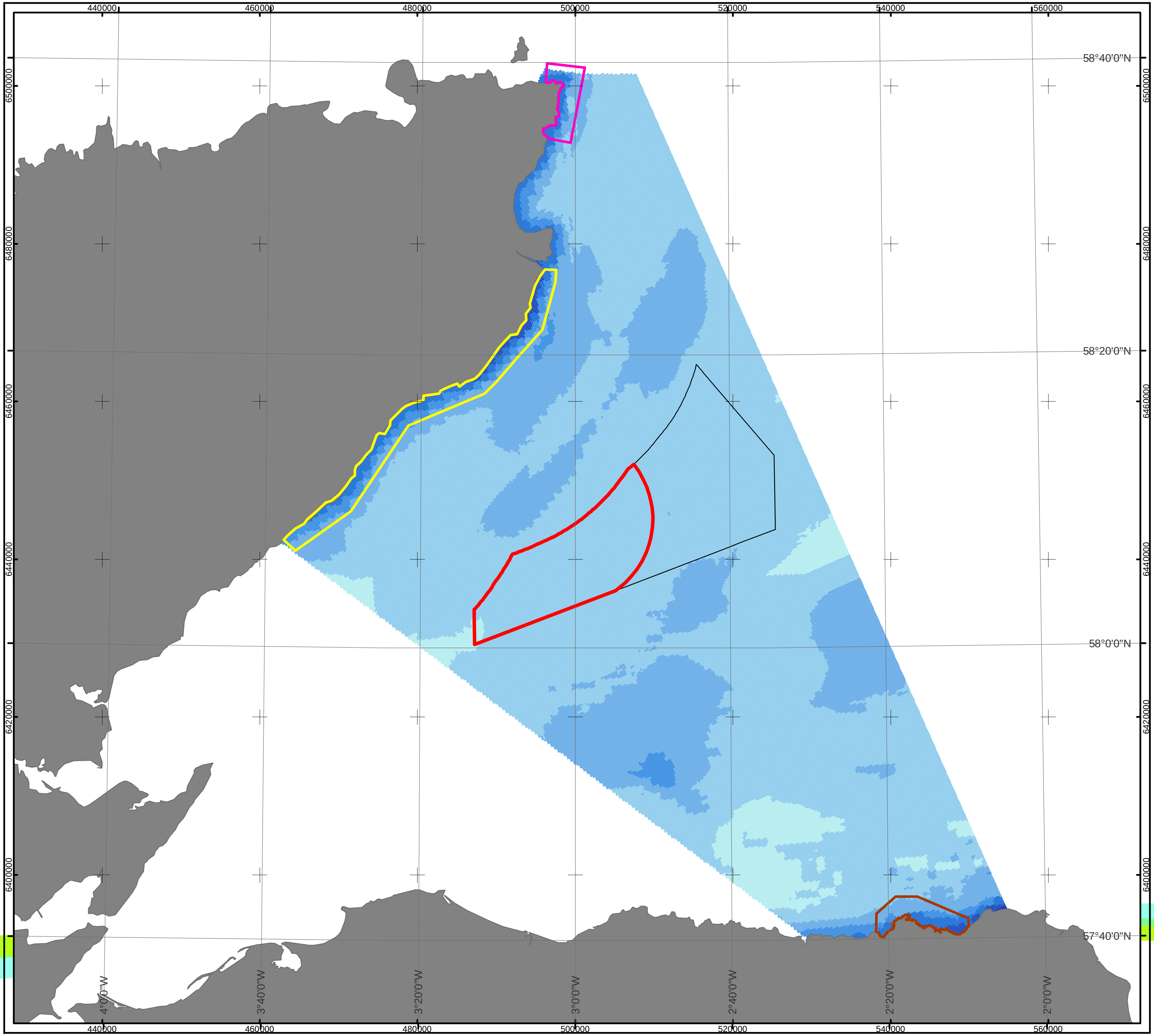
Produced: RH
Reviewed: CR
Approved: SP

Date: 19/04/2016
Revision: A

REF: 8460001-PQW0010-MOR-MAP-019

Figure 3.6-3
Density Surface Model Outputs
Razorbill (APEM 2011 Surveys)

Moray Offshore
Renewables Ltd



Moray Offshore Renewables Ltd

KEY

🟥 Western Development Area

☐ Eastern Development Area

Puffin Density per 250m2

▨	0.00 - 0.05
▨	0.06 - 0.17
▨	0.18 - 0.39
▨	0.40 - 0.70
▨	0.71 - 1.32
▨	1.33 - 2.46
▨	2.47 - 4.43
▨	4.44 - 9.74

Special Protection Areas

☐ East Caithness Cliffs

☐ North Caithness Cliffs

☐ Troup Pennan and Lions Head

Horizontal Scale: 1:650,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

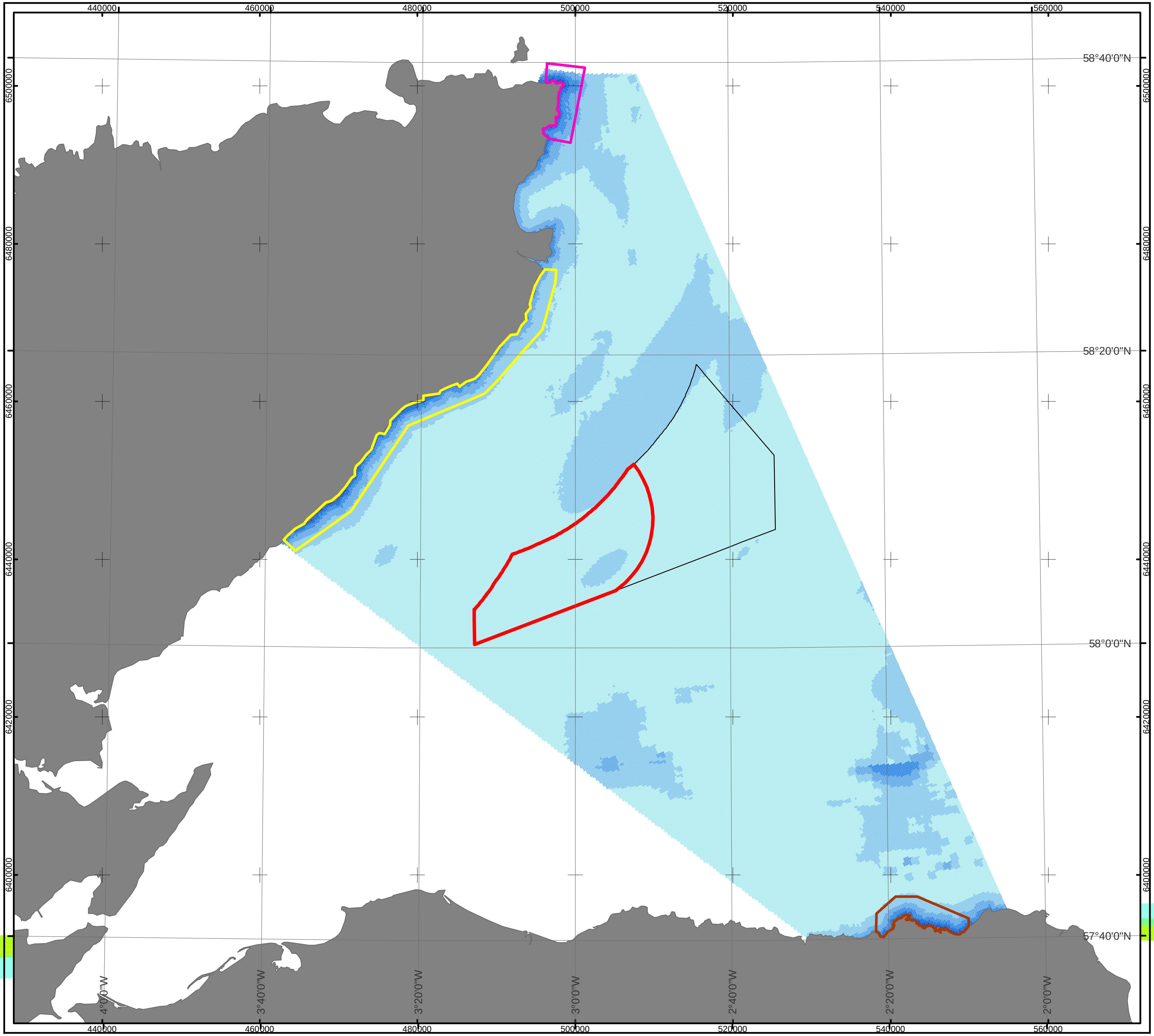
Produced: RH
Reviewed: CR
Approved: SP

Date: 19/04/2016 Revision: A

REF: 8460001-PQW0010-MOR-MAP-020

Figure 3.6-4
Density Surface Model Outputs
Puffin (APEM 2011 Surveys)

Moray Offshore
Renewables Ltd



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Geodetic Parameters: WGS84 UTM Zone 30N

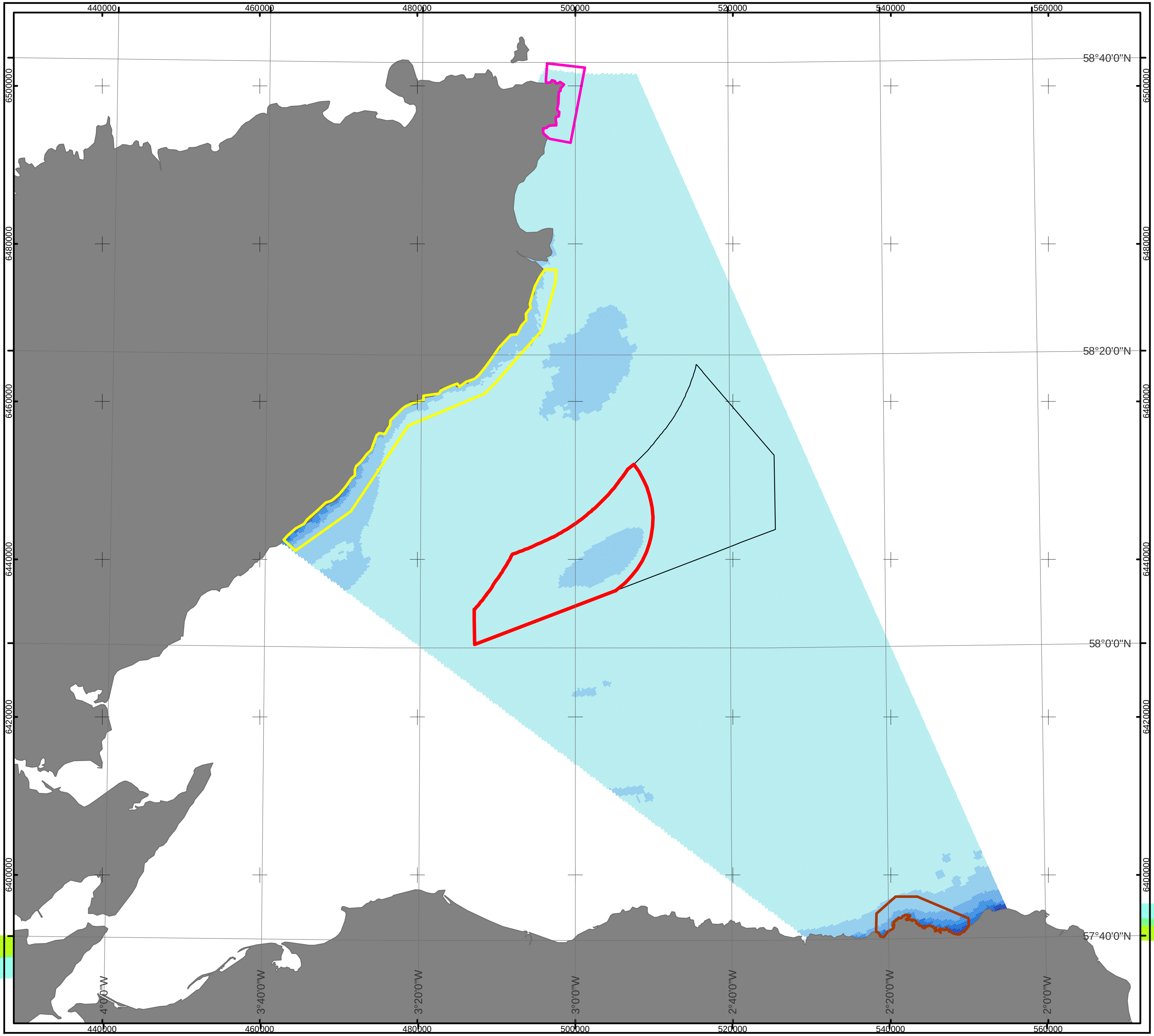
Produced: RH
Reviewed: CR
Approved: SP

Date: 19/04/2016
Revision: A

REF: 8460001-PQW0010-MOR-MAP-021

Figure 3.6-5
Density Surface Model Outputs
Fulmar (APEM 2011 Surveys)

Moray Offshore
Renewables Ltd



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Moray Offshore Renewables Ltd

Geodetic Parameters: WGS84 UTM Zone 30N

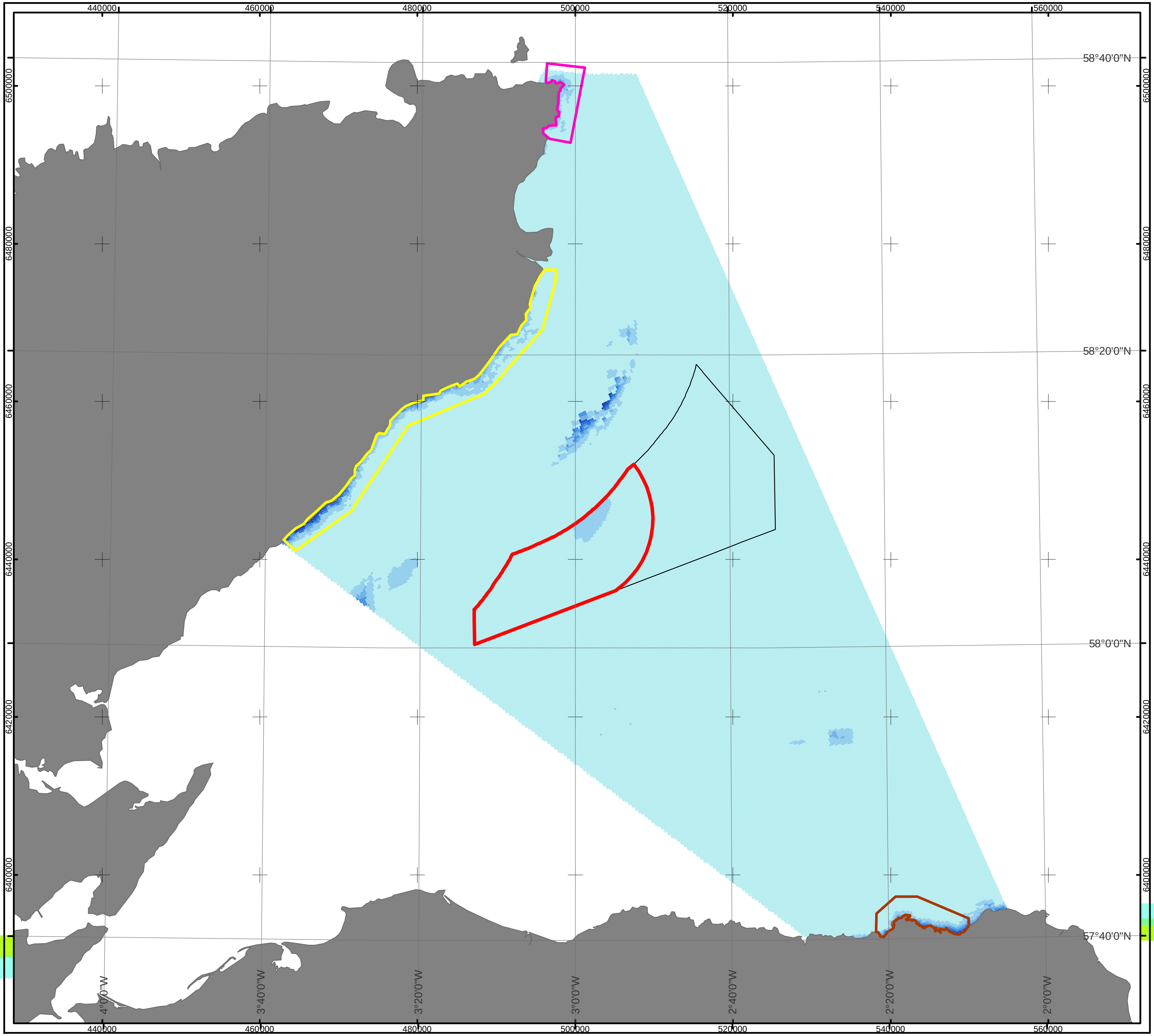
Produced: RH
Reviewed: CR
Approved: SP

Date: 19/04/2016
Revision: A

REF: 8460001-PQW0010-MOR-MAP-022

Figure 3.6-6
Density Surface Model Outputs
Kittiwake (APEM 2011 Surveys)

Moray Offshore
Renewables Ltd



Moray Offshore Renewables Ltd

KEY

□ Western Development Area
□ Eastern Development Area

Great Black Backed Gull (GBBG) Density per 250m2

■ 0.00 - 0.07
■ 0.08 - 0.23
■ 0.24 - 0.44
■ 0.45 - 0.71
■ 0.72 - 1.12
■ 1.13 - 1.74
■ 1.75 - 3.12
■ 3.13 - 5.05

Special Protection Areas

□ East Caithness Cliffs
□ North Caithness Cliffs
□ Troup Pennan and Lions Head

Horizontal Scale: 1:650,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: CR
Approved: SP

Date: 04/05/2016 Revision: A

REF: 8460001-PQW0010-MOR-MAP-023

Figure 3.6-7
Density Surface Model Outputs
GBBG (APEM 2011 Surveys)

Moray Offshore
Renewables Ltd

Migration surveys

Migration surveys from boat-based surveys and coastal vantage points were undertaken in Autumn 2010 and Spring 2011. The main aim of these surveys was to provide additional data on migrating swans and geese. Estimates of numbers of migrating swans and geese that were expected to fly through the MORL EDA are provided in Table 3.6-4 below for context.

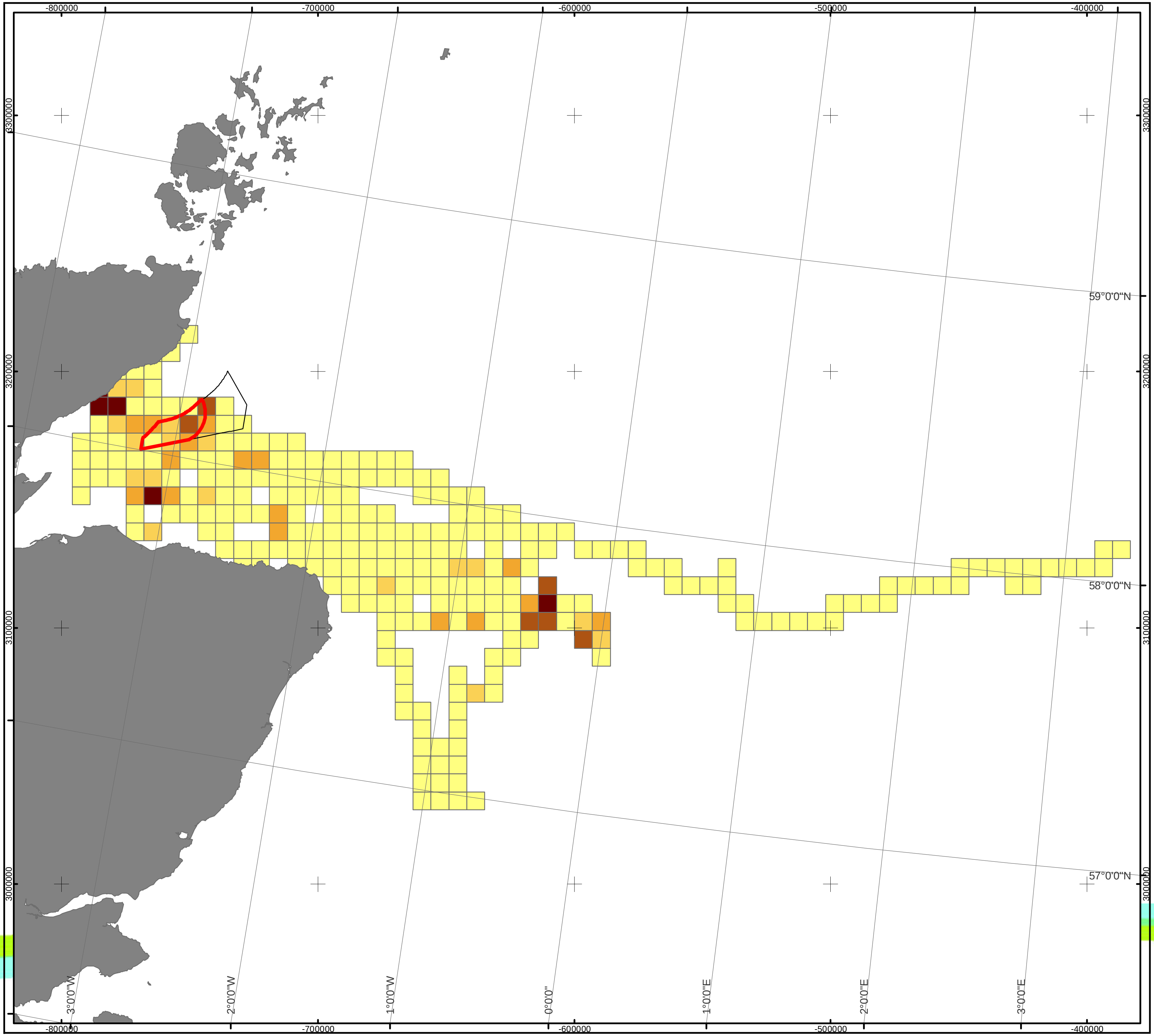
Table 3.6-4 Estimates of Annual Swans / Geese Flights and Mortality, Based on Migration Surveys

Species	Extrapolated Number of Flights			Estimated annual collision rate	
	Possible	Probable	Total	Possible	Probable
Whooper Swan	0	36	36	0	0.1
Pink-Footed Goose	5,202	18,705	23,907	4.3	15.5
Greylag Goose	206	3,049	3,255	0.2	2.6
Barnacle Goose	175	0	175	0.1	0

Seabird Tracking Study 2011

A seabird tracking study was undertaken in 2011 by the Marine Biology and Ecology Research Centre, University of Plymouth at the ECC SPA. GPS loggers were attached to four key species of seabirds (fulmar, kittiwake, guillemot and razorbill). Full details of the methodology and results can be found in Technical Appendix 4.5 C of the MORL ES 2012.

The large majority of the guillemots, razorbill and kittiwakes tracks were recorded within the inner part of the Moray Firth (Figures 3.6-8 to 3.6-11 below), with a small number commuting through the western part of the WDA area (approximately 5% of guillemot and 10% of kittiwake flights (three flights of each species)). Fulmars travelled over a much wider areas compared with the other three species, heading to more offshore foraging grounds. Twelve birds (80%) passed through WDA, and three birds (20%) foraged there.



Moray Offshore Renewables Ltd

KEY

No. of Fulmar track fixes in 7km grid

- 🟨 1 - 50
- 🟨 51 - 100
- 🟧 101 - 200
- 🟫 201 - 300
- 🟥 >300
- ☐ Western Development Area
- ☐ Eastern Development Area

Horizontal Scale: 1:2,000,000 A4 Chart

0 30,000 60,000 Meters

N

Geodetic Parameters: Europe Albers Equal Area Conic

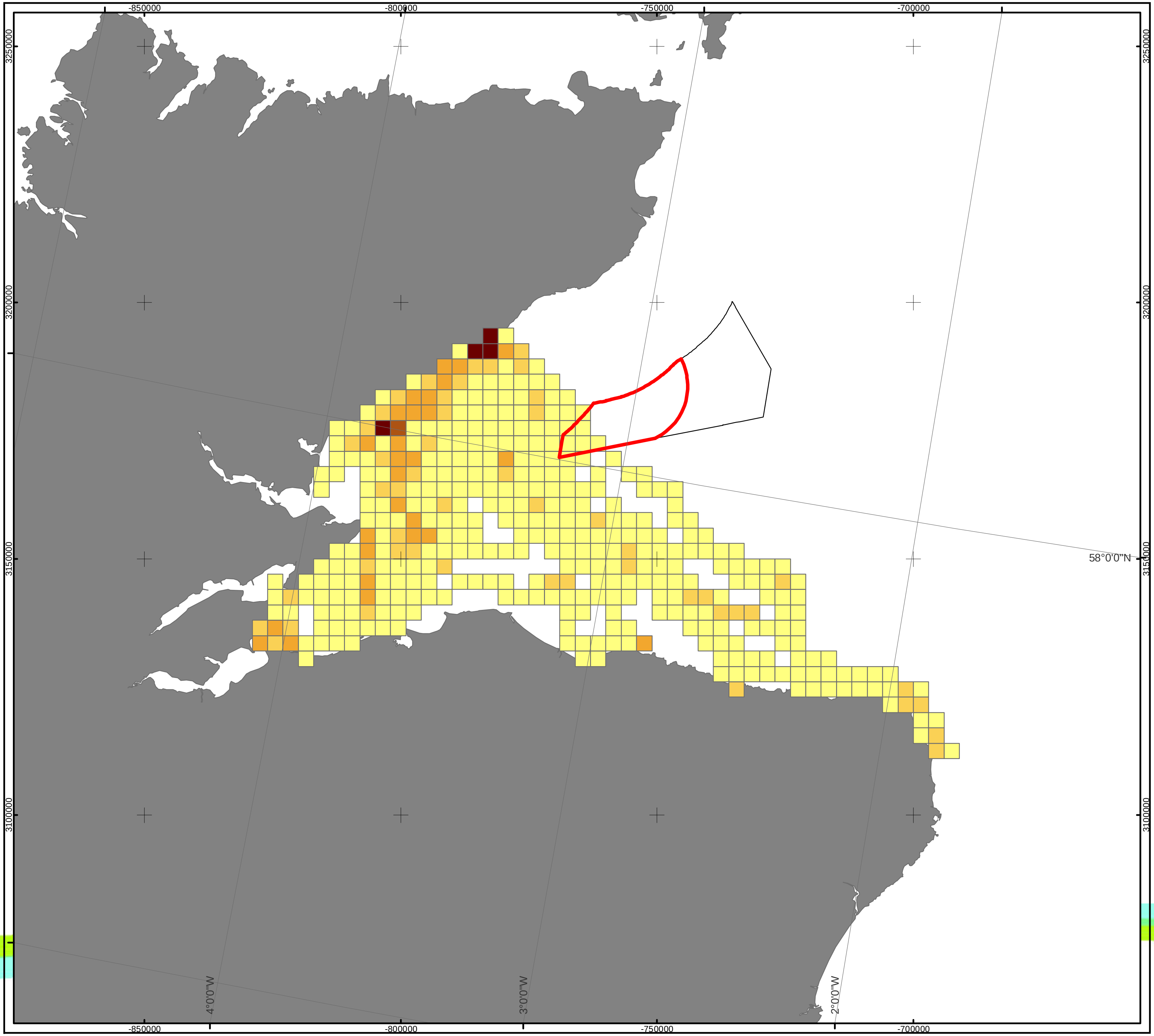
Produced: RH
Reviewed: CR
Approved: SP

Date: 04/05/2016 Revision: A

REF: 8460001-PQW0010-MOR-MAP-024

Figure 3.6-8
Seabird Tracking 2011
Fulmar

Moray Offshore
Renewables Ltd



Moray Offshore Renewables Ltd

KEY

No. of Kittiwake track fixes 3km grid

- 🟨 1 - 50
- 🟨 51 - 100
- 🟧 101 - 200
- 🟫 201 - 300
- 🟥 >300
- 🟥 Western Development Area
- ☐ Eastern Development Area

Horizontal Scale: 1:1,000,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: Europe Albers Equal Area Conic

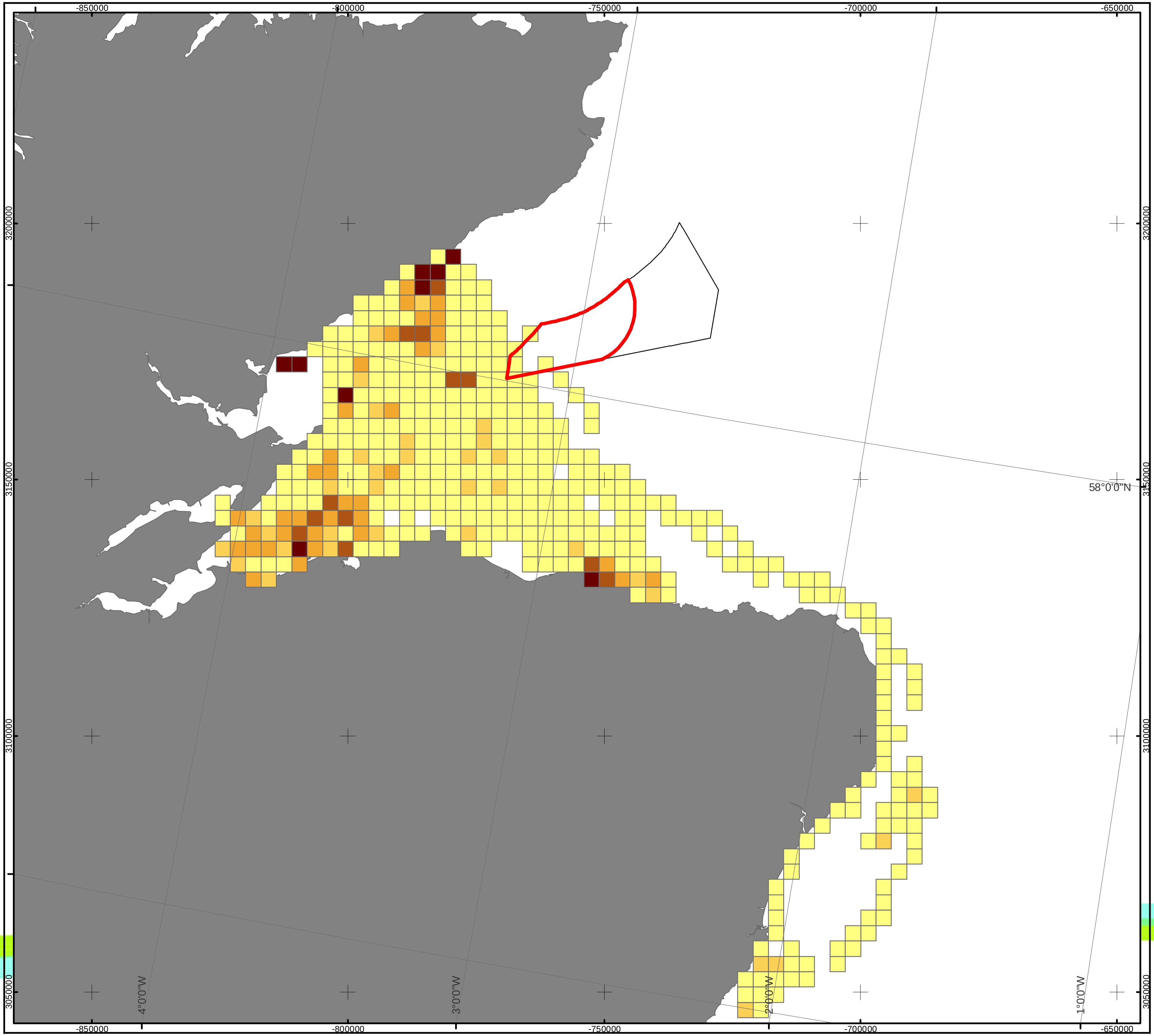
Produced: RH
Reviewed: CR
Approved: SP

Date: 04/05/2016	Revision: A

REF: 8460001-PQW0010-MOR-MAP-025

Figure 3.6-9
Seabird Tracking 2011
Kittiwake

Moray Offshore
Renewables Ltd



Moray Offshore Renewables Ltd

KEY

No. of Guillemot track fixes 3km grid

🟨	1 - 50
🟨	51 - 100
🟧	101 - 200
🟫	201 - 300
🟥	301 - 16812
🟥	Western Development Area
☐	Eastern Development Area

Horizontal Scale: 1:1,000,000
A4 Chart
N
0 10,000 20,000 Meters

Geodetic Parameters: Europe Albers Equal Area Conic

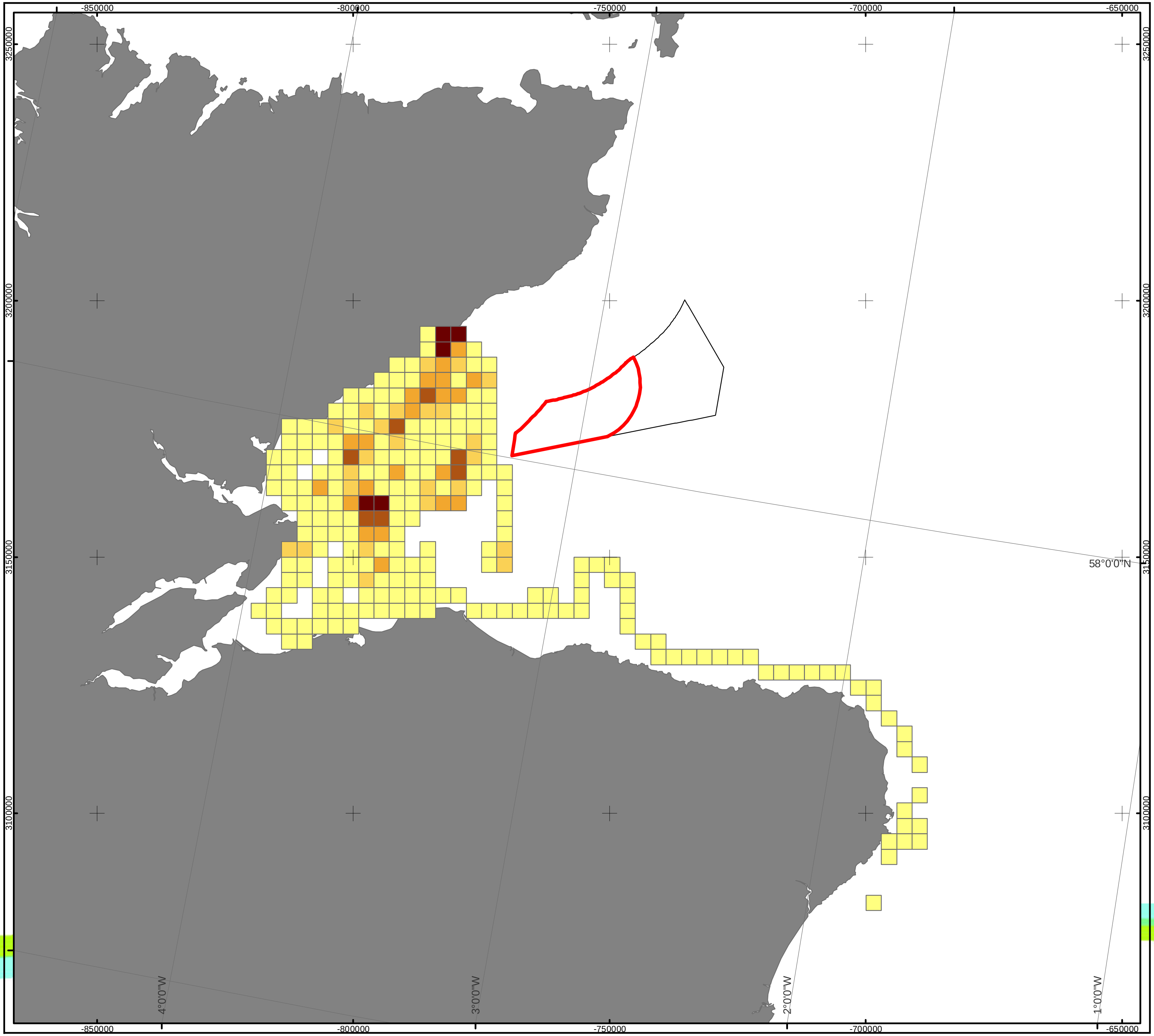
Produced: RH
Reviewed: CR
Approved: SP

Date: 04/05/2016
Revision: A

REF: 8460001-PQW0010-MOR-MAP-026

Figure 3.6-10
Seabird Tracking 2011
Guillemot

Moray Offshore
Renewables Ltd



Moray Offshore Renewables Ltd

KEY

No. of Razorbill track fixes 3km grid

- 🟨 1 - 50
- 🟨 51 - 100
- 🟧 101 - 200
- 🟫 201 - 300
- ■ 301 - 8850
- 🟥 Western Development Area
- □ Eastern Development Area

Horizontal Scale: 1:1,000,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: Europe Albers Equal Area Conic

Produced: RH
Reviewed: CR
Approved: SP

Date: 04/05/2016 Revision: A

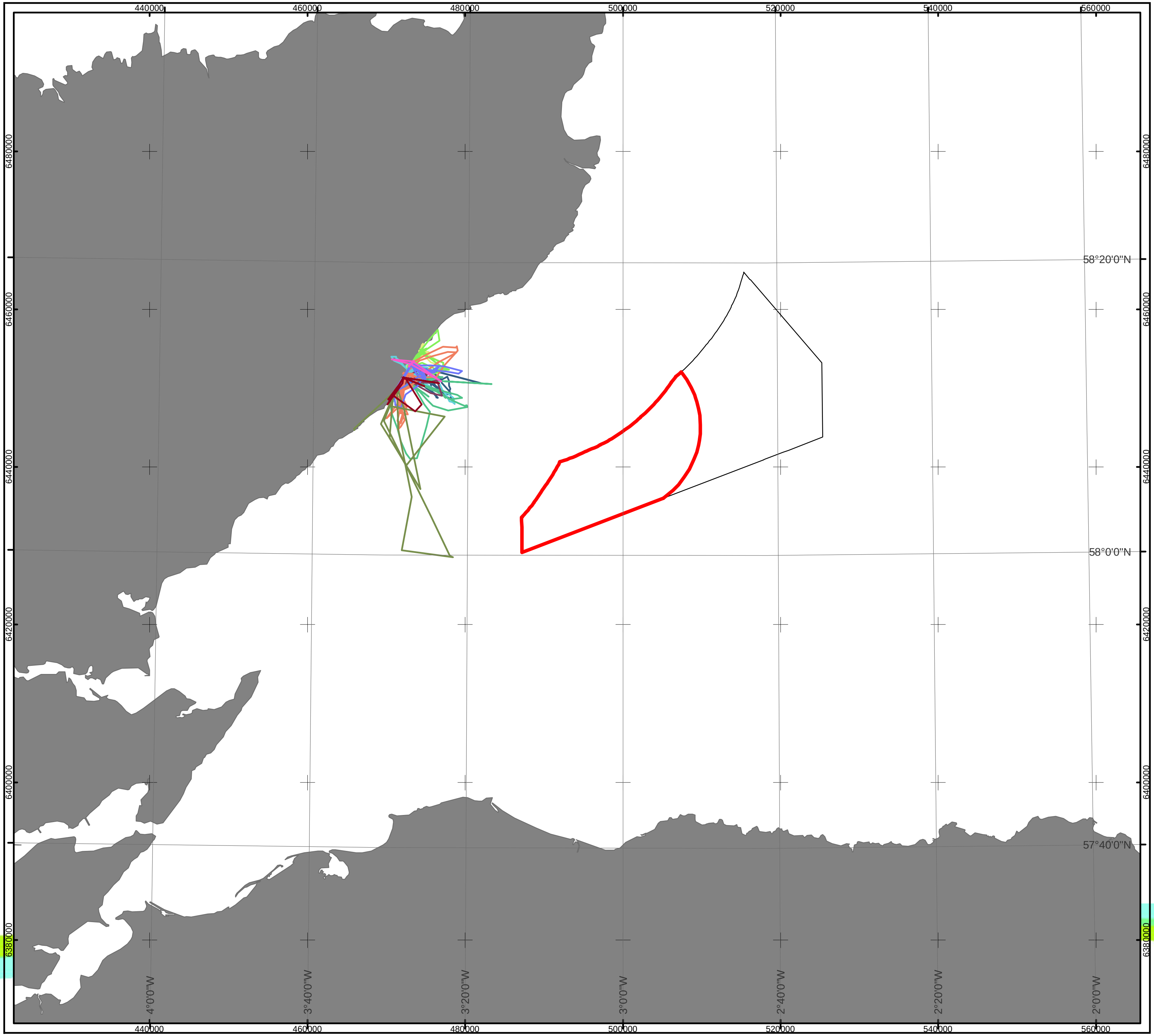
REF: 8460001-PQW0010-MOR-MAP-027

Figure 3.6-11
Seabird Tracking 2011
Razorbill

Moray Offshore
Renewables Ltd

Great Black-Backed Gull and Herring Gull Tracking 2014

Herring gulls and great black-backed gulls were tracked at ECC SPA during May and June 2014. Eleven great black-backed gulls and 10 herring gulls were caught on the nest and fitted with a 26 g remotely downloadable GPS / accelerometer tag. The results of this study showed that great back-backed gulls foraged mainly across inshore areas (maximum distance recorded from the nest was around 20 km although the vast majority of trips shorter than this) (see Figure 3.6-12 below). Herring gulls were also largely coastal, but foraged further to the south-east compared with great back-backed gulls, to waters north of the Cromarty Firth (see Figure 3.6-13 below). No herring gulls or great back-backed gulls were recorded within the WDA. Full survey details are provided within Archibald *et al.* (2014).



edp renewables

Moray Offshore Renewables Ltd

KEY

Great black-backed gull (GBBG) tracks

- Gull 4 (tag 3782)
- Gull 6 (tag 3741)
- Gull 11(tag 3743)
- Gull 12 (tag 3748)
- Gull 13 (tag 3783)
- Gull 16 (tag 3796)
- Gull 17 (tag 3789)
- Gull 18 (tag 3772)
- Gull 19 (tag 3750)
- Gull 21 (tag 3744)
- Gull 5 (tag 3764)
- 🟥 Western Development Area
- ☐ Eastern Development Area

Horizontal Scale: 1:650,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

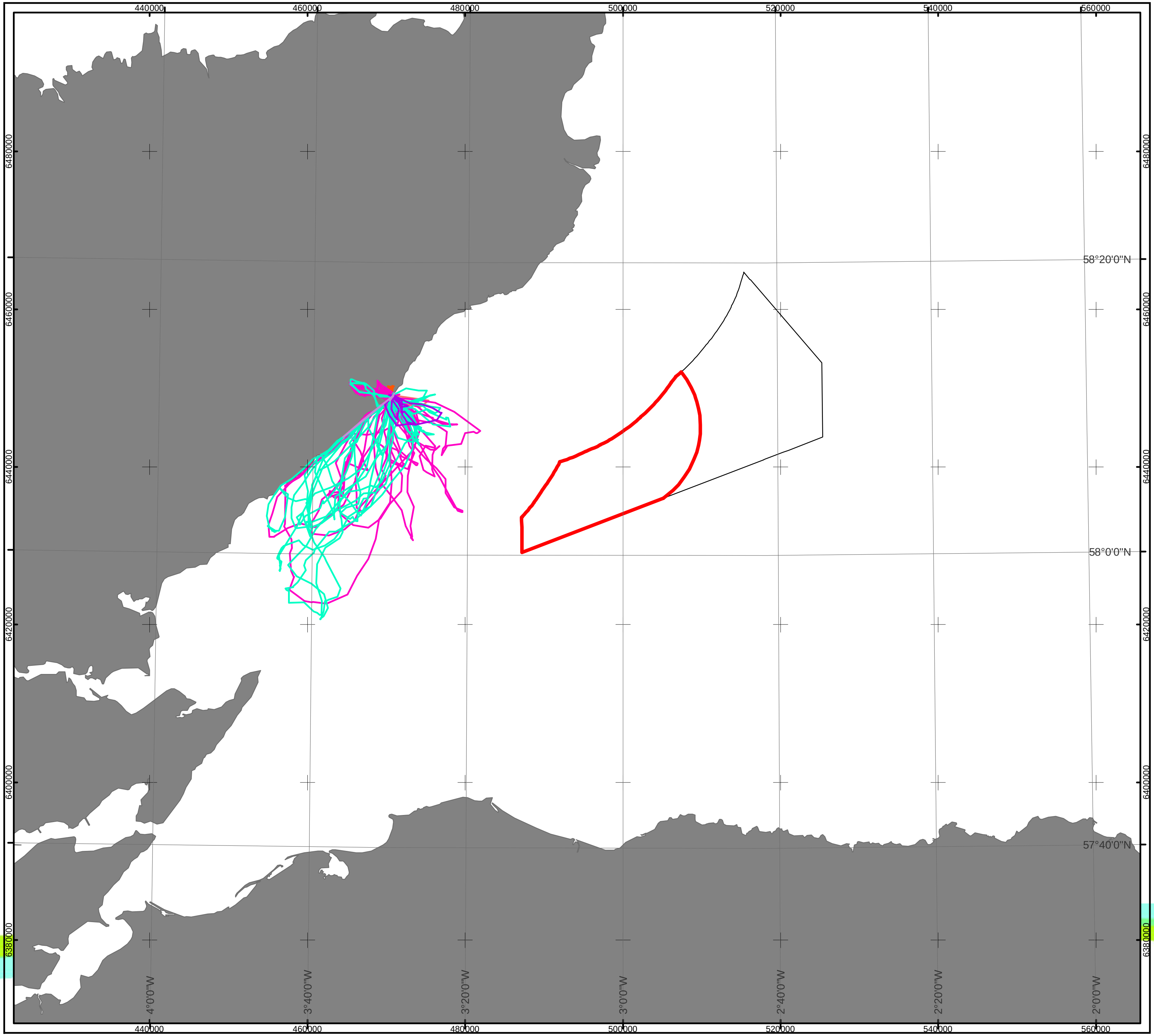
Produced: RH
Reviewed: CR
Approved: SP

Date: 04/05/2016 Revision: A

REF: 8460001-PQW0010-MOR-MAP-028

Figure 3.6-12
GBBG Foraging Behaviour
2014 Tracking Study

Moray Offshore
Renewables Ltd



Moray Offshore Renewables Ltd

KEY

Herring Gull tracks

- Gull 1 (tag 3751)
- Gull 2 (tag 3762)
- Gull 8 (tag 3792)
- Gull 10 (tag 3767)
- Gull 14 (tag 3784)
- Gull 15 (tag 3763)
- Gull 20 (tag 3786)
- 🟥 Western Development Area
- ☐ Eastern Development Area

Horizontal Scale: 1:650,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: CR
Approved: SP

Date: 19/04/2016 Revision: A

REF: 8460001-PQW0010-MOR-MAP-029

Figure 3.6-13
Herring Gull Foraging Behaviour
2014 Tracking Study

Moray Offshore
Renewables Ltd

3.6.2 *Data Gaps*

Unlike at the scoping stage for the MORL EDA, a large amount of data has been collected in the Moray Firth and is now available which provides a good indication of the ornithology baseline for the WDA. Nevertheless further aerial surveys of the WDA are proposed to complement the datasets already available which are discussed in detail in Section 3.6.5 below.

3.6.3 *Potential Effects*

3.6.3.1 Summary of Potential Effects

Based on the EIA for birds for the MORL EDA and data collected since the submission of the MORL ES 2012, the following are thought to be the main potential effects of development in the WDA on ornithology:

Potential Effect	**Construction**	**Operation**	**Decommissioning**	**Scoped Out**
Disturbance	✓	×	✓	×
Disturbance / Displacement	×	✓	×	×
Collision Risk	×	✓	×	×
Barrier Effects	×	✓	×	×

Whilst a specific assessment will be carried out in relation to the WDA, given the proximity of the MORL EDA and WDA and the potential similarities in relation to potential effects, the findings of the MORL EDA ornithology assessment have been included below for context.

3.6.3.2 Potential Effects During the Construction Phase

Disturbance

Disturbance effects can operate by deterring birds from using suitable or preferred habitat. During construction disturbance has the potential to arise as a result of the presence of vessels and construction works.

Different species show differing sensitivities to disturbance. Assessment of birds' sensitivity to disturbance will be based upon: the number of each species within the WDA, the estimated proportion of the colony–population within the WDA, their estimated sensitivities to vessel presence (Furness *et al.* 2013), whether their distribution over the wider area is localised or widespread, their reliance on specific habitat types, and any published information on habituation.

The direct effects of construction noise on birds will not be considered in line with the approach agreed for the MORL EDA EIA (through consultation with JNCC and SNH).

It is highlighted that the assessments for the MORL EDA assessed the potential for effects of disturbance on pink-footed goose, greylag goose, fulmar, gannet, kittiwake, herring gull, great black-backed gull, guillemot, razorbill and puffin. The disturbance for pink-footed goose and greylag goose was assessed as 'no risk'.

For the other species, the disturbance (direct and indirect) was assessed as minor risk (certain, short-term, temporary). Since effects were considered to be significant within the MORL ES 2012 if they were above moredate significance, this was not considered to be a significant effect.

3.6.3.3 Potential Effects During the Operational Phase

Disturbance / Displacement

Displacement affects bird populations by denying them access to a habitat on a long term basis, as a result of the combined effect of changes to the environment as a result of the wind farm, including presence of the turbine structures, disturbance from operations and maintenence activities (e.g. boat traffic), etc. and having an impact on prey distribution / abundance (indirect effects). The effect that displacement has on a population depends on the species' dependence on specific habitats and the availability of viable alternatives to the area from which the birds have been displaced. In terms of the MORL ES short–listing species of birds sensitive to displacement was based upon the same criteria used to shortlist birds susceptible to disturbance. Further details are provided in Technical Appendix 4.5 A of the MORL ES 2012.

It is highlighted that the assessments for the MORL EDA assessed the potential for effects of disturbance/displacement as 'no risk' for pink-footed goose and greylag goose. For fulmar, gannet, kittiwake, herring gull, great black-backed gull, guillemot and puffin the disturbance /displacement (direct and indirect) was assessed as minor risk (certain, medium-term, temporary). For razorbill the disturbance / displacement (direct and indirect) was assessed as minor (probable, medium-term, temporary). Since effects were considered to be significant within the MORL ES 2012 if they were above moredate significance, this was not considered to be a significant effect.

Collision Risk

There is the potential for birds flying through the wind farm to collide with the rotating turbines, which would then be predicted to result in mortality (Drewitt & Langston, 2006). The risk of a bird colliding with a turbine depends on several factors:

- The height of the turbines, area of air swept by the rotors, the speed of the rotating blades, and the overall number of turbines;
- Effects from specific developments are influenced further by the suite of species that occur on or pass through the sites: the number of birds of each species flying through the risk zone can be predicted by the number observed flying through the sites at the relevant heights during baseline surveys, but also the avoidance behaviour of the species is key to determine the true effect; and
- The probability that a bird flying through the rotor–swept area will be at risk also varies dependent on flight speed and bird size (length and wingspan).

Assessment of collision risk will follow protocols set out by Band (2012). Collision Risk Modelling (CRM) will be undertaken in R using the code produced by Masden (2015). These developments allow for the error and variance around data to be included in the calculation of collision risk, resulting in a range of possible collision mortalities around a central value. Guidance will be required on how this range of values should be incorporated in to an impact assessment. The most recent available evidence on the avoidance rates of birds will also be used, noting that there is current advice from SNH and JNCC on suitable avoidance rates for use with the Band (2012) offshore collision risk model. Output from the ongoing Offsfore Renewables Joint Industry Programme project on bird avoidance behaviour (ORJIP 1) will also be considered if available at the time of assessment, following discussion with MSS, SNH and JNCC.

It is highlighted that the assessments for the MORL EDA assessed the potential for effects of collision risk as negligible for fulmar, guillemot, razorbill and puffin, minor for pink-footed goose, graylag goose, kittiwake and great black-backed gull and moderate for gannet and herring gull. Since effects were considered to be significant within the MORL ES 2012 if they were above moredate significance, this was not considered to be a significant effect.

Barrier Effects

Barrier effects may arise when birds incur extra energetic costs as a result of avoiding a wind farm. Species passing through an area infrequently, such as birds traversing the sites as part of a longer biannual migration flight, would incur much less impact than a species breeding near the development that needed to avoid it on a daily basis as part of its foraging routine. Effects upon birds simply passing through an area will be negligible (although possibly contributing to cumulative effects where other barriers exist on a migration route), whereas those making frequent flights across the sites may do so to the detriment of their body condition, which may affect adult survival or reproductive success.

Assessment of barrier effects on the adult survival and productivity of breeding birds will follow the best practice available at the time of assessment, noting that Marine Scotland are currently investigating the application of the Centre for Ecology and Hydrology (CEH) energetic model used in the consents for the Forth and Tay wind farms to other areas.

Short–listing species for barrier effect considerations will be based upon: the number of each species recorded on the site, the likelihood of locally breeding individuals foraging on the site (based on empirical tracking data and mean of the maximum foraging ranges, from BirdLife and the review by Thaxter *et al*, 2012), the frequency of foraging flights made by each species (from Masden, 2010), the efficiency of each species' flight and wing loading, and known macro–avoidance rates (from Cook *et al*., 2014).

It is highlighted that the assessments for the MORL EDA assessed the potential for barrier effects as 'minor risk' (probable, medium-term, temporary) for pink-footed goose, greylag goose, fulmar, gannet, kittiwake, razorbill and puffin. For large gulls (herring gull and great black-backed gull) the effects were assessed as 'negligible risk' (probable, medium-term, temporary). Since effects were considered to be significant within the MORL ES 2012 if they were above moredate significance, this was not considered to be a significant effect.

Population Viability Analysis (PVA) was carried out within the MORL EDA EIA for the following species: fulmar, gannet, kittiwake, herring gull, great black-backed gull, guillemot, razorbill and puffin. This was used to predict the difference in the quasi-extinction threshold (QET) of modelled populations with and without the predicted effects of the MORL EDA alone and cumulatively with other projects (particularly the BOWL project).

The results of the PVA were used to understand the likely risk to these species populations and supported the overall 'no significant effects' assessment results. The Additional Ornithology Information Report (MORL, 2013b) provided more detailed PVA modelling with input parameters adapted following consultation with SNH, JNCC and MSS. These results were then used in consenting the MORL EDA.

3.6.3.4 Potential Effects During the Decommissioning Phase

At this stage, decommissioning effects are expected to be similar to those described for the construction phase.

3.6.4 *Approach to EIA*

For each of the potential effects identified above surveys and/or studies and the method of impact assessment are described in the tables below. MORL will seek to agree with relevant stakeholders including MSS, SNH and JNCC the key parameters and detailed methodologies to be used in the assessments following receipt of the responses to this Scoping Report.

3.6.4.1 Construction Phase

Potential Effect	**Disturbance**
Study / Survey Proposed	Digital aerial surveys will be carried out across the WDA and 4 km buffer around the site. Species specific densities will be calculated based on the results of the aerial surveys and absolute abundance estimates will be derived from these. AIS surveys will also be undertaken to assess vessel traffic within the WDA (see Section 4.3 Shipping and Navigation below).
EIA Methodology	Bird species observations, distribution and behavioural data will be used to model population densities across the site. The results from the Shipping & Navigation assessment (see Section 4.3 below) will be used to inform the predicted disturbance effects on seabirds from vessels during the construction phase of the WDA. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

3.6.4.2 Operation Phase

Potential Effect	**Disturbance / Displacement**
Study / Survey Proposed	Digital aerial surveys will be carried out across the WDA and 4 km buffer around the site. Species specific densities will be calculated based on the results of the aerial surveys and absolute abundance estimates will be derived from these.
EIA Methodology	Bird species observations, distribution and behavioural data will be used to model population densities across the site over time. The potential for effects will be assessed in relation to the baseline data. The potential for effects will also be assessed with regard to the time of year so that levels of effect may be assumed with regard to different seasonal patterns of use. The significance of potential effects will be assessed using the sensitivity of the receptors against a measure of the magnitude of the effect (assessed from a measure developed by Furness *et al*, 2013).

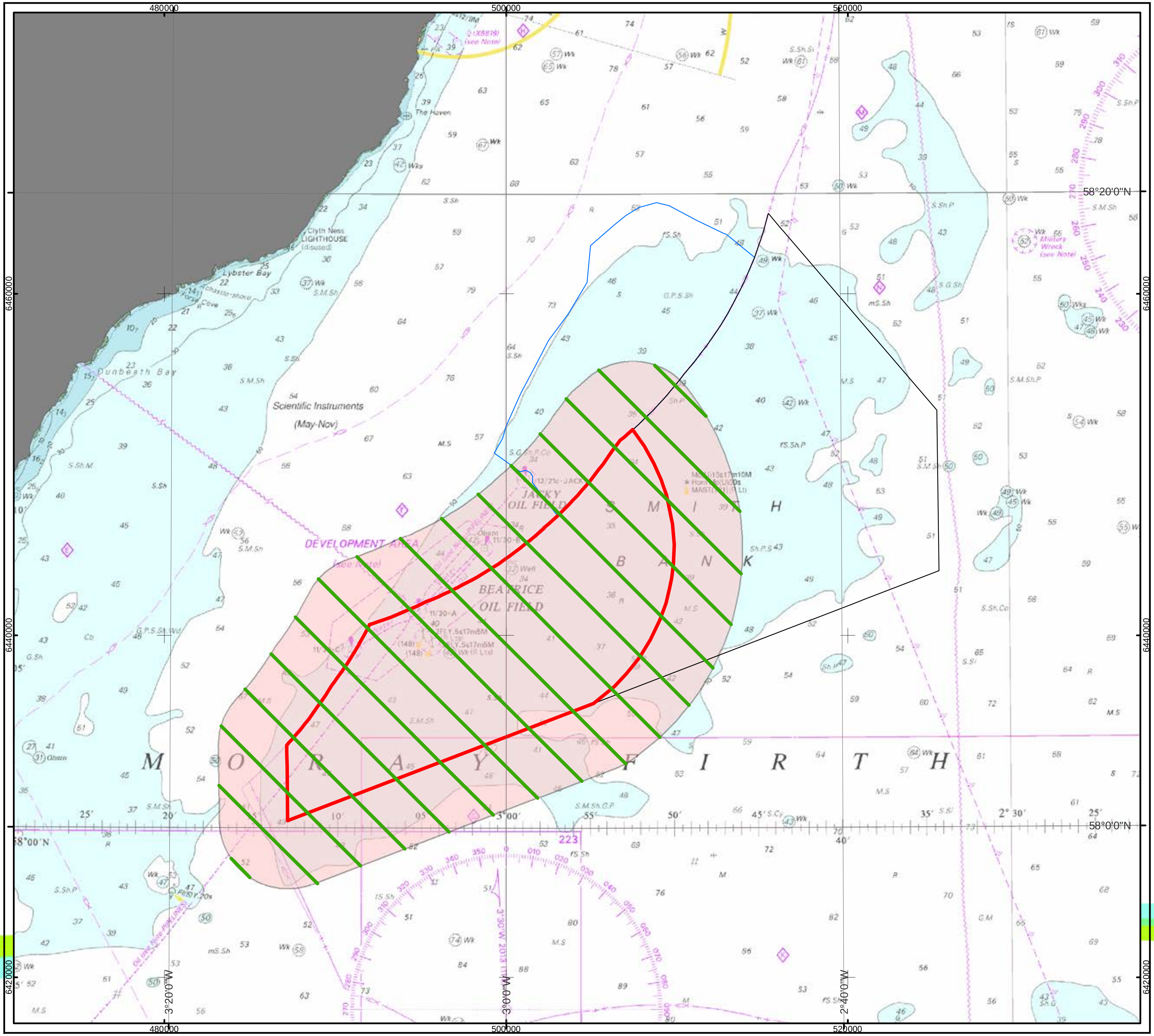
Potential Effect	**Collision Risk**
Study / Survey Proposed	Digital aerial surveys will be carried out across the WDA and 4 km buffer. Abundance and densities as well as flight heights will be calculated based on the results of the aerial surveys.
EIA Methodology	Collision risk modelling (CRM) will be undertaken to assess the potential direct impacts of the presence of operational turbines. This analysis will be on a species basis and will provide an estimate of those species at greatest risk. The assessment will be related to the relative abundance and nature conservation status of each species and past studies from existing offshore wind farms to provide an overall assessment of the potential for the proposed development to significantly affect key species populations.

Potential Effect	**Barrier Effects**
Study / Survey Proposed	Digital aerial surveys will be carried out across the WDA and 4 km buffer. Species specific aerial bird densities will be calculated based on the results of the digital aerial surveys.
EIA Methodology	The methodology used to assess barrier effects will follow advice from MSS, SNH and JNCC at the time of assessment, in the absence of current guidance and in light of the modelling approach used in the Forth and Tay. It is noted that Marine Scotland has commissioned a research project on displacement and barrier effects that is expected to report in autumn 2016. If available any relevant results from this study will be considered in the assessment. The results will be cross-referenced against existing wind farm studies.

3.6.5 Site Specific Survey Methodology

As mentioned above there is extensive data available on the ornithology baseline in the Moray Firth. The only surveys MORL proposes to undertake to support the WDA EIA are digital aerial surveys.

Digital aerial video surveys will be undertaken monthly for a period of 12 months between April 2016 and March 2017. The surveys will consist of a series of parallel transects, each spacing 2.531 km apart, aligned in a south-east to north-west orientation within the WDA boundary and 4 km buffer. The survey has been designed to allow for a 10.21% coverage of the survey area. Surveys will be undertaken at a height of 550 m above sea level and data collected at a 2 cm resolution Figure 3 6- 14 below provides an overview of the proposed transect survey design (the transects at the eastern and western boundaries of the survey area have been increased to 4 km in line with the size of the buffer).



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KEY

━ Survey Transects (Spaced at 2531m apart)

▨ WDA 4km Buffer

□ Western Development Area

□ Eastern Development Area

□ BOWL

Horizontal Scale: 1:300,000

A4 Chart

0 5,000 10,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: CR
Approved: SP

Date: 03/05/2016

Revision: A

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Figure 3.6-14
Proposed Survey Design WDA

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The following data will be collected:

- Date and time of each bird recorded;
- GPS coordinate location of each bird recorded, ± error in the location;
- Survey transect number;
- Species ID (structured approach to ID and confidence in ID is needed);
- Bird age, gender and moult status (where possible);
- Whether the individual is in flight or on the sea surface;
- Behaviour in flight (e.g. part of a flock, carrying fish, diving);
- Flight height (± an appropriate error and confidence);
- Flight orientation (in compass degrees to true North); and
- Sea state (at the time of the image being collected).

A thorough quality assurance (QA) process will be followed during data processing. A summary is provided below:

- 20% of all camera reels selected at random for blind QA by experienced auditors;
- Greater than 90% agreement is required to pass; otherwise data is re-reviewed;
- Object ID carried out by some of the most experienced identification experts and seabird surveyors (includes 3 current members of the British Birds Rarities Committee);
- 20% of objects undergoing blind QA, again requiring 90% agreement;
- Partial agreements and disagreements undergo adjudication by Senior ID experts; and
- Final quality assurance sign-off by a senior seabird expert.

The flight heights will be calculated on the principal of parallax using all frames in which the bird is present. Availability bias will be accounted for using diving behavioural data from telemetry studies to calculate the proportion of time at sea for key species or using the ratio of attended and unattended chicks at sea for guillemots and razorbills in late June and July (if possible).

As mentioned above in Section 3.6.1 there is an extensive amount of ornithology data for the Moray Firth as detailed in the MORL ES 2012, and further data has been collected since then through great back-backed gull and herring gull tagging as well as through regional strategic monitoring (MSS). Table 3.6-5 below provides an overview of the existing seabird datasets relevant to the WDA EIA and HRA.

Table 3.6-5 Existing seabird data sets relevant to the WDA EIA and HRA.

	Data owner	Survey type	Species	Survey timing	No. of surveys	Survey location	Survey extent	Coverage of WDA (+ 4 km buffer)	Limitations	Further analysis
1	Talisman	Vantage Point	All	January 2005 - June 2008	To be confirmed with Talisman	Smith Bank, Moray Firth	3.14 km^2	TBC	Very small area sampled	None
2	The Crown Estate	Digital aerial	All	29 May 2009 - 06 August 2009	3	The MORL Zone including the MORL EDA and WDA.	TBC	100%	Limited species ID	Re-identification of images (if possible), analysis of spatial abundance (if possible)
3	BOWL	Boat	All	14 October 2009 - 22 September 2011	22	The BOWL site and buffer which includes part of the MORL EDA and WDA	379 km^2	16.9% (19.7%)	None	None
4	MORL	Boat	All	27 April 2010 - 15 March 2012	28	MORL EDA	653 km^2	28.4% (33.0%)	None	None
5	MORL	Boat & Vantage Point	Geese & Swans	2010 - 2011	Boat = 17 days, Vantage Point (VP) = 32 days	Boat = MORL EDA and buffer which includes parts of the WDA and BOWL sites. VP = Caithness & Moray coasts	n/a	n/a	None	None
6	MORL	Digital aerial	All	1 May 2011 - 20 July 2011	6	Wide area between Moray and Caithness coasts. Covers the MORL EDA, WDA, and BOWL sites.	4,333 km^2	100% (100%)	No availability bias correction	Availability bias correction for diving birds on the water

	Data owner	Survey type	Species	Survey timing	No. of surveys	Survey location	Survey extent	Coverage of WDA (+ 4 km buffer)	Limitations	Further analysis
7	MORL	GPS tracking	Fulmar, Guillemot, Razorbill, Kittiwake	May - July 2011	n/a	East Caithness Cliffs SPA	n/a	n/a	Only during chick rearing stage	None
8	MORL	GPS tracking	Great black-backed gull, herring gull	May - June 2014	n/a	East Caithness Cliffs SPA	n/a	n/a	Only during chick rearing stage	None
9	MSS	Digital aerial	All	2014 - 2015	TBC	Part of the WDA buffer may be covered	2,678 km^2	0% (0.02%)	None	Bird data not analysed. Area of interest is the overlap with survey 6 above.
10	BOWL	Digital aerial	All	30 May 2015 - 05 August 2015	6	The BOWL site and buffer which includes part of the MORL EDA and WDA	1,123 km^2	34.7% (32.7%)	None	None

The extent of the surveys, and the resulting datasets, are shown in Figure 3.6-15 below. These include one breeding season of digital aerial survey data across the WDA in 2011 and one in 2009, two boat-based survey datasets, each covering part of the WDA were collected between 2009 and 2012, and a further two aerial surveys during 2014 and 2015 covering large areas of the Moray Firth and overlapping with the WDA or a 4 km buffer of this region.

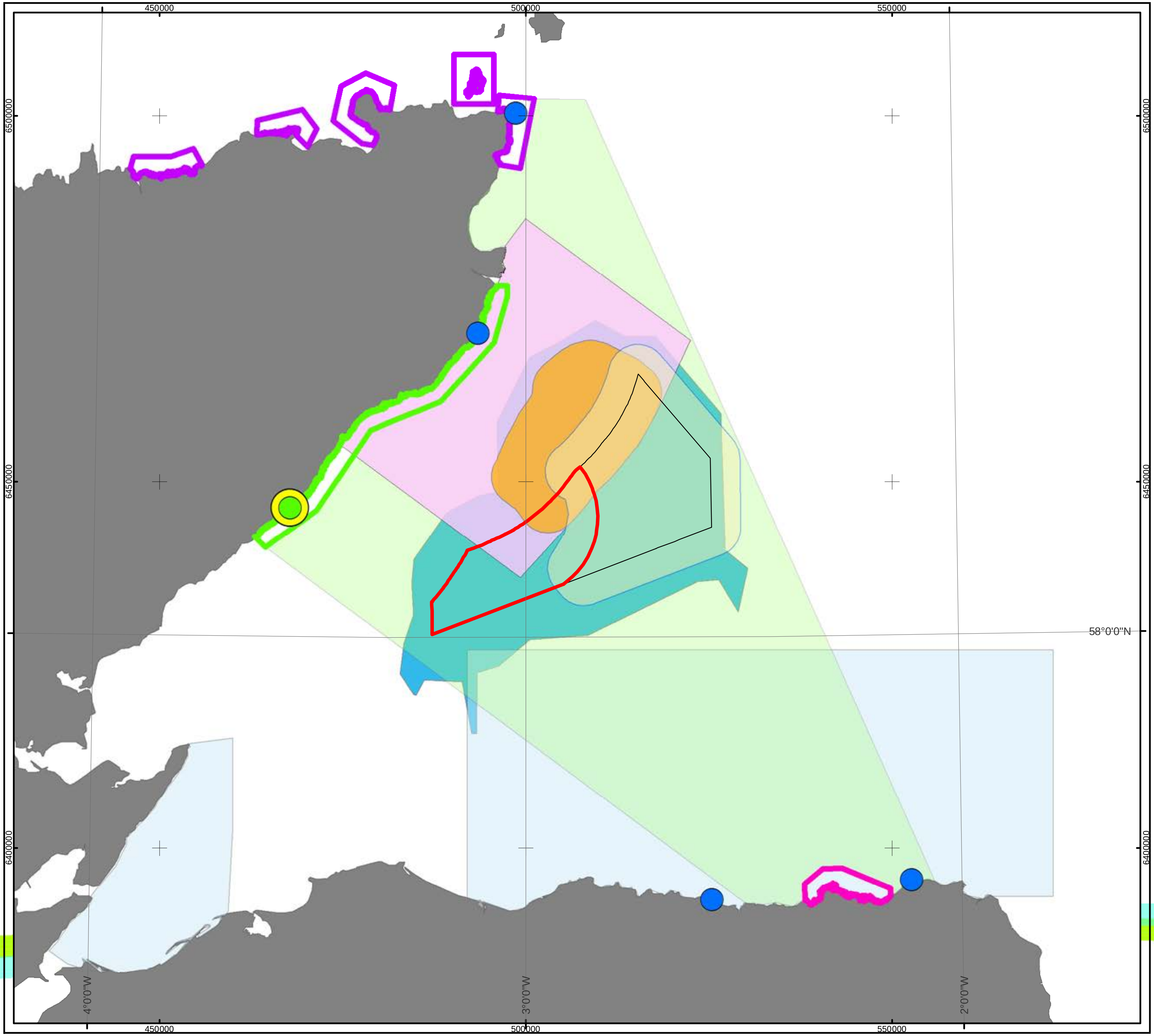
Analysis of the existing breeding season data from both digital aerial and boat-based surveys will be undertaken prior to completion of the 2016 - 2017 (April – March) aerial survey within the WDA and 4 km buffer as described above. This analysis will aim to determine which available environmental covariates can predict the abundance of key seabird species in the Moray Firth across the years of available data in order to investigate underlying causes of inter-annual variation. This analysis will aim to allow prediction of species abundance for a given year based on environmental data for that year.

This proposed approach will require analysing the data separately, depending on the platform used (i.e. boat-based data and digital aerial data). The two existing boat-based datasets provide data from the breeding seasons of 2010 and 2011 and are directly comparable allowing a simple combined analysis.

The three existing digital aerial datasets provide data from the breeding seasons of 2009, 2011, and 2015. The 2015 data used HiDef (digital video) technology and the data for diving birds have been corrected for availability bias but this bias is not available at present for the 2009 (HiDef digital video) and 2011 (APEM digital still) datasets. The data will be corrected to take into account availability bias if possible.

There is also a large overlap between the 2011 data and the 2014 /15 data collected by Marine Scotland in the southern Moray Firth. However, the footage collected in 2014/15 has not been analysed to extract bird information, so cannot be used at present.

It is proposed that these analyses will feed into the development of a final model which would aim to predict the abundance of key species in a given year using remotely sensed environmental covariates (e.g. sea surface temperature etc.) that are known to affect temporal abundance in the key species. A literature review of existing studies that have used environmental co-variates will be used to identify the likely data required and a further review of the availability and applicability of relevant remotely sensed data will be required.



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KEY

- 🟥 Western Development Area
- □ Eastern Development Area
- 🟪 North Caithness Cliffs
- 🟩 East Caithness Cliffs
- 🟪 Troup, Pennan and Lion's Head
- 🔵 Autumn 2010 and Spring 2011 Migration Surveys
- 🟢 2011 Tagging Surveys (F., KI, GU, RA)
- 🟡 2014 GBBG and HERGU Tagging
- 🟨 MORL Boat-based surveys 2010-2012 (EDA 4km boundary)
- 🟧 BOWL Boat-based Surveys 2009-2011
- 🟪 BOWL Pre-Construction Aerial Survey 2015
- 🟩 MORL 2011 Aerial Surveys
- ⬜ Marine Scotland Seabird Srategic Surveys 2014-2015
- 🟦 TCE 2009 Aerial Surveys (HiDef)

Horizontal Scale: 1:700,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: CR
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Date: 04/05/2016 Revision: A

REF: 8460001-PQW0010-MOR-MAP-041

Figure 3.6-15
Areas of Existing Datasets
Moray Firth

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It is currently proposed that a stepwise process is used to assess the key species. This process would limit the analysis to one or two species initially. The selection of those species would be based on those species known to occur in the WDA and that may be sensitive to offshore wind farm development. Additionally, species where there is published information on the effects of environmental co-variates on species distribution and abundance will be initially selected. The analysis would then be expanded to the other key species identified in the Moray Firth.

The final aim of this modelling would be to predict the inter-annual variation in abundance of the key seabird species in the WDA so that impact assessments for both EIA and HRA are properly informed. In the past it has been typical for two seasons of survey work to be used as a means to assess the inter-annual variation in seabird abundances. The approach described here aims to replicate this and improve upon it by exploring the underlying drivers of inter-annual variation in seabird abundance. Modelling could then predict what the potential variation across more than two years is likely to be.

Based on the results from the assessments of the MORL EDA and BOWL projects it is predicted that the key species for the adjacent MORL WDA will be guillemot, razorbill, puffin, gannet, kittiwake, herring gull and great black-backed gull. It is intended that modelling of inter-annual variation in abundance is limited to these key species, though as the analysis progresses some species may be removed or added to the modelling should the data support this.

In addition, and based on the MORL EDA and BOWL assessments, it is predicted that the breeding season will be the key season when assessing potential effects from the development of the WDA. The core period of the breeding season is May to July for most of the key species, though it is slightly longer for gannet. While most of the key species begin breeding in April and are dispersing from colonies in August, it is important to note that these are also important months for migration of these species. In addition, the presence of birds on migration in the Moray Firth may affect the ability of models to robustly predict inter-annual variation of breeding birds using the WDA. It is expected at this stage that the key bird abundance data for modelling inter-annual variation will be from May, June and July, which is also the period with the most available data.

3.6.6 *Cumulative and In-combination Effects*

There is foreseeable potential for the extent or magnitude of any effects identified in Section 3.6.3 above to be cumulatively increased by the simultaneous presence of other existing or proposed activities or developments. The extent to which these cumulative effects may arise will depend upon the design and extent of the infrastructure or the frequency and intensity of the activities.

As discussed in Section 1.3.2.6 above, the method for cumulative impact assessment will be carried out in accordance with the methods outlined within the MFOWDG discussion document 'Moray Firth Offshore Wind Developers Group Cumulative Impact Assessment Discussion Document' (MORL, 2012) unless otherwise agreed with MS-LOT and appropriate stakeholders. This document has been included as Annex 1 to this Scoping Report.

3.6.7 *Potential Mitigation Measures*

If in light of the conclusions of the EIA, potential mitigation measures are required, these will be determined following the production of the impact assessments and consultation with consenting authorities and appropriate stakeholders.

It is highlighted that mitigation put forward for the MORL EDA (MORL, 2012), included designated vessel routes (wind farm vessel corridors) during construction and operation to reduce potential disturbance effects during construction and operation.

3.6.8 *Habitats Regulations Appraisal*

As discussed in Section 3.2 above there are a large number of SPAs in close proximity to the WDA and therefore effects on the qualifying features may affect the integrity of related SPAs. This will require the WDA to undergo a Habitats Regulations Appraisal (see Section 3.2.1 above).

Identification of the SPAs likely to be affected will be carried out in consultation with SNH, JNCC, MSS and MS-LOT. Potential SPAs that may be included are listed in Table 3.2-1 above.

For the SPAs identified as relevant for assessment, the effects on the relevant bird qualifying species will be assessed (taking account of their conservation objectives) using the following criteria:

- Changes in the distribution or extent of the habitats supporting the species;
- Changes in the structure, function and supporting processes of habitats supporting the species;
- Significant disturbance to the qualifying species;
- Changes in the distribution of the species within the site; and
- The species being maintained as a viable component of the site in the long term, and therefore the integrity of the site.

Apportioning of estimated effects to SPAs will follow best practice guidance and following agreement of the detailed methodology with key stakeholders including SNH, JNCC, MSS and MS-LOT. It is noted that Marine Scotland is currently carrying out a research project titled "*Attributing Seabirds at Sea to Appropriate Breeding Colonies and Populations*" expected to be completed in Spring 2017. If available any relevant results from this study will be considered in the assessment.

4 Human Environment

4.1 Introduction

This section presents the main characteristics of the offshore physical environment for the WDA. The following topics are covered:

- Commercial Fisheries;
- Shipping and Navigation;
- Military and Civil Aviation;
- Sescape, Landscape and Visual Receptors;
- Archaeology and Cultural Heritage;
- Socio-economics; and
- Other Human Activities.

In each topic the relevant baseline characteristics, identified potential effects from construction, operation and decommissioning of the WDA and the proposed approach for the EIA are set out. Relevant datasets and specific guidance have been listed where appropriate.

4.2 Commercial Fisheries

4.2.1 Baseline Characteristics

This section describes the Commercial Fisheries baseline environment and potential effects associated with the WDA. Information on the WDA baseline characteristics have been derived mostly from the MORL ES 2012. The Commercial Fisheries ES Chapter and Technical Appendices can be accessed via the following links – Chapter 5.1 Commercial Fisheries and Technical Appendix 5.1A Commercial Fisheries. Table 4 2 -1 below lists the proposed datasets that will inform the assessment.

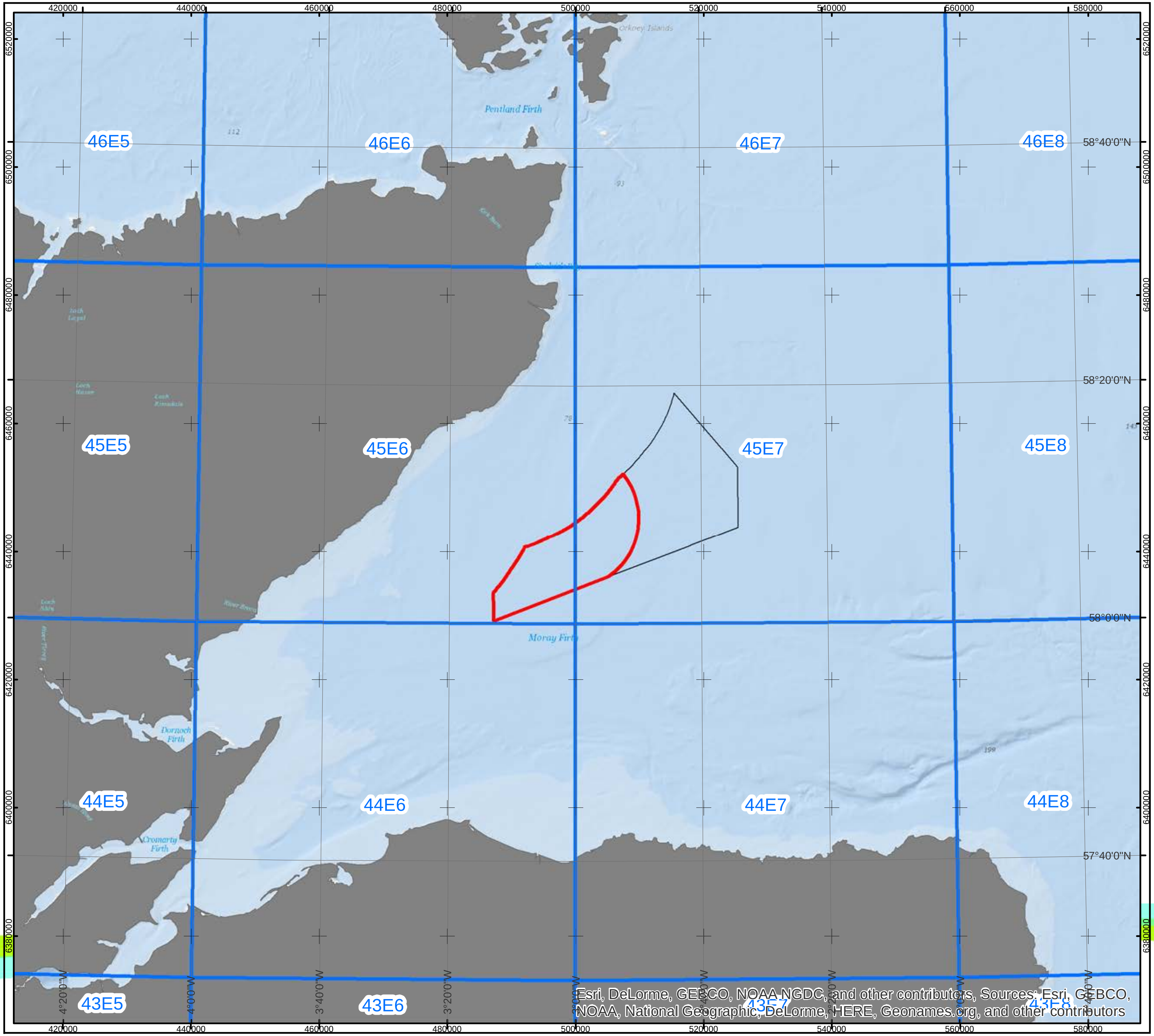
Table 4.2-1 Datasets for the Commercial Fisheries EIA

Dataset	Coverage	Date
International Council for the Exploration of the Sea (ICES) publications	UK	n/a
MMO landings data by ICES rectangle	UK	TBC
MSS VMS Amalgamated Fishing Intensity Layers	Scotland	2009 – 2013
ScotMap Inshore Fisheries Mapping in Scotland	Scotland	2007-2011
Marine Scotland Science Fish and Shellfish Stocks 2015 Edition	Scotland	2015

It is proposed that the guidance and published work set out in Section 4.2.5 below will inform the Commercial Fisheries assessment.

The description of the fisheries baseline provided below is based primarily upon fisheries data (MMO Fisheries Statistics, 2000-2009) collected for all commercial fishing vessels by ICES rectangles, and a dataset produced by MSS showing the distribution of commercial fishing landings from vessels exceeding 15 m in length, by weight and value.

ICES statistical rectangles are currently the smallest area of statistical units used for the collation of fisheries data. Rectangle boundaries align to 1° longitude and 30' latitude and for the most part have sea areas equating to approximately 900 nm. The WDA is located within ICES rectangles 45E7 and 45E6 (Figure 4.2-1 below). The very large sea area which these rectangles comprise and the potential for discrete, small-scale fisheries to occur within smaller areas within these rectangles is noted. Additionally, rectangle 45E6 also covers the coastal zone, which is targeted by different fishery gear types compared to the offshore area of the Smith Bank, upon which the WDA is located. Figure 3.4-4 above shows the species caught in each ICES rectangle.



Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors, Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, HERE, Geonames.org, and other contributors

edp renewables

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KEY

🟦 ICES Rectangles
🟥 Western Development Area
☐ Eastern Development Area

Horizontal Scale: 1:800,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: CR
Approved: SP

Date: 26/04/2016	Revision: A

REF: 8460001-PQW0010-MOR-MAP-033

Figure 4.2-1
Study Area and
ICES Rectangles

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All EU fishing vessels over 15 m in length are required to be satellite monitored (Vessel Monitoring System (VMS)) and their positions recorded on a 2 hourly basis. The MSS dataset links VMS data to landings data. Vessels under 15 m do not currently require to be monitored and as a result the activity of this fleet may not be represented in this dataset.

Scallops account for over half of the landings, by value, in offshore rectangle 45E7, and Nephrops and demersal fish species (haddock and monkfish principally) comprise a third of the landings by value. For ICES rectangle 45E6, as stated above the data is likely to be skewed by the presence of the coastal zone, however the data from 2000 -2009 do suggest that king scallops form a significant proportion of the commercial catch from the WDA area and haddock are also likely to be a key commercial species.

Squid are fished throughout the Moray Firth, however they are a sporadic species and landings have fluctuated considerably over the past ten years. As a result, it is considered that squid fishing grounds can occur anywhere within the Moray Firth. A high proportion of vessels targeting Nephrops will seasonally switch their gear to target squid when Nephrops stocks are low or quota is restricted. In addition to these vessels, there are also visiting vessels based at home ports outside the Moray Firth which will seasonally target squid in the area when they are present. The majority of squid landings are recorded between July and November.

Scallops are targeted by vessels towing toothed dredges attached to beams towed over the seabed. Nephrops are a burrowing shellfish targeted by both demersal trawlers and potting (creel) vessels. The principal methods for targeting demersal species such as haddock and monkfish are demersal trawlers and Scottish seines (flydraggers).

The scallop fishery is cyclical and grounds are often left to recover from intensive fishing periods while the fleet targets grounds elsewhere. The Nephrops fishery is concentrated in muddier substrates in the southern half of the Moray Firth, primarily to the south of the WDA, and is the most valuable fishery in the Moray Firth.

There are relatively very low recorded landings values of pelagic species in the Moray Firth, although there is a seasonal mackerel fishery targeted by inshore vessels. Analysis of fishing effort by vessel category (2000 - 2009) shows that the large majority of fishing effort within offshore rectangle 45E7 is undertaken by vessels greater than 15 m in length.

As a result of limitations upon availability of data regarding foreign vessel activity in UK waters, consultation and liaison with fishing interests active in the region will be required to establish the full extent of foreign vessel activity in the area. However, preliminary assessment of obtained data sets (over-flight sightings, MMO/Marine Scotland) shows there to be very little recorded activity of foreign vessels within the Moray Firth in the period 2000 – 2009.

4.2.2 Data Gaps

Although there was a good understanding of the baseline at the time of publishing the MORL ES 2012, the baseline will be updated through analysis of statistics relating to the ICES rectangle and MORL will undertake consultation with the fishing industry throughout the EIA process in order to make an assessment of the potential effects upon commercial fisheries.

4.2.3 Potential Effects

4.2.3.1 Summary of Potential Effects

Potential Effect	**Construction**	**Operation**	**Decommissioning**	**Scoped Out**
Adverse effects to commercial fish and shellfish populations (indirect effect upon commercial fishing activities)	✓	✓	✓	×
Adverse effects on recreational fish populations (indirect effect for recreational fishing activities)	✓	✓	✓	×
Temporary or complete loss or restricted access to traditional fishing grounds	✓	✓	✓	×
Safety issues for fishing vessels	✓	✓	✓	×
Increased steaming times to fishing grounds	✓	×	✓	×
Displacement of fishing vessels into other areas	✓	✓	✓	×
Interference with fishing activities	✓	✓	✓	×
Obstacles on the seabed post construction	×	✓	✓	×

Whilst a specific assessment will be carried out in relation to the WDA, given the proximity of the MORL EDA and WDA and the potential for similarities in relation to potential effects, the findings of the MORL EDA Commercial Fisheries assessment have been included below for context.

4.2.3.2 Potential Effects During the Construction Phase

Adverse effects to commercial fish and shellfish populations (indirect effect upon commercial fishing activities)

There is the potential for wind farm development to cause adverse effects to fish and shellfish populations of commercial importance, and hence result in changes to behaviour or a decline in species abundance, which may indirectly affect the productivity of the fishery. This is an indirect effect which will be assessed as a direct effect as part of the fish and shellfish ecology impact assessment (see Section 3.4 above) and as an indirect effect within the commercial fisheries impact assessment.

It is highlighted that the assessments for the MORL EDA predicted minor effects with mitigation upon commercial fish and shellfish populations during construction of the MORL EDA. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Adverse effects on recreational fish populations (indirect effect for recreational fishing activities)

There is not considered to be regular or directed recreational fishing activity occurring within the boundary of the WDA. It is, however, recognised that there may be effects upon migrating fish species such as salmon and sea trout, which have significant socio-economic importance as recreational fish species and this will be assessed within the commercial fisheries assessment for the WDA EIA.

It is highlighted that the assessments for the MORL EDA predicted minor-moderate effects on recreational fish populations during the construction phase. It is also worth noting that the impact assessment on these species took a precautionary approach, where conservative assumptions were applied as a result of the uncertainty surrounding currently available information on the use that salmon and sea trout may make of the areas during the construction phase. To improve the knowledge base on salmon population ecology and migratory movements, BOWL is scheduled to undertake a salmon smolt tagging study at Spey Bay this year and MORL is due to follow this up with further studies prior to construction of the MORL EDA. As well as contributing to the National Research and Monitoring Strategy for Diadromous Fish (NRMSDF) (http://www.gov.scot/Topics/marine/marineenergy/Research/NatStrat), led by MSS, this research along with the other work being undertaken by the NRMSDF will inform the impact assessment for the WDA.

Temporary loss or restricted access to traditional fishing grounds

The principal aspects of the construction phase considered to potentially cause complete loss or restricted access to fishing grounds are:

- Exclusion zones around construction activities; and
- Installed offshore infrastructure in addition to construction exclusion zones.

Safety zones of 500 m are expected to be imposed around construction works, from which all non-construction associated vessels would be excluded.

Infrastructure already partially or completely installed on the seabed in addition to ongoing construction works could further restrict access to fishing grounds.

It is highlighted that the assessments for the MORL EDA predicted moderate effects on the scallop fishery and minor effects on the whitefish fishery. In order to reduce these effects, MORL agreed a draft Commercial Fisheries Mitigation Strategy with the Scottish Fishermen's Federation (SFF) (see Section 4.2.7 below) and established the Moray Firth Commercial Fisheries Working Group to discuss concerns and mitigation measures.

Safety issues for fishing vessels

In line with standard practice, it is expected that construction safety zones of 500 m will be in place around offshore construction activities, from which all vessels, including fishing vessels, will be excluded. Infrastructure that is not fully constructed will be marked in consultation with the Northern Lighthouse Board and it is likely that a safety zone of 50 m will be put in place around it.

Risks to fishing vessels would only occur if infringements of these safety zones occurred. It should also be recognised that in line with standard maritime practice, the ultimate responsibility with regards to safety lies with the master of a vessel.

It is highlighted that the assessments for the MORL EDA determined that, with safety zones in place, the safety issues posed would be within acceptable limits.

Increased steaming times to fishing grounds

The implementation of safety exclusion zones during the construction phase could result in some short-term increases in steaming distances and times, and therefore higher operational costs for fishing vessels.

It is highlighted that the assessments for the MORL EDA predicted minor effects of increased steaming times to fishing grounds on all fisheries during the construction phase. In order to reduce these effects, MORL agreed a draft Commercial Fisheries Mitigation Strategy with the SFF (see Section 4.2.7 below) and established the Moray Firth Commercial Fisheries Working Group to discuss and address ongoing concerns and to share information on the construction plan in order to minimise the impacts.

Displacement of fishing vessels into other areas

During the development of the MORL EDA, concerns were raised during consultation with fishermen and their representatives that any loss or restricted access to fishing grounds as a result of the wind farm development could result in increased competition for grounds outside of the site. This could result in either conflict between vessels competing for the same resource, or between different fishing methods (i.e. static and towed gear vessels).

The extent of displacement will be a function of the temporary loss or restricted access to traditional fishing grounds during the construction phase.

It is highlighted that the assessments for the MORL EDA predicted moderate effects on the scallop fishery and minor effects on the whitefish fishery in terms of displacement of fishing vessels during the construction phase. In order to reduce these effects, MORL agreed a draft Commercial Fisheries Mitigation Strategy with the SFF (see Section 4.2.7 below) and established the Moray Firth Commercial Fisheries Working Group to discuss concerns and mitigation measures.

Interference with fishing activities

In addition to the above effects which could cause interference to fishing vessels, an additional effect to be considered is the potential for navigational conflicts arising between fishing vessels and construction vessels transiting to and from the site. This could include towed gear vessels being required to alter towing direction and the fouling of static gear markers, buoys and dhans (marker flags), although there is no static gear fishing within the WDA itself. As a result, this interference has the potential to affect fishing vessels operating in the regional area.

It is highlighted that the assessments for the MORL EDA predicted minor effects on all fisheries in terms of interference during the construction phase of the wind farms.

4.2.3.3 Potential Effects During the Operational Phase

Adverse effects to commercial fish and shellfish populations (indirect effect upon commercial fishing activities)

There is the potential for wind farm development to cause adverse effects to fish and shellfish populations of commercial importance, and hence result in changes to behaviour or a decline in species abundance, which may indirectly affect the productivity of the fishery. Possible effects during the operational phase include loss of habitat, introduction of new habitat, electro-magnetic fields (EMF) and operational nosie. This is an indirect effect which will be assessed as a direct effect as part of the fish and shellfish ecology impact assessment (see Section 3.4 above) and as an indirect effect within the commercial fisheries impact assessment.

It is highlighted that the assessments for the MORL EDA predicted minor effects on all identified fish populations during the operational phase. Since the direct effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Adverse effects on recreational fish populations (indirect effect upon commercial fishing activities)

There is not considered to be regular or directed recreational fishing activity occurring within the boundary of the WDA. It is, however, recognised that there may be effects upon migrating fish species such as salmon and sea trout, which have significant socio-economic importance as recreational fish species and this will be assessed.

There is the possibility that a recreational fishery may develop within the WDA during the operational phase, depending upon available recreational fish populations. It is however recognised that there is currently little evidence for such an activity developing within existing wind farms.

It is highlighted that the assessments for the MORL EDA predicted minor effects on recreational fish species during the operational phase of the MORL EDA. Since direct effects were considered to be significant within the MORL ES 2012 if they were above minor significance, the effects listed above were not considered to be significant effects.

Temporary or complete loss or restricted access to traditional fishing grounds

Existing legislation does not currently prohibit fishing from occurring within operational wind farm sites, though it is possible that MORL may apply for 50 m safety zones around infrastructure such as turbines and met masts. It is however noted that individual skippers, particularly those operating bottom towed gear, may consider it unsafe to continue fishing within the operational WDA because of the presence of infrastructure, which would result in a complete loss of area from within the WDA for these vessels.

It is highlighted that the assessments for the MORL EDA predicted minor effects on the whitefish fishery and moderate effects on the scallop fishery. In order to reduce these effects, MORL agreed a draft Commercial Fisheries Mitigation Strategy with the SFF (see Section 4.2.7 below) and established the Moray Firth Commercial Fisheries Working Group to discuss and address ongoing concerns.

Included within the draft Commercial Fisheries Mitigation Strategy is the development of scallop dredge gear modification trials. Since obtaining consent for the MORL EDA, MORL has appointed Bangor University to develop trial methodology. This has been finalised through consultation with the SFF, TCE, MSS and key scallop industry stakeholders.

Safety issues for fishing vessels

MORL may apply for safety zones of 50 m around infrastructure. Cables will be buried wherever possible and, upon consultation with Marine Scotland, protected where sufficient burial cannot be achieved. Safety concerns will be fully explored through consultation with the industry and measures taken to address these to ensure the perceived risks from the wind farm are minimised.

It is highlighted that the assessments for the MORL EDA determined safety issues for fishing vessels would be within acceptable limits during the operational phase.

Displacement of fishing vessels into other areas

The fisheries identified within the WDA are limited in the grounds they are able to target elsewhere in the regional area, principally by the availability of target species and their habitat requirements, and for which fishing areas in the regional area have been defined.

It is highlighted that the assessments for the MORL EDA predicted minor effects on the whitefish fishery and moderate effects on the scallop fishery. In order to reduce these effects, MORL agreed a draft Commercial Fisheries Mitigation Strategy with the SFF (see Section 4.2.7 below) and established the Moray Firth Commercial Fisheries Working Group to discuss and address ongoing concerns.

Included within the draft Commercial Fisheries Mitigation Strategy is the development of scallop dredge gear modification trials. Since obtaining consent for the MORL EDA, MORL appointed Bangor University to develop trial methodology. This has been finalised through consultation with the SFF, TCE, MSS and key scallop industry stakeholders.

Interference with fishing activities

In addition to the above effects which could cause interference to fishing vessels, an additional effect to be considered is the potential for navigational conflicts arising between fishing vessels and operations and maintenance vessels transiting to and from site. This could include towed gear vessels being required to alter towing direction and the fouling of static gear markers, buoys and dhans (marker flags), although there is no static gear fishing within the WDA itself. As a result, this interference has the potential to affect fishing vessels operating in the regional area.

It is highlighted that the assessments for the MORL EDA predicted minor effects on all fisheries in terms of interference with fishing activities during the operational phase of the MORL EDA. In order to reduce these effects, MORL agreed a draft Commercial Fisheries Mitigation Strategy with the SFF (see Section 4.2.7 below) and established the Moray Firth Commercial Fisheries Working Group to discuss and address ongoing concerns.

Obstacles on the seabed post construction

There is the potential for obstacles to be left on the seabed post construction, which could result in damage to or loss of fishing gear as well as representing a safety hazard. Offshore works such as construction vessels' anchoring, jack up legs or cable trenching can produce seabed obstructions which can cause fishing net fastenings and damage to fishing gear.

Offshore policy (IMO, 1996) prohibits the discarding of objects or waste at sea. The reporting and recovery of any accidentally dropped object is also required. The potential effects will be fully assessed in the ES.

It is highlighted that the assessments for the MORL EDA determined that, through standard industry practice, any potential risk posed from obstacles on the seabed post-construction would be within acceptable limits.

4.2.3.4 Potential Effects During the Decommissioning Phase

At this stage, decommissioning effects are envisaged to be similar to those described for the construction phase.

4.2.4 Approach to EIA

4.2.4.1 Construction Phase

Potential Effect	**Adverse effects on commercially exploited species,** **Adverse effects on recreationally exploited species,** **Interference with fishing activities,** **Restricted or temporary loss of access to fishing ground,** **Displacement of fisheries, and** **Increased steaming times to fishing grounds**
Study / Survey Proposed	To determine the potential for effects as listed above, the following studies will be undertaken: Description of fisheries in the area; Assessment of landings data; and Assessment of effort data.
EIA Methodology	In the case of each effect, the assessment will take account of: The spatial extent of effect; The duration of effect; The scale of effect; Recoverability of the receptor; and Importance of the receptor. Best practice at the time of assessment will be used together with previous experience gained from the MORL EDA EIAs.

Potential Effect	**Safety issues for fishing vessels and associated fishing activities**
Study / Survey Proposed	To determine the potential for effects to navigational safety, the following study will be undertaken: Navigational risk assessment.
EIA Methodology	A navigational risk assessment will assess the risk associated with ship to ship collision, vessel grounding, collision with wind turbine array infrastructure and the potential effect on communication systems. Best practice at the time of assessment will be used together with previous experience gained from the MORL EDA EIAs.

4.2.4.2 Operation Phase

Potential Effect	**Adverse effects on commercially exploited species,** **Adverse effects on recreationally exploited species,** **Interference with fishing activities,** **Restricted or temporary loss of access to fishing ground,** **Displacement of fisheries, and** **Safety issues for fishing vessels and associated fishing activities**
Study / Survey Proposed	As described above (4.2.4.1 Construction Phase)
EIA Methodology	As described above (4.2.4.1 Construction Phase)

Potential Effect	**Presence of seabed obstacles**
Study / Survey Proposed	To determine the potential for effects to gear safety arising from the operation of the wind farm, the following survey will be undertaken: Side-scan swathe bathymetry pre and post construction.
EIA Methodology	The baseline character of the seabed features will be determined during the EIA stage to understand whether there are any current hazards to fishing gear safety. It is intended that this baseline will be compared to post-construction surveys to identify any hazards to gear safety associated with the construction of the proposed wind farm.

4.2.5 Site Specific Survey Methodology

The following references provide best practice guidance for use in assessing effects upon commercial fisheries:

- BWEA (2002). Best Practice Guidelines for Consultation for Offshore Renewable Developers.
- Cefas (2004). Guidance note for Environmental Impact Assessment in respect of FEPA and CPA requirements, version 2 – June 2004.

- BERR (2008). Fishing Liaison with offshore wind and wet renewables group (FLOWW) recommendations for fisheries liaison.
- OSPAR (2008). Guidance on Environmental Considerations for Offshore Wind Farm Development. Reference number: 2003-8.

To assist the assessment of potential effects of the proposed development upon commercial fisheries, consultation will be undertaken with the relevant national and local marine fisheries bodies and fishermen's associations and representatives.

4.2.6 Cumulative and In-combination Effects

There is foreseeable potential for the extent or magnitude of any effects identified in Section 4.2.3 above to be cumulatively increased by the simultaneous presence of other existing or proposed activities or developments. The extent to which these cumulative effects may arise will depend upon the design and extent of the infrastructure or the frequency and intensity of the activities.

As discussed in Section 1.3.2.6 above, the method for cumulative impact assessment will be carried out in accordance with the methods outlined within the MFOWDG discussion document 'Moray Firth Offshore Wind Developers Group Cumulative Impact Assessment Discussion Document' (MORL, 2012) unless otherwise agreed with MS-LOT and appropriate stakeholders. This document has been included as Annex 1 to this Scoping Report.

4.2.7 Potential Mitigation Measures

If in light of the conclusions of the EIA, potential mitigation measures are required, these will be determined following the production of the impact assessments and consultation with consenting authorities and appropriate stakeholders.

It is highlighted that mitigation put forward for the the MORL EDA offshore wind farms (MORL, 2012), included:

- Construction Safety Zones and marking of infrastructure;
- Construction management plan;
- Cable burial and/or protection;
- Overtrawlability surveys;
- Establishment of a Moray Firth Commercial Fisheries Working Group;
- Fisheries liaison officer; and
- Guard vessels.

In addition to this, a Commercial Fisheries Mitigation Strategy has been drafted by MORL in consultation with the SFF which incorporates many of the above mitigation measures as well as a commitment to investigate other mitigation options which may arise such as the scallop dredge gear trials, as discussed above. This will be agreed and finalised prior to construction of the MORL EDA.

4.3 Shipping and Navigation

4.3.1 *Baseline Characteristics*

This section describes the Shipping and Navigation baseline environment and potential effects associated with the WDA. Information on the WDA baseline characteristics have been derived mostly from the MORL ES 2012. The Shipping and Navigation ES Chapter and Technical Appendices can be accessed via the following links - Chapter 5.2 Shipping and Navigation and Technical Appendix 5.2 A Hazard Log, Technical Appendix 5.2 B Consequences Assessment, Technical Appendix 5.2 C MCA MGN 371 Checklist and 5.2 D Navigational Risk Assessment (Wind Farm Sites). Table 4.3-1 below lists the proposed datasets that will inform the assessment.

Table 4.3-1 Datasets for the Shipping and Navigation EIA

Dataset	Coverage	Date
Automatic Identification Systems (AIS) and radar (non-AIS) survey data	MORL Zone	April – July 2010
AIS and radar (non-AIS) survey data	MORL Zone	November 2010 – January 2011
AIS survey data	MORL Zone	July & December 2013
Fishing surveillance satellite data	MORL Zone	2009
Over-flight data	MORL Zone	2005 – 2009
Maritime incident data from the Maritime Accident Investigation Branch (MAIB) and Royal National Lifeboat Institute (RNLI)	MORL Zone	2001 – 2010
UK Admirality Charts	Moray Firth	2016
Admirality Sailing Directions, North Coast of Scotland Pilot	Moray Firth	2015

The assessment will be undertaken in line with the following guidance:

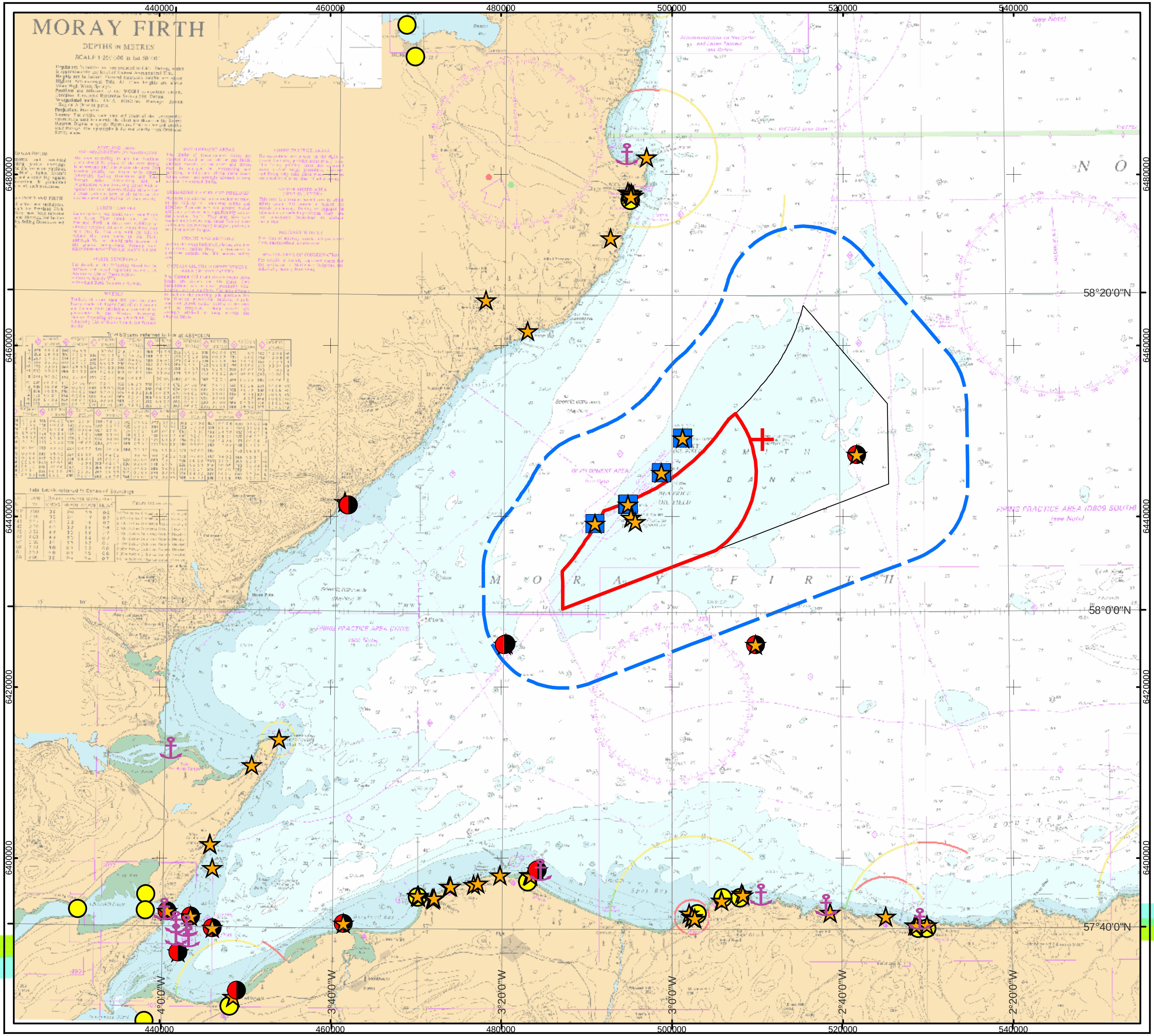
- Department of Environment and Climate Change (DECC, 2011b). Applying for Safety Zones Around Offshore Renewable Energy Installations.
- IALA Recommendation O-139 (IALA, 2008). The Marking of Man-Made Offshore Structures. IALA: Brussels.
- MCA Marine Guidance Notice 543 (MGN 543) (M+F) (MCA, 2016). Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – UK Navigationsal Practice, Safety and Emergency Response. MCA: Southampton.
- International Maritime Organisation (IMO, 2007). Guidelines for Formal Safety Assessment(FSA) (2007).
- Search and Rescue (SAR) Framework, MCA (MCA, 2002). – Chapter 1 MCA and Chapter 4 RNLI.

4.3.1.1 Navigational Features

Figure 4.3-1 below presents the relevant navigation features within the study area (MORL Zone plus a 5 nm buffer). There are no anchorages within the study area.

Offshore infrastructure is present in the Beatrice Oil Field and Jacky Platform. The oil platforms are located on the northern boundary of the WDA. The two Beatrice demonstrator offshore wind turbines are located within the WDA in the vicinity of the Beatrice oil platforms. MORL understands that decommissioning of the Beatrice Oil Field is currently anticipated to commence in 2017 and complete in 2021. It is also understood from Ithaca Energy that preparatory works for decommissioning of the Jacky Platform may commence in the summer of 2016 with removal of the platform expected to take place in 2017 subject to receiving DECC consent.

Consented, but as-yet unbuilt, offshore wind farms lie in the MORL EDA to the immediate east of the WDA and north-east (Beatrice Offshore Windfarm).



Moray Offshore Renewables Ltd

KEY

- ✚ MORL Offshore Meteorological Mast
- ⚓ Anchorage
- ◐ Buoy
- ★ Lights
- ○ Port
- ■ Platforms
- ▭ Western Development Area
- ▭ Eastern Development Area
- ⬚ Study Area

Horizontal Scale: 1:600.000 A4 Chart

0 10.000 20.000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: PM
Approved: SP

Date: 16/05/2016 Revision: D

REF: 8460001-PQW0010-MOR-MAP-030

Figure 4.3-1
Navigational Features
Moray Firth

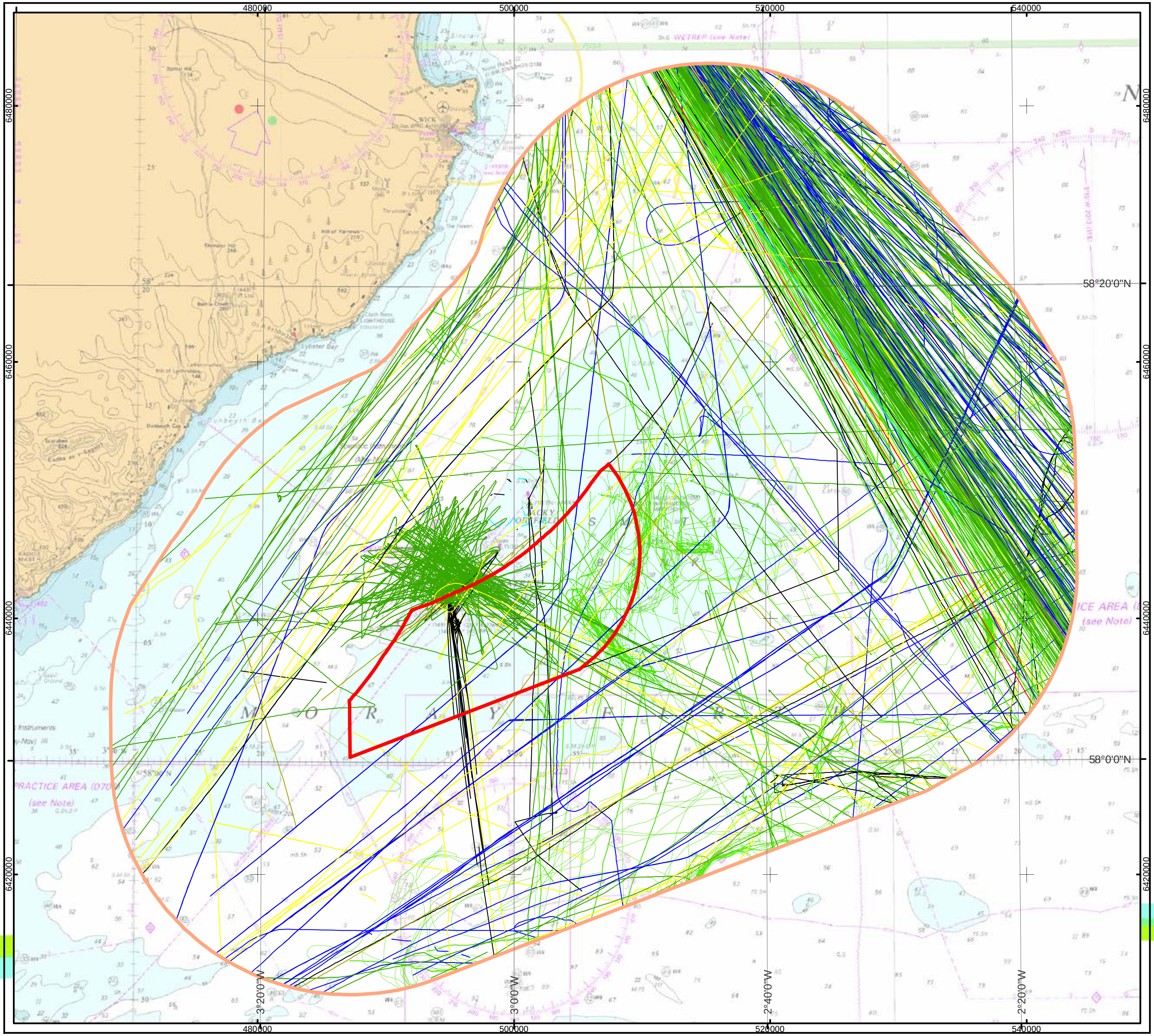
Moray Offshore
Renewables Ltd

4.3.1.2 Shipping surveys

Vessel-based AIS and radar track data on vessel movements have been gathered during previous MORL surveys to identify the vessel activity in the study area. Previous AIS and radar surveys undertaken by MORL are:

- AIS and radar (non-AIS) survey data, MORL Zone, April to July 2010 (from Gargano vessel, 38 days);
- AIS and radar (non-AIS) survey data, MORL Zone, November 2010 to January 2011(from Chartwell vessel, 31 days); and
- AIS survey data, MORL Zone, July (28 days) & December 2013 (28 days).

Overviews of the shipping data recorded in the surveys are presented in Figure 4.3-2 below. On average there were approximately 14 vessels per day passing within 10 nm of the MORL Zone during the winter and 18 vessels per day recorded during the summer.



edp renewables

Moray Offshore Renewables Ltd

KEY

Ship Type
(Gargano Survey, 38 days)

- Unspecified
- Fishing
- Military
- Dredger/Subsea
- Tug
- Passenger
- Cargo
- Tanker
- Other Ship
- Moray Firth Zone 10nm Buffer
- Western Development Area
- Eastern Development Area

Horizontal Scale: 1:400,000 A4 Chart

0 5,000 10,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: PM
Approved: SP

Date: 04/05/2016 Revision: A

REF: 8460001-PQW0010-MOR-MAP-031

Figure 4.3-2
Overview of Shipping
AIS Data across WDA

Moray Offshore
Renewables Ltd

4.3.1.3 Fishing activity

Higher fishing activity is recorded in the summer months. Fishing vessels were the second most common ship type within the wider area, after cargo vessels. However, cargo vessels are generally associated with the Pentland Firth route steaming either north-north-west or south-south-east, east of the MORL EDA and not directly within the WDA.

4.3.1.4 Recreational vessel activity

Fourteen recreation vessels were recorded passing through the study area during the survey, headed north-west or south-east (generally to and from Wick). Recreational vessels were mostly using cruising routes from Banff and Peterhead to Wick and Northern Isle marinas. No recreational vessels were recorded during winter months.

The study area is intersected by a 'medium use' cruising route passing from Wick to north eastern Scottish marinas including Whitehills and Peterhead.

4.3.1.5 Maritime incidents

A total of three incidents were reported to Marine Accident Investigation Branch (MAIB) within the study area between January 2001 to December 2010.

Data on RNLI lifeboat responses within the study area in the ten year period between 2001 and 2010 have been analysed. There were no incidents recorded within the study area over the 10 year period analysed.

4.3.1.6 Search and Rescue

The MORL Zone lies within the Scotland and Northern Ireland Search and Rescue (SAR) region with the nearest rescue coordination centre located at Marine Rescue Coordination Centre (MRCC) Aberdeen.

In the event of an emergency arising within or adjacent to the WDA, the first response will be from the developer / operator. If the initial emergency response is unsuccessful, search and rescue would be carried out by Royal National Lifeboat All-weather Life Boats (ALBs) (from either Wick or Buckie and / or SAR helicopter from Inverness.

4.3.2 Data Gaps

Baseline data will be updated through AIS surveys from MORL's EDA meteorogical mast in the MORL EDA, from land or from MORL survey vessels. Desktop studies will also be undertaken to update the baseline data regarding maritime incidents etc within the study area.

4.3.3 Potential Effects

4.3.3.1 Summary of Potential Effects

Potential Effect	**Construction**	**Operation**	**Decommissioning**	**Scoped Out**
Disruption to commercial shipping	✓	✓	✓	×
Disruption to fishing vessels	✓	✓	✓	×
Disruption to recreation vessels	✓	✓	✓	×
Disruption to SAR operations	×	✓	×	×
Disruption to SAR helicopter operations	×	✓	×	×
Radar interference on marine equipment	×	✓	×	×

Whilst a specific assessment will be carried out in relation to the WDA, given the proximity of the MORL EDA and WDA and the potential for similarities in relation to potential effects, the findings of the MORL EDA Shipping and Navigation assessment have been included below for context.

4.3.3.2 Potential Effects During the Construction Phase

Disruption to commercial shipping

There will be an increased level of vessel activity within the WDA during the construction phase (including jack-ups / barges, mothership(s) and transfer vessels). Construction traffic and the presence of construction safety zones could lead to an increase in vessel-to-vessel encounters in the area from the baseline conditions.

It is highlighted that the assessments for the MORL EDA identified that potential effects on disruption to commercial shipping were negative, probable and of minor significance. The effects of the MORL EDA will be minimised through the implementation of industry standard risk control measures during the construction and operation of the MORL EDA. These mitigation measures will further serve to reduce the impact of the MORL EDA and ensure the development conforms to regular requirements and industry good practice.

Disruption to fishing vessels

Fishing vessels could be affected during the construction phase of the WDA as 500 m exclusion / safety zones are expected to be implemented during turbine installation. Construction traffic could also lead to an increase in vessel-to-vessel encounters in the area from the baseline conditions.

It is highlighted that the assessments for the MORL EDA identified that potential effects on disruption to fishing vesels were negative, probable and of minor significance. In order to reduce these effects, MORL agreed a draft Commercial Fisheries Mitigation Strategy with the SFF (see Section 4.2.7 above) and established the Moray Firth Commercial Fisheries Working Group to discuss and address ongoing concerns and to share information on the construction programme in order to minimise the effects.

Disruption to recreation vessels

There will be an increased level of vessel activity within the WDA during the construction phase (including jack-ups / barges, mothership(s) and transfer vessels). Construction traffic and the presence of construction safety zones could lead to an increase in vessel-to-vessel encounters in the area from the baseline conditions.

It is highlighted that the assessments for the MORL EDA identified that potential effects on disruption to recreation vessels were negative, probable and of minor significance. The effects of the MORL EDA will be minimised through the implementation of industry standard risk control measures during the construction and operation of the MORL EDA. These mitigation measures will further serve to reduce the impact of the MORL EDA and ensure the development conforms to regular requirements and industry good practice.

4.3.3.3 Potential Effects During the Operational Phase

Disruption to commercial shipping

The main effect on shipping during the operational phase is expected to be the displacement of ships on the route passing through the MORL Zone on approach / departure from Wick.

In addition, offshore vessels heading to the Beatrice and Jacky Platforms may need to route around the development which will comprise up to 90 turbines in a grid or diamond pattern with 1,050 by 1,200 m spacing between turbines, except around the perimeter where there may be reduced spacing between the turbines. MORL understands that decommissioning of the Beatrice Oil Field is currently anticipated to commence in 2017 and complete in 2021. It is also understood from Ithaca Energy that preparatory works for decommissioning of the Jacky Platform may commence in the summer of 2016 with removal of the platform expected to take place in 2017 subject to receiving DECC consent.

There is also a risk of vessel to wind farm structure collision.

It is highlighted that the assessments for the MORL EDA identified that potential effects on disruption to commercial shipping were negative, probable and of minor significance. The effects of the MORL EDA will be minimised through the implementation of industry standard risk control measures during the construction and operation of the MORL EDA. These mitigation measures will further serve to reduce the impact of the MORL EDA and ensure the development conforms to regular requirements and industry good practice.

Disruption to fishing vessels

During operation, the presence of the wind farm could affect steaming times to/from fishing grounds. However, it is noted that there is good prospect for fishing vessels to navigate within / between the turbines and the WDA, due to the smaller size of vessels and the spacing between turbines

There is also a risk of vessel to wind farm structure collision.

It is highlighted that the assessments for the MORL EDA identified that potential effects on disruption to commercial fishing were negative, probable and of minor significance. In order to reduce these effects, MORL agreed a draft Commercial Fisheries Mitigation Strategy with the SFF (see Section 4.2.7 above) and established the Moray Firth Commercial Fisheries Working Group to discuss and address ongoing concerns and to share information on the construction programme in order to minimise the effects.

Disruption to recreation vessels

The air clearance between turbine rotors and sea level conditions at Mean High Water Springs (MHWS) will not be less than 22 m, as recommended by the MCA. This minimises the risk of interaction between rotor blades and yacht masts. Vessels should be able to pass between turbines in suitable conditions (i.e. during good visibility and calm sea conditions), as well as being able to pass inshore and offshore of the wind farm areas.

There is also a risk of vessel to wind farm structure collision.

It is highlighted that the assessments for the MORL EDA identified that potential effects on disruption to recreation vessels were negative, probable and of minor significance. The effects of the MORL EDA will be minimised through the implementation of industry standard risk control measures during the construction and operation of the MORL EDA. These mitigation measures will further serve to reduce the impact of the MORL EDA and ensure the development conforms to regular requirements and industry good practice.

Disruption to SAR operations

A review of historical incidents indicated that the accident levels in the vicinity of the WDA have tended to be low. Therefore, given the relatively low level of incidents in the area it is considered unlikely that the operational phase of the WDA will exacerbate maritime safety risks in the area or affect SAR operations / access but it is possible that SAR operations could be affected by the presence of the turbines.

It is highlighted that the assessments for the MORL EDA identified that potential effects on disruption on SAR operations were negative, probable and of minor significance. The effects of the MORL EDA will be minimised through the implementation of industry standard risk control measures during the construction and operation of the MORL EDA. These mitigation measures will further serve to reduce the impact of the MORL EDA and ensure the development conforms to regular requirements and industry good practice.

Disruption to SAR helicopter operations

There is the potential for the operational phase of the WDA to affect SAR helicopters, including SAR helicopter access.

It is highlighted that the assessments for the MORL EDA identified that potential effects on disruption on SAR helicopter operations were negative, probable and of minor significance. The effects of the MORL EDA will be minimised through the implementation of industry standard risk control measures during the construction and operation of the MORL EDA. These mitigation measures will further serve to reduce the impact of the MORL EDA and ensure the development conforms to regular requirements and industry good practice.

Radar interference on marine equipment

Within a range of approximately 1.5 nm from wind turbine structures there is a risk of false returns, with a progressive increase in the impact of the effects on radar to about 500 m.

It is highlighted that the assessments for the MORL EDA identified that potential effects on radar interference were negative, probable and of minor significance. The effects of the MORL EDA will be minimised through the implementation of industry standard risk control measures during the construction and operation of the MORL EDA. These mitigation measures will further serve to reduce the impact of the MORL EDA and ensure the development conforms to regular requirements and industry good practice

4.3.3.4 Potential Effects During the Decommissioning Phase

At this stage, decommissioning effects are envisaged to be similar to those described for the constrction phase.

4.3.4 Approach to EIA

4.3.4.1 Construction Phase

Potential Effect	**Disruption to commercial, fishing and recreation vessels, and Inhibited SAR**
Study / Survey Proposed	To determine the potential for impacts on shipping, a vessel traffic survey of the area will be performed in line with MCA's Marine Guidance Note 543. This will be used as one of the inputs to the Marine Navigational Risk Assessment which will be carried out as per the recommended methodology outlined in the DECC publication Guidance on the Assessment of the Impact of Offshore Wind Farms: Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms.
EIA Methodology	The data collected during the vessel traffic survey of the area will be used in the assessment of the impacts listed above. The risk assessment will be carried out using a formal safety assessment process centred on a Hazard workshop and resulting Hazard register. An overview of the methodology to be applied is presented in Figure 4.3-3 below.

4.3.4.2 Operation Phase

Potential Effect	**Disruption to commercial, fishing and recreation vessels,** **Inhibited SAR, and** **Radar impacts on shipping**
Study / Survey Proposed	To determine the potential for impacts on shipping, a vessel traffic survey of the area will be performed in line with MCA's Marine Guidance Note 543. This will be used as one of the inputs to the Marine Navigational Risk Assessment which will be carried out as per the recommended methodology outlined in the DECC publication Guidance on the Assessment of the Impact of Offshore Wind Farms: Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms.
EIA Methodology	The data collected during the vessel traffic survey of the area will be used in the assessment of the impacts listed above. The risk assessment will be carried out using a formal safety assessment process centred on a Hazard workshop and resulting Hazard register. An overview of the methodology to be applied is presented in Figure 4.3-3 below.

4.3.5 Site Specific Survey Methodology

4.3.5.1 Best practice guidance

The assessment will be undertaken in line with the the relevant guidance listed under Section 4.3.1 above.

4.3.5.2 Vessel traffic surveys

A detailed site-specific assessment of the existing traffic will be performed in accordance with MGN 543. This will involve AIS carried out over different times of year to cover both seasonal and tidal variations. In addition to the surveys, further validation will be carried out through consultation with local harbour masters, Vessel Masters and Operators. This will ensure the best available data is used to assess the navigational impact of the site and subsequent decision making to minimise obstruction and risk to navigation.

4.3.5.3 Navigational Risk Assessment

A Navigational Risk Assessment will be prepared (see Figure 4.3-3 below) which will assess the:

1. Base case vessel activity without wind farm level of risk;
2. Base case vessel activity with wind farm level of risk;
3. Future case vessel activity without wind farm level of risk; and
4. Future case vessel activity with wind farm level of risk.

Some displacement effects on shipping and navigation may include but not be limited to:

- Additional voyage distances;
- An increase in vessel encounters and the creation of 'choke points'; and
- A reduction in the available depth and width of navigable water.

Navigation and collision avoidance impacts may arise from, for example:

- Structures hindering the view of navigational features and other vessels; and
- Interference with electronic navigation and communication equipment.

Published studies into effects on marine radio navigation and communications systems will be consulted (for example the 2007 BWEA report into effects on radar at Kentish Flats).

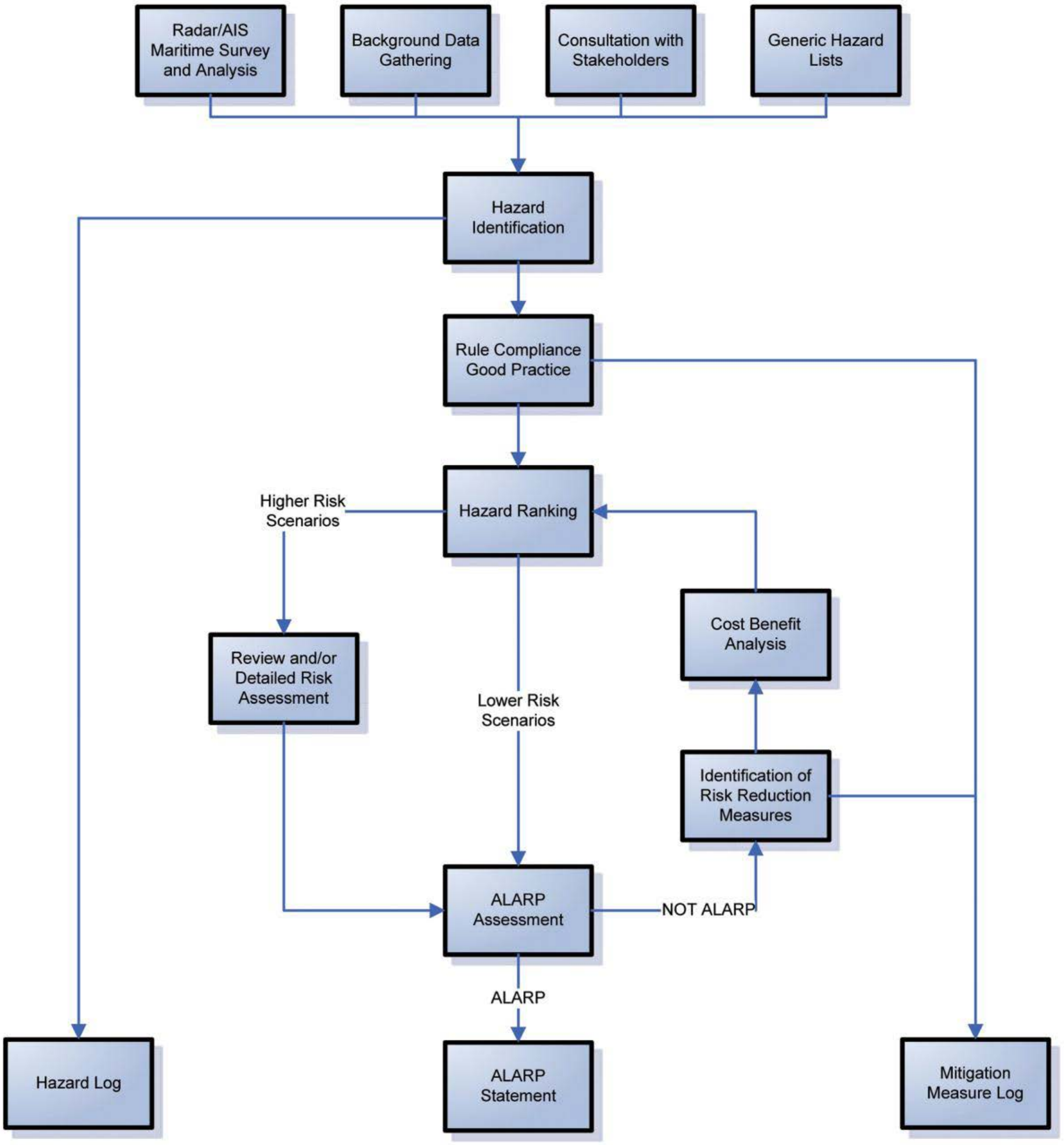


Figure 4.3-3 Navigational Risk Assessment methodology.

4.3.6 *Cumulative and In-combination Effects*

There is foreseeable potential for the extent or magnitude of any effects identified in Section 4.3.3 above to be cumulatively increased by the simultaneous presence of other existing or proposed activities or developments. The extent to which these cumulative effects may arise will depend upon the design and extent of the infrastructure or the frequency and intensity of the activities.

As discussed in Section 1.3.2.6 above, the method for cumulative impact assessment will be carried out in accordance with the methods outlined within the MFOWDG discussion document 'Moray Firth Offshore Wind Developers Group Cumulative Impact Assessment Discussion Document' (MORL, 2012) unless otherwise agreed with the consenting authorities and appropriate stakeholders. This document has been included as Annex 1 to this Scoping Report.

4.3.7 *Potential Mitigation Measures*

If in light of the conclusions of the EIA, potential mitigation measures are required, these will be determined following the production of the impact assessments and consultation with consenting authorities and appropriate stakeholders.

It is highlighted that mitigation put forward for the the MORL EDA offshore wind farms (MORL, 2012), included:

- Construction Safety Zones;
- Information promulgation;
- Fisheries liaison officer; and
- Guard vessels.

4.4 Military and Civil Aviation

4.4.1 *Baseline Characteristics*

This section describes the military and civil aviation interests relevant to the WDA assessment. Information on WDA baseline characteristics have been derived mostly from the MORL ES 2012. The Military and Civil Aviation ES Chapter and Technical Appendices can be accessed via the following links – Chapter 5.3 Military and Civil Aviation and Technical Appendix 5.3 A Initial Aviation Assessment, Technical Appendix 5.3 B Helicopter Impact Assessment and Technical Appendix 5.3 C Radar Propogation Modelling.

It is proposed that the following guidance and published work will inform the aviation assessment:

- CAA (2016). CAA Guidance CAP 764: Policy and Guidance on Wind Turbines; and
- MCA (2016). Marine Guidance Notice 543 (MGN 543) (M+F) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – UK Navigational Practice, Safety and Emergency Response.

In terms of military aviation, RAF Lossiemouth is located to the west of the town of Lossiemouth in Moray. RAF Kinloss is located further west of Lossiemouth and there is a Ministry of Defence (MOD) Primary Surveillance Radar located there. This is used to provide navigational services to aircraft inbound to and outbound from the airfield and to military aircraft operating over the Moray Firth.

Regarding civilian aviation, NERL operate a primary surveillance radar at Allanshill, west of Fraserburgh. This is used to support Civil Air Traffic Control (ATC) and en-route operations to helicopters and fixed wing aircraft operating to the north and north east of Aberdeen. Highland and Islands Airports Ltd (HIAL) also operate an airport and radar at Wick to the north-east of the WDA and at Inverness to the west of the WDA.

The WDA is situated in an area of Class G uncontrolled airspace which is established from the surface up to Flight level (FL) 195 (approximately 19,500 ft). Class C controlled airspace is established above FL195. Under this classification of airspace the following applies:

- Class G uncontrolled airspace - any aircraft can operate in this area of uncontrolled airspace without any mandatory requirement to be in communication with or receive a radar service from any Air Traffic Control (ATC) Unit. Pilots of aircraft operating under Visual Flight Rules (VFR) in Class G airspace are ultimately responsible for seeing and avoiding other aircraft and obstructions.

In the area of the WDA, the Class G uncontrolled airspace is sub-divided into areas with the following aviation stakeholder responsibility:

- RAF Lossiemouth ATC uses their Primary Surveillance Radar (PSR) to provide services to aircraft inbound to and outbound from the airfield, to military aircraft operating over the Moray Firth, including over the WDA. In addition, RAF Lossiemouth is responsible for navigational services to transitory civil and military aircraft operating within a 40 nm radius of the airfield, up to 9,500 ft, from Monday to Friday between 0900 and 1700 hrs;
- HMR X-Ray, which crosses the WDA, is used by helicopters transiting between Aberdeen, via Wick to the Atlantic Rim offshore installations west of the Shetland Islands. HMR X-Ray is established between 1,500 ft and FL 55 (approximately 5,500 ft). Navigational services for aircraft operating on this route are provided by Aberdeen Airport, using a radar feed of NERL Allanshill PSR, and RAF Lossiemouth when aircraft are operating at low altitudes due to better Lossiemouth coverage. These helicopters normally fly at altitudes which will be unaffected by the presence of wind turbines. However in some weather conditions they may wish to fly at less than 1,500 ft. Obstacle clearance from the turbines could then become an issue;
- Helicopters are used to access the Beatrice oil platforms. When weather conditions preclude visual flight, helicopters operating to and from these platforms carry out instrument approach procedures. Civil Aviation Authority (CAA) guidance CAP 764 recommends an obstacle-free zone of 6 nm around the platforms in order to protect these procedures. The WDA is within this 6 nm zone around the platforms;

- Advisory Route W4D follows the same route as HMR X-Ray between Aberdeen and Wick but extends from FL 55 up to FL 185. Advisory Routes provide a degree of protection to aircraft using them, but unlike fully controlled airspace, do not provide separation against all other aircraft. W4D is predominantly used by scheduled passenger services between Wick and Aberdeen Airports and by aircraft on transatlantic flights between the UK / Europe and North America; and
- Above 9,500 ft, the responsibility for the provision of navigation services lies with NERL and the military service providers based at the NERL Centre at Prestwick, Ayrshire.

In the Class C controlled airspace (i.e. above FL 195) all aircraft must be in receipt of an air traffic service from NERL or a separate authorised military service provider.

Temporary Reserved Area (TRA) 008B is established above the WDA from FL 195 up to FL 245. Promulgated activity within the TRA 008B includes air combat and training exercises and supersonic flight.

MOD Airspace Surveillance and Control Systems (ASACS) are located at Buchan PSR. This supports UK air defence operations and training. ASACS Units using radar data supplied from the Buchan PSR are responsible for navigation services and support to aircraft activity within TRA 008B during promulgated activity times.

D712D within the Northern Managed Danger Area (MDA) complex is established from FL 245 up to FL 660. Distinct areas within the Northern MDA are activated when required. Promulgated activity within the Northern MDA includes Air Combat and training exercises and supersonic flight. ASACS Units using radar data supplied from the Buchan Air Defence radar are responsible for navigation services and support to aircraft activity within the Northern MDA when active.

Outside the times that TRA 008B and the Northern MDA are active, NERL is responsible for the provision of navigation services to aircraft in transit above FL195 above the WDA.

It should also be noted that the CAA has approved a Transponder Mandatory Zone (TMZ) to be implemented over the BOWL and MORL EDA sites in two phases – the first phase will be implemented over the BOWL site prior to BOWL commencing operation (estimated to be 2018) and then over the MORL EDA prior to the MORL EDA commencing operation.

4.4.2 Data Gaps

To inform the EIA process, a full consultation will be undertaken with all stakeholders but, other than this, it is not proposed that any surveys are required other than a desk-based data collection exercise.

4.4.3 Potential Effects

4.4.3.1 Summary of Potential Effects

Potential Effect	**Construction**	**Operation**	**Decommissioning**	**Scoped Out**
Degradation of NERL Allanshill PSR	×	✓	×	×
Degradation of RAF Lossiemouth PSR	×	✓	×	×
Degradation of ASACS Buchan ADR	×	×	×	✓
Effects on operations at Wick Airport	×	✓	×	×
Effects on operation of HMR X-Ray	×	✓	×	×
Effects on operations at offshore installations	×	✓	×	×
Increase in minimum safe altitude	×	✓	×	×

Whilst a specific assessment will be carried out in relation to the WDA, given the proximity of the MORL EDA and WDA and the potential for similarities in relation to potential effects, the findings of the MORL EDA military and civil aviation assessment have been included below for context.

4.4.3.2 Potential Effects During the Operational Phase

The potential effects of wind turbines on aviation interests have been widely publicised and are restricted to the operation phase of wind farms. There are two dominant scenarios that lead to objection from aviation stakeholders:

- Physical obstruction: turbines can present a physical obstruction at or close to an aerodrome or other landing / take-off point; and
- Radar / air traffic services: turbine clutter appearing on radar display can affect the safe provision of air traffic services as it can mask unidentified aircraft from air traffic controllers and / or prevent them from accurately identifying aircraft under his control. In some cases, radar reflections from the turbines can affect the performance of the radar system itself.

Degradation of NERL Allanshill PSR

The NERL air traffic controller is responsible for maintaining typically 5 nm lateral separation between aircraft. Where line of sight to a PSR exists, turbines may appear as genuine aircraft targets and could mask genuine aircraft responses. The radar may also be de-sensitised by its clutter processing within the sector containing turbines meaning that real aircraft targets may disappear from radar. At an anticipated maximum height of 272 m (HAT) to blade tip, the WDA could cause clutter to be presented on radar displays. Effects were considered to be significant within the MORL ES 2012 if they were above negligible significance, due to the safety critical function of aviation interests. This was not considered to be a significant effect with mitigation in place.

Degradation of RAF Lossiemouth PSR

At a minimum distance of 31 km, the WDA is within the operational range of Lossiemouth PSR. At a maximum height of 272 m (HAT) to blade tip, the WDA will theoretically be detectable by the Lossiemouth PSR. This direct, permanent effect could hamper the operators' ability to distinguish actual aircraft returns from those created by the wind farms and degrade the safety and efficiency of the services being provided. Effects were considered to be significant within the MORL ES 2012 if they were above negligible significance due to the safety critical function of aviation interests. This effect was not considered to be a significant effect with mitigation in place.

Effects on operation of HMR X-Ray

The presence of turbines within 2 nm either side of the route of HMR X-Ray will have the potential to restrict operations below the routine operational altitudes when icing conditions exist. The ability of a helicopter to operate at the expected altitudes would be dependent upon the 0° isotherm (icing level). Effects were considered to be significant within the MORL ES 2012 if they were above negligible significance due to the safety critical function of aviation interests. This was not considered to be a significant effect with mitigation in place.

Effects on operations at offshore installations

Turbines could be considered as physical obstructions and infringe the minimum obstacle clearance criteria of 1,000 ft on helicopter approaches to the offshore oil platforms or to the operational BOWL or MORL EDA offshore wind farms. The minimum obstacle clearance dictates the height at which helicopters can transit in the region of the WDA and the height that instrument approaches to offshore platforms or wind farms commence.

Wind turbine development within 6 nm of offshore oil and gas installations or wind farms has the potential to affect Instrument Flight Procedures to such installations in poor weather conditions. Many helicopters operating in the Moray Firth region are fitted with airborne weather radar. This weather radar can be used to conduct an instrument approach to offshore platforms in poor visibility. The radar is designed to display weather phenomena, such as rain, as well as obstacles such as oil or gas platforms and wind turbines. There is potential for the volume of targets generated by wind turbines, platforms and weather, to hamper a flight crew's ability to correctly distinguish the location of the required destination platform. Furthermore during the approach to an installation, all radar contacts (including radar contacts that are turbines) have to be avoided laterally by at least 1 nm.

There are helidecks established on Beatrice platforms A, B and C. Whilst there is no permanently established helideck on the Jacky platform, there is the capability to establish one if required. MORL understands that decommissioning of the Beatrice Oil Field is currently anticipated to commence in 2017 and complete in 2021. It is also understood from Ithaca Energy that preparatory works for decommissioning of the Jacky Platform may commence in the summer of 2016 with removal of the platform expected to take place in 2017 subject to receiving DECC consent.

If helicopter access is required to the neighbouring operational BOWL and MORL EDA wind farms, the presence of the WDA may affect Instrument Flight Procedures to the wind farms. Effects on operations at oil installations were considered to be significant within the MORL ES 2012 if they were above negligible significance due to the safety critical function of aviation interests. This was not considered to be a significant effect with mitigation in place.

Increase in minimum safe altitude

The minimum safe altitude (MSA) for aircraft operations in Instrument Meteorological Conditions (IMC), essentially poor weather, in the Moray Firth region is 1,500 ft (457 m) above HAT. This allows for a minimum of 1,000 ft (305 m) clearance between aircraft and known en-route obstacles (the highest point of the Beatrice platform complex). The MSA dictates the height at which instrument approaches to offshore platforms commences and is therefore relevant to the HMR assessment and Helicopter Approaches Procedures to Offshore Platforms. The maximum tip height of proposed turbines of the WDA will be 272 m (893 ft). Therefore, the MSA in the area of the WDA will be required to be raised to 1,900 ft to ensure that a minimum of 1,000 ft vertical separation between the anticipated turbine tip height and aircraft is maintained. Effects were considered to be significant within the MORL ES 2012 if they were above negligible significance due to the safety critical function of aviation interests. This was not considered to be a significant effect with mitigation in place.

Effects on operations at Wick Airport

The north-east boundary of the WDA is located 16.5 nm south-west of Wick Airport. Within a 25 nm radius of Wick Airport, the Minimum Sector Altitude (the lowest altitude to which aircraft can safely descend while maintaining 1,000 ft vertical separation from all terrain and obstacles within the 25 nm radius) is 1,800 ft above mean sea level. Further descent below 1,800 ft is not authorised until the aircraft is established on the final approach track.

The maximum tip height of any turbines will be 272 m HAT (892.4ft). The current MSA of 1,800 ft may therefore require to be raised to 1,900 ft to ensure that a minimum of 1,000 ft vertical separation between the anticipated turbine height and aircraft is maintained. Effects were considered to be significant within the MORL ES 2012 if they were above negligible significance due to the safety critical function of aviation interests. This was not considered to be a significant effect with mitigation in place.

4.4.3.3 Potential Effects Scoped Out

Degradation of ASACS Buchan ADR

Turbines in coverage areas of Buchan ADR could shield the radar from genuine aircraft targets and / or hide genuine aircraft targets from the ASACS controller. These direct and permanent effects would affect the controller's ability to provide a safe service to aircraft in support of training exercises and to use the radar data to monitor the UK air picture for Air Defence purposes.

Based on experience gained through the MORL EDA (and given the minimum distance of 94 km), the WDA is not likely to be within the operational range of ASACS ADR located at Buchan and the turbines are unlikely to be detectable. Therefore these effects have been scoped out.

4.4.4 *Approach to EIA*

4.4.4.1 Operation Phase

Potential Effect	**Degradation of NERL Allanshill PSR; and** **Degradation of RAF Lossiemouth PSR**
Study / Survey Proposed	To determine the potential for effects upon radar systems and issues associated with obstacle clearance, the following studies will be undertaken: Radar modelling Air traffic/airspace operational assessment
EIA Methodology	Radar modelling will be undertaken to determine the extent of radar visibility and the predicted effects on radar performance. The air traffic/airspace operational assessment will analyse traffic flows and airspace structure to determine the operational impact of any effects on radar. This will be undertaken in consultation with the CAA, MOD, NATS.

Potential Effect	**Effects on operation of HMR X-Ray**
Study / Survey Proposed	A desk based study of the HMR X-Ray and its potential interactions with the development will be undertaken.
EIA Methodology	To determine the potential for effects upon HMR X-Ray, the location of the wind farm and its potential for affecting the HMR X-Ray route will be assessed and consultation will be carried out with helicopter operators.

Potential Effect	**Effects on operations at offshore installations**
Study / Survey Proposed	To determine the potential for effects upon radar systems and issues associated with obstacle clearance, the following study will be undertaken: Desktop study and consultation on operations at offshore installations
EIA Methodology	The helicopter approach procedures assessment will analyse the vertical and horizontal profiles of existing and future procedures and use meteorological data to predict the frequency with which helicopter approaches to the Beatrice platforms (where this infrastructure has not commenced decommissioning), or to the BOWL or MORL EDA offshore wind farms may be affected by the development. This will be undertaken in consultation with helicopter operators.

Potential Effect	**Increase in minimum safe altitude, and** **Effects on operations at Wick Airport**
Study / Survey Proposed	The requirements for minimum safe altititude within the WDA will be determined through desktop study and consultation with aviation stakeholders.
EIA Methodology	Any necessary amendments to minimum safe altitude will be discussed with aviation stakeholders and proposed within the ES.

4.4.5 Site Specific Survey Methodology

Desk-based studies backed up by thorough consultation with aviation stakeholders including CAA, NATS, MOD, HIAL and helicopter operators including SAR service providers will be done. No specific site surveys are proposed.

4.4.6 Cumulative and In-combination Effects

There is foreseeable potential for the extent or magnitude of any effects identified in Section 4.4.3 above to be cumulatively increased by the simultaneous presence of other existing or proposed activities or developments. The extent to which these cumulative effects may arise will depend upon the design and extent of the infrastructure or the frequency and intensity of the activities.

As discussed in Section 1.3.2.6 above, the method for cumulative impact assessment will be carried out in accordance with the methods outlined within the MFOWDG discussion document 'Moray Firth Offshore Wind Developers Group Cumulative Impact Assessment Discussion Document' (MORL, 2012) unless otherwise agreed with MS-LOT and appropriate stakeholders. This document has been included as Annex 1 to this Scoping Report.

4.4.7 Potential Mitigation Measures

If in light of the conclusions of the of the EIA, potential mitigation measures are required, these will be determined following the production of the impact assessments and consultation with consenting authorities and appropriate stakeholders.

It is highlighted that mitigation put forward for the MORL EDA offshore wind farms (MORL, 2012) or in subsequent discussions with the relevant stakeholders included:

- Specialist lighting and marking;
- Updates to procedures, charts and notifications to aviation safety stakeholders;
- Implementation of a TMZ over the sites; and
- Radar-specific mitigation in the form of blanking.

4.5 Seascape, Landscape and Visual Receptors

4.5.1 Baseline Characteristics

This section describes the seascape, landscape and visual baseline environment and potential effects associated with the WDA. Information on the WDA baseline characteristics have been derived mostly from the MORL ES 2012. The Seascape, Landscape and Visual Assessment (SLVIA) ES Chapter and Technical Appendices can be accessed via the following links - Chapter 5.4 SLVIA, and Technical Appendix 5.4 A (SLVIA Methodology) , Technical Appendix 5,4 B (Meteorological Data) and Technical Appendix 5.4 C (SLVIA Secondary Assessments). Table 4.5-1 below lists the proposed datasets that will inform the assessment.

Table 4.5-1 Datasets for the SLVIA EIA

Dataset	Coverage	Date
Meteorological data from Wick Airport	50 km radius around MORL Zone	2002 - 2011

It is proposed that the following guidance and published work will inform the SLVIA assessment:

- BOWL (2012). Beatrice Offshore Wind Farm Environmental Statement.
- Countryside Council for Wales (2001). Guide to Best Practice in Seascape Assessment.
- Department of Trade and Industry (2005). Guidance on the Assessment of Impact of Offshore Wind Farms: Seascape and Visual Impact Report.
- Landscape Institute and Institute of Environmental Management and Assessment (2013). Guidelines for Landscape and Visual Impact Assessment': Third Edition
- Horner and MacLennan and Envision (2006). Visual Representation of Windfarms: Good Practice Guidance for Scottish Natural Heritage, The Scottish Renewables Forum and the Scottish Society of Directors of Planning.
- MORL ES (2012). Telford, Stevenson and MacColl Wind Farms and Associated Transmission Infrastructure Environmental Statement.
- Scott, K.E., Anderson, C., Dunsford, H., Benson, J.F. and MacFarlane, R. (SNH, 2005). An Assessment of the Sensitivity and Capacity of the Scottish Seascape in Relation to Wind Farms.
- SNH, Natural England (2012). Seascape Character Assessment Guidance.
- SNH (TBC). Guidance on Coastal Character Assessment (currently draft).

Seascape is defined as “the coastal landscape and adjoining areas of open water, including views from land to sea, from sea to land and along the coastline” (DTI, 2005). The effect upon seascape, landscape and visual resources is dependent upon a range of interacting factors, including, among others: the Zone of Theoretical Visibility (ZTV); the visual sensitivity of the area; the sensitivity of the landscape and seascape; meteorological conditions; the design and layout of the development; and, the location of the development. The WDA may give rise to seascape, landscape and visual effects. The completion of a seascape, landscape and visual assessment allows the significance of effects of the development on the landscape, seascape and visual resources to be assessed, with reference to established methodology and guidance.

The seascape, landscape and visual impact assessment (SLVIA) will assess the potential effects of the WDA, consisting of up to 90 turbines up to 272 m (HAT) in height, on seascape, landscape and visual receptors in a defined study area.

The WDA consists of offshore elements (wind turbines), therefore the baseline environment consists of seascape and visual receptors.

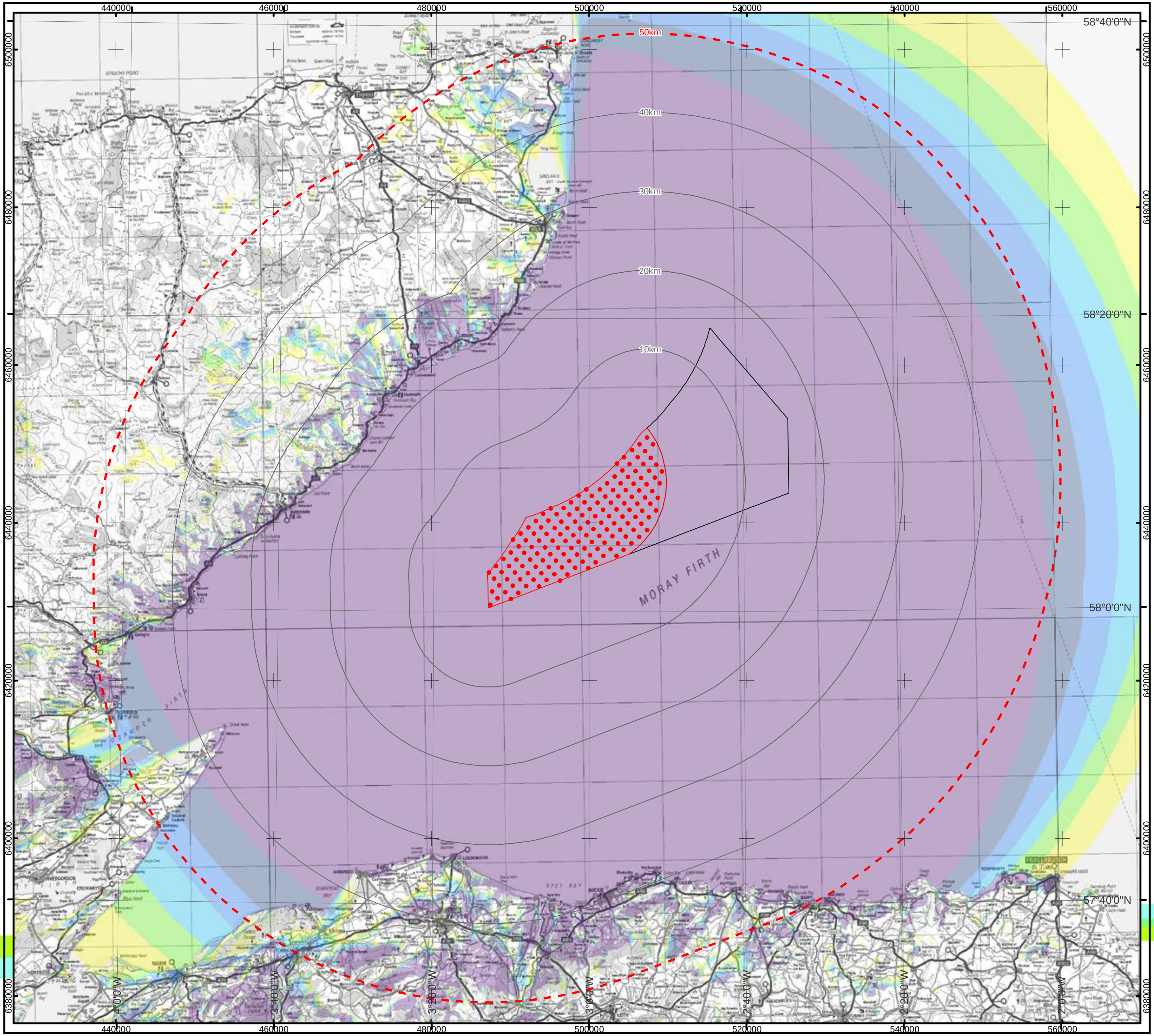
The extent of the theoretical visibility of the WDA is illustrated in Figure 4.5-1 below. An A3 version of this figure has been provided in Annex 2. This will determine the study area for the SLVIA, which will include coastal areas of Caithness, Moray and Aberdeenshire. A strategic seascape assessment for offshore wind has been completed for Scotland, which is based upon regional seascape units (Scott et al., 2005). The assessment investigated the potential effect on seascape as capacity for development, which is derived from an assessment of the visibility of wind farms and the sensitivity and value of the seascapes. The study provides the basis for a seascape classification for Scotland at the national level. The regional seascape units of relevance to the proposed wind farm are:

- Area 5: North Aberdeenshire/Morayshire Coast;
- Area 6: Moray Firth; and
- Area 7: East Caithness & Sutherland

The seascape types that are found within these seascape units/areas are:

- Type 1: Remote High Cliffs;
- Type 2: Rocky coastline / open sea views;
- Type 3: Depression coastline / open views;
- Type 4: Outer firths;
- Subtype 4a: Smaller & less developed outer firths;
- Type 5: Developed inner firths;
- Type 6: Narrow coastal shelf; and
- Type 11: Less developed inner firths.

The Scottish seascape study (Scott *et al.*, 2005) determined a strategic scale of national Seascape Units and Seascape Character Types. It suggests that a regional scale seascape character assessment is an appropriate level of detail for offshore wind development. The definition of these regional scale Seascape character units and their sensitivity to the proposals is an essential part of the assessment process and it is proposed that this will utilise the same methodology and units as those defined, and subsequently approved, in the MORL ES 2012. The methodology for undertaking this baseline seascape assessment will be based on published guidance, particularly the 2005 DTI Seascape and Visual Impacts Report and the 2012 SNH Seascape Character Assessment Guidance. The MORL ES 2012 defined seascape character units/types along the Caithness and Moray coasts, informed by SNH's Seascapes Report (SNH, 2005). SNH currently have draft Guidance on Coastal Character Assessment out for consultation and, assuming this is published in due course, this will be incorporated into the assessment. Within the draft Guidance, the SLVIA undertaken for the MORL EDA is cited as good practice and the coastal characterisation completed by MORL as part of that assessment is being adopted for the Moray Firth region. The SLVIA for the WDA will follow a similar approach.



Moray Offshore Renewables Ltd

KEY

● Scoping Turbine Layout

🟥 Western Development Area

☐ 10km Radii

🟥 50km Study Area

☐ Eastern Development Area

Blade Tip ZTV

No. of Blade Tips Visible

☐ 0

🟨 1 - 30

🟩 31 - 60

🟦 61 - 90

🟦 91 - 120

⬛ 121 - 150

🟪 151 - 159

Note:
Although there are 159 turbines shown here, there will only be a maximum of 90 turbines within the WDA. For the purposes of this ZTV and in order to provide an indication of the maximum extent of visibility regardless of the turbines' geographic location within the WDA, this ZTV has been created assuming the site is filled with turbines at the minimum spacing (1,050 x 1,200 m). It should also be noted that reduced spacing between the perimeter turbines is being considered for the WDA but these are not included within this indicative ZTV.

Blade Tip:	272m	Observer height:	2m
DTM:	OS T50	Surface features:	Excluded
DTM resolution:	50m	Earth curvature:	Included

Horizontal Scale: 1:650,000 A4 Chart

0 10,000 20,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: TH
Reviewed: SM
Approved: SM

Date: 10/05/2016 Revision: A

REF: 8460001-PQW0010-OPE-MAP-001

Figure 4.5-1
Blade Tip ZTV

Moray Offshore
Renewables Ltd

4.5.2 Data Gaps

A study to determine cumulative and in-combination viewpoints will be required. Site visits to viewpoints and the production of site specific Zones of Theoretical Visual influence (ZTVs) will also be required.

4.5.3 Potential Effects

4.5.3.1 Summary of Potential Effects

Potential Effect	**Construction**	**Operation**	**Decommissioning**	**Scoped Out**
Change in seascape character	✓	✓	✓	×
Change in visual resource	✓	✓	✓	×

Whilst a specific assessment will be carried out in relation to the WDA, given the proximity of the MORL EDA and WDA and the potential similarities in relation to potential effects, the findings of the MORL EDA SLVIA have been included below for context.

Figure 4.5-1 above shows an indicative Zone of Theoretical Visibility, extending out to 50 km from the WDA, for turbines with a tip height of 272 m (HAT).

Although there will only be a maximum of 90 turbines within the WDA, for the purposes of the ZTV and in order to provide in indication of the maximum extent of visibility regardless of the turbines' geographic location within the WDA, the WDA has been assumed to contain the maximum number of turbines within the space at the minimum spacing (1,050 x 1,200 m) (i.e. 159 turbines in total). It should also be noted that reduced spacing between the perimeter turbines is being considered for the WDA but these are not included within this indicative ZTV.

4.5.3.2 Potential Effects During the Construction, Operation and Decommissioning Phases

Change in seascape character

Depending on their sensitivity to change, the construction, decommissioning and/or presence of a wind farm in the WDA could affect particular seascape character types around the Moray Firth.

It is highlighted that the assessments for the MORL EDA identified no significant effects on seascape character.

Change in visual resource

Visual receptors could be affected by the construction, decommissioning and/or presence of a wind farm in the WDA. This could include direct and indirect effects on visual receptors including:

- Views from residential areas;
- Views from transport routes, roads, railways and ferries;
- Views from designated landscapes;

- Views from publicly accessible historic environment features;
- Views from recreational routes, footpaths and cycleways; and
- Views from other publicly accessible land.

It is highlighted that the MORL ES 2012 identified significant effects on seven viewpoints located on the closest points to the MORL EDA along the Caithness coast as a result of the proposed development appearing to occupy a significant proportion of the sea skyline.

4.5.4 Approach to EIA

Potential Effect	**Change in seascape character during construction, operation and decommissioning of the WDA**
Study / Survey Proposed	To determine the potential for effects on landscape character, the following studies will be undertaken: Desk-based study using a ZTV; and Field work to confirm desk-based study, delineate and describe regional seascape units/areas.
EIA Methodology	The SLVIA will be undertaken with due regard to best practice guidance set out in: Countryside Council for Wales: Guide to Best Practice in Seascape Assessment (2001); Landscape Institute and Institute of Environmental Management and Assessment (2013): Guidelines for Landscape and Visual Impact Assessment': Third Edition; Department of Trade and Industry, Guidance on the Assessment of Impact of Offshore Wind Farms: Seascape and Visual Impact Report (November 2005); Scott, K.E., Anderson, C., Dunsford, H., Benson, J.F. and MacFarlane, R. (SNH, 2005). An Assessment of the Sensitivity and Capacity of the Scottish Seascape in Relation to Wind Farms; SNH, Natural England: Seascape Character Assessment Guidance (2012); and SNH (TBC): Guidance on Coastal Character Assessment (draft currently out for consulation). Further information on methodology relevant for all potential effects provided below.

Potential Effect	**Change in visual resource during construction, operation and decommissioning of the WDA**
Study / Survey Proposed	To determine the potential for effects on visual resources, the following studies will be undertaken: Desk-based study using a ZTV; Consultation with consultees to reach agreement on viewpoints; Assessment of meteorological data for visibility; Assessment of sea use/users; and Field survey to confirm desk-based study, describe and assess viewpoints.
EIA Methodology	The SLVIA will be undertaken with due regard to best practice guidance set out in: Department of Trade and Industry, Guidance on the Assessment of Impact of Offshore Wind Farms: Seascape and Visual Impact Report (November 2005); Horner and MacLennan and Envision, Visual Representation of Windfarms: Good Practice Guidance (2006), for Scottish Natural Heritage, The Scottish Renewables Forum and the Scottish Society of Directors of Planning; and, Landscape Institute and Institute of Environmental Management and Assessment Guidelines for Landscape and Visual Impact Assessment': Third Edition (2013). Further information on methodology relevant for all potential effects provided below.

The methodology for the SLVIA will accord with the Guidelines for the Assessment of Landscape and Visual Effects: Third Edition, 2013. This methodology has drawn on the considerable experience gained in this field of work.

A baseline desk study will be undertaken to review the existing seascape and visual resource of the study area and will form the basis against which to evaluate the sensitivity of the study area to the WDA development. The main elements of the baseline desk study will include a review of baseline information, seascape characterisation and baseline visual analysis.

The desk study will review existing mapping and written information sources, including admiralty charts, Ordnance Survey (OS) maps, aerial photography, existing seascape assessments, capacity studies, inventories of designed landscapes, development plans and Met Office weather data. Other surveys will also be relevant when defining the seascape, landscape and visual baseline, including activity surveys, tourist information, ferry route information, historic and cultural guides, cultural heritage, conservation interests and recreational route maps.

The maximum extent of the WDA development is shown in Figure 1.1-2 above. The study area for the EIA will be agreed in advance with the relevant consultees. Seascape characterisation and visual analysis will provide a robust baseline from which to assess the sensitivity and capacity of the study area to the WDA. The seascape and visual assessment will be carried out through desk study, field survey and analysis.

A baseline seascape and visual characterisation will be undertaken to define the seascape units of potential significance in the study area, based on published seascape character assessment methodologies. In tandem with this characterisation, the visual resource of the study area will be defined and sensitive receptors identified, through analysis of activities, visibility and views in the study area, and with reference to published guidance on visual assessment.

Representative viewpoints will be identified from which to predict and assess the effects of the development.

Following the completion of the seascape characterisation and baseline visual analysis, the sensitivity of the seascape and visual resource to change of the nature proposed will be assessed and this will form the basis for the assessment. The sensitivity of the seascape and visual resource will be evaluated and defined in terms of the interactions between the seascape and views, the way it is perceived and valued, and the particular nature of the type of change associated with the WDA. The determination of the sensitivity of the seascape and visual resource will be based on an assessment of key elements and characteristics, using defined criteria, to arrive at an overall sensitivity for each seascape unit and visual receptor/viewpoint.

The magnitude of change to both the identified seascape units and visual receptors (such as viewpoints, settlements, routes and visitor attractions) will be assessed in a transparent manner. The magnitude of change arising from the development will be described based on the interpretation of a combination of factors, such as the distance from the infrastructure, the amount of the infrastructure that is visible, the proportion of view occupied, the position and relationship of the infrastructure to other focal points, the duration of effect (whether temporary or permanent, intermittent or continuous, frequent or infrequent) and the number and extent of resources affected.

The SLVIA will include the residual effects during construction, operation and decommissioning on seascape character and visual receptors. An assessment of the significance of effects will be carried out based on the combination of the sensitivity to change of a given receptor and the magnitude of change upon it resulting from the developments. The SLVIA will include assessment and reporting of effects on seascape character and assessment of effects on visual resources.

When predicting the potential seascape and visual effects, the extent of potential visibility of the WDA will be shown using ZTVs. A visibility assessment of the development will be carried out using the ZTV to describe the general extent and pattern of visibility of the WDA within the study area. The visibility assessment will also describe the extent of visibility from the main activities in the study area, such as recreational activities, settlements and the main road, rail and footpath network.

4.5.5 Site Specific Survey Methodology

Viewpoint photography, wirelines and photomontages will be prepared and presented in accordance with current best practice techniques. Viewpoint locations specific to the WDA will be included in the assessment. The viewpoint locations will be proposed / discussed with relevant stakeholders.

Photographs will show the existing view from these locations and a computer visualization / wireline view of the development proposals will be produced for each viewpoint. Rendered photomontages of the WDA will also be produced. Plan graphics will illustrate the development proposals in relation to the seascape and visual receptors on OS mapping or aerial photography. It is also likely that nighttime visualisations including rendered photomontages will be produced.

4.5.5.1 Summary of Methodology

Using industry guidance contained within the relevant documents referred in Section 4.5.4 above, the SLVIA will undertake the following:

- The valued regional and local seascape resources and viewpoints will be identified. These are expected to be similar to those included within the MORL ES 2012 but a detailed scoping exercise and consultation with statutory and non-statutory consultees will be undertaken to establish a comprehensive list;
- Baseline studies of existing seascape and visual environment incorporating national level conclusions;
- Assess the sensitivity of those resources and receptors to the proposals;
- Provide advice on any mitigation that may be possible, e.g. layout or screening and incorporate agreed mitigation into the scheme description;
- Propose and agree monitoring;
- Identify the potential effects of the proposal on the seascape and visual environment during the construction, operation and decommissioning phases of the wind farm and assess the significance of these effects;
- A cumulative assessment on the combined effects of the development of the WDA in combination with any other major developments that lie within the agreed study area. A list of such developments would be agreed with the relevant authorities; and
- Present the findings in the ES.

4.5.6 Cumulative and In-combination Effects

There is foreseeable potential for the extent or magnitude of any effects identified in Section 4.5.3 above to be cumulatively increased by the simultaneous presence of other existing or proposed activities or developments. The extent to which these cumulative effects may arise will depend upon the design and extent of the infrastructure or the frequency and intensity of the activities.

As discussed in Section 1.3.2.6 above, the method for cumulative impact assessment will be carried out in accordance with the methods outlined within the MFOWDG discussion document 'Moray Firth Offshore Wind Developers Group Cumulative Impact Assessment Discussion Document' (MORL, 2012) unless otherwise agreed with MS-LOT and appropriate stakeholders. This document has been included as Annex 1 to this Scoping Report.

4.5.7 *Potential Mitigation Measures*

Alongside the assessment, options for mitigation of the identified potential effects which are predicted to arise from the development will be considered, and practical measures agreed to avoid, reduce or off-set these effects. The SLVIA will identify measures for avoiding or reducing the level of significance of potential effects. These measures will potentially include:

- measures embedded into the design; and
- measures additional to these which would further reduce long term seascape and visual effects.

Potential embedded mitigation measures for effects on seascape and visual effects include the site selection for development, e.g. locating at distance from the coast and the realisation of design objectives for the development, achieved through alterations to layout and design.

The mitigation measures proposed for the development will be dependent upon the final design of the site and the potential effects as determined by the EIA studies. Mitigation options will be discussed with the relevant authorities.

4.6 Archaeology and Cultural Heritage

4.6.1 *Baseline Characteristics*

This section describes the Archaeology and Cultural Heritage baseline environment and potential effects associated with the WDA. Information on the WDA baseline characteristics have been derived mostly from the MORL ES 2012. The Archaeology and Cultural Heritage ES Chapter and Technical Appendix can be accessed via the following links Chapter 5.5 A Archaeology and Cultural Heritage and Technical Appendix 5.5 A Archaeology and Cultural Heritage. Table 4.6-1 below lists the proposed datasets that will inform the assessment. For a full list of wave, stratification, sea level and wind data see Physical Processes – Section 2.2 above

Table 4.6-1 Datasets for the Archaeology and Cultural Heritage EIA

Dataset	**Coverage**	**Date**
Geophysical survey (Osiris Projects)	MORL Zone	May –July 2010
Geotechnical survey (Fugro)	MORL Zone	2012

It is proposed that the following guidance will inform the Archaeology and Cultural Heritage Assessment:

- The Code of Practice for Seabed Development (The Joint Nautical Archaeology Policy Committee, 2008).
- Collaborative Offshore Wind Research Into the Environment (Cowrie), Historic Environment Guidance for the Renewable Energy Sector (Wessex Archaeology, 2007).
- COWRIE Guidance for Assessment of Cumulative Impact on the Historic Environment from Offshore Renewable Energy (Oxford Archaeology, 2008).

- Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector (Leather & Gribble/COWRIE 2011).
- Managing Change in the Historic Environment: Setting (HS, 2010).
- Standard and Guidance for Desk Based Assessment (Institute for Archaeologists, revised 2011).
- Article 303 of the United Nations Convention on the Law of the Sea (UNCLOS);
- Article 2.ii. The European Convetion on the Protection of Archaeological Heritage (revised) (The Valetta Convention).
- Scottish Government, Planning Advice Note (PAN) 2/2011: Planning and Archaeology.
- Scottish Government (2014). Scottish Planning Policy.
- Historic Scotland Archaeological Procedure, Paper 4, 1996.
- BMAPA & English Heritage (2003) Marine Aggregrate Dredging and the Historic Environment. Guidance Note.
- Protocol for Archaeological Discoveries: Offshore Renewables Projects (The Crown Estate/Wessex Archaeology, 2010b).
- The Crown Estate (2010) Round 3 Offshore Renewables Projects Model Clauses for Archaeological Written Schemes of Investogation.

It is acknowledged that the seas around Britain contain many archaeological sites and remains. Such sites reflect the changing nature of both the coastline around Britain and the activities of the country throughout previous centuries, and broadly include:

- Submerged prehistoric landscapes formed when parts of the UK seas were still dry land;
- Remains and sites, including but not limited to shipwrecks, evidence of Britain's early history; and
- More recent sites, reflecting Britain's role as a major naval, mercantile, industrial and imperial power.

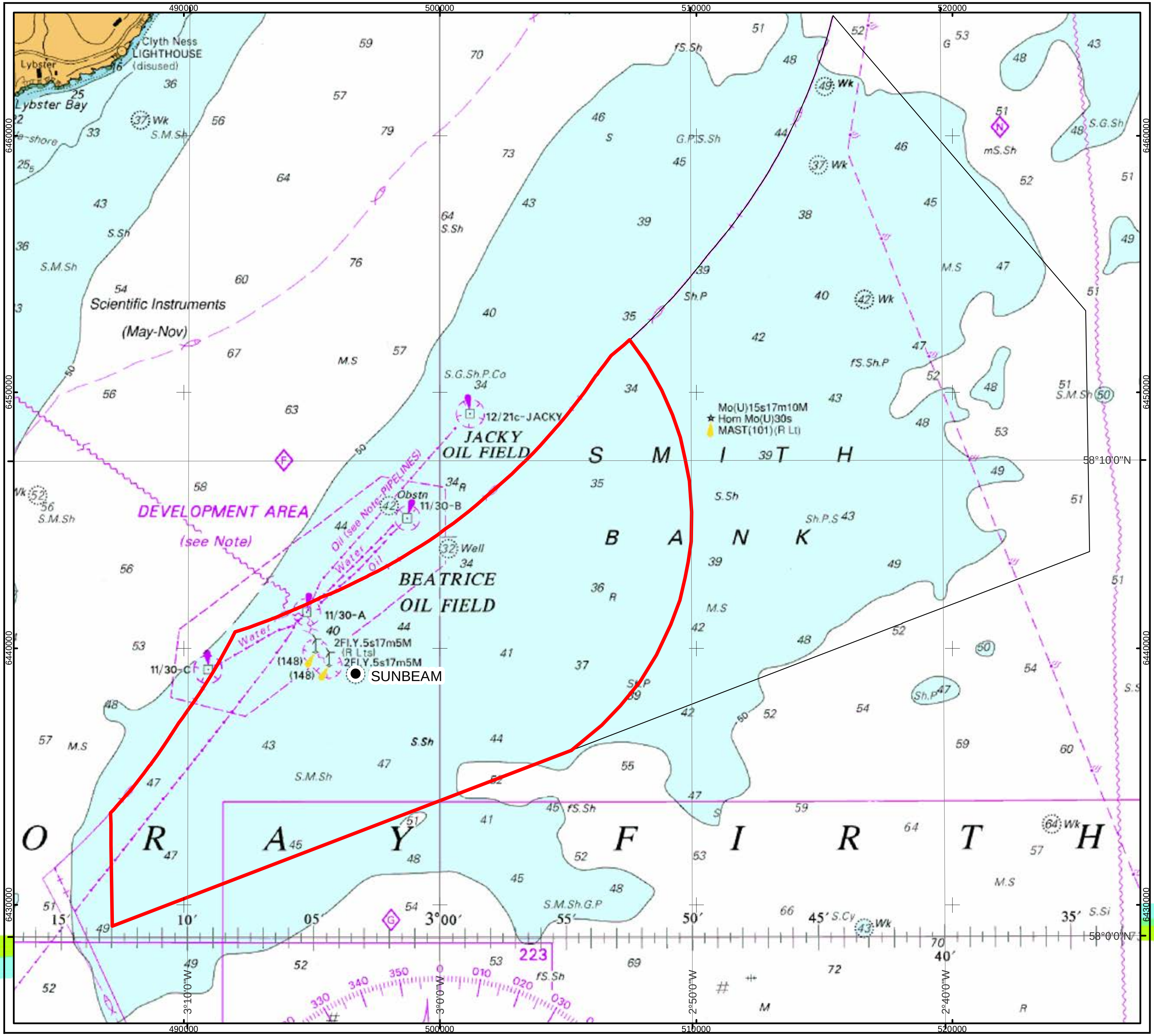
Cultural heritage and archaeological assets within the marine environment are located both on and below the seabed. Cultural heritage and archaeological remains that are afforded protection include wrecks and wreckage of historical, archaeological or artistic importance. Military remains are designated as 'protected places' or 'controlled sites' under the Protection of Military Remains Act 1986.

It is an offence to cause damage to protected archaeological remains and in some cases where a restricted zone exists around the remains, a licence is required before any intrusive works can be undertaken. Restricted zones can vary in size depending on the extent of any associated remains and the degree of sensitivity of a site. Obstructions and foul ground areas also have the potential to represent cultural heritage assets but are not classified as such until the character of such anomalies have been confirmed. The Merchant Shipping Act 1995 also requires that any material classified as 'wreck' recovered from the seabed during the course of a development is reported as a legal requirement to the Receiver of Wreck.

In addition to cultural heritage assets that are afforded protection, the seas around Scotland also contain a large number of assets that are currently unprotected or that are yet to be discovered.

A total of 375 marine archaeology sites have been identified in the Moray Firth from surveys commissioned by Historic Scotland. Most of these are intertidal sites (Talisman, 2005). In addition to marine archaeological sites within the Moray Firth, there are ship and aircraft wrecks in the area. The strategic importance of the Moray Firth area to the navy during WWI and WWII; the concentration of much of the North Sea fishing fleet in coastal ports along the north east coast of Scotland; the importance of maritime trade routes in the area, and the treacherous nature of near shore waters has led to this area containing several wrecks. In the MORL EDA three wreck sites were identified and a number of sites of archaeological potential including currently unknown seabed obstructions identified through sidescan sonar.

A preliminary geophysical survey was undertaken within the WDA in 2010. The survey methodology was the same as that undertaken in the MORL EDA in 2010. The survey extent offered approximately 20% coverage of the area, however this is yet to be assessed for archaeological potential. There is one charted wreck within the WDA '*Sunbeam*' (see Figure 4.6-1 below) The charted wreck is located within the centre of the WDA at -3.0559, 58.0927. This is a protected wreck and will have a required exclusion zone. Within controlled sites, it is an offence to tamper with, damage, move or unearth any remains, enter any hatch or opening or conduct diving, salvage or excavation operations for the purposes of investigating or recording the remains, unless authorised by licence.



Moray Offshore Renewables Ltd

KEY

● Charted Wreck

🟥 Western Development Area

☐ Eastern Development Area

Horizontal Scale: 1:200,000

A4 Chart

0 2,500 5,000 Meters

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: AH
Approved: SP

Date: 04/05/2016

Revision: B

REF: 8460001-PQW0010-MOR-MAP-034

Figure 4.6-1
WDA Charted Wreck Sunbeam

Moray Offshore Renewables Ltd

4.6.2 Data Gaps

Geophysical surveys were undertaken in 2010 covering the full extent of the MORL Zone. This allowed for 20% coverage of the WDA. There will be a further geophysical survey undertaken on the site, however, this is likely to be post consent award. The WDA EIA will utilise the existing geophysical data for the site.

4.6.3 Potential Effects

4.6.3.1 Summary of Potential Effects

Potential Effect	Construction	Operation	Decommissioning	Scoped Out
Contamination, damage or loss of archaeological remains in or on the seabed	✓	×	✓	×
De-stabilisation of sites through changed sedimentary regimes	✓	×	✓	×
Indirect effect due to changes to the setting of designated cultural heritage receptors	✓	✓	✓	×

Whilst a specific assessment will be carried out in relation to the WDA, given the proximity of the MORL EDA and WDA and the potential for similarities in relation to potential effects, the findings of the MORL EDA Archaeology and Cultural Heritage assessment have been included below for context.

The listed effects will be assessed against the following categories of archaeological asset / potential:

- Recorded sites such as known wrecks;
- Sites of medium or high potential identified in the geophysical survey data;
- Unrecorded cultural heritage assets;
- Scheduled monuments, listed buildings, conservation areas, inventory designed gardens and designed landscapes (IGDLs), inventory battlefields and non–designated cultural heritage assets;
- Unrecorded cultural heritage assets; and
- Sites affected through changes in sedimentary regime.

4.6.3.2 Potential Effects During the Construction Phase

Contamination, damage or loss of archaeological remains in or on the seabed

The installation of wind turbines and their foundations, the installation of inter-array cabling and all associated activities including the deployment of construction vessels, has the potential to damage or destroy cultural heritage assets. This may occur as a result of the design or as an accidental consequence of construction activity. Installation activity would seek to avoid any features of historical interest on the seabed and it is expected that any accidental disturbance of features will be appropriately treated through the use of established protocols and procedures for unexpected archaeological discoveries.

It is highlighted that the assessments for the MORL EDA identified negligible significance for this effect with mitigation. Since effects were considered to be significant within the MORL ES 2012 if they were above moderate significance, this was not considered to be a significant effect.

De-stabilisation of sites through changed sedimentary regimes

There is the potential for alterations in sediment transport regimes as a result of the installation of wind turbines and their foundations, the installation of inter-array cabling and all associated activities including the deployment of construction vessels to have an indirect effect on cultural heritage assets or the exposure of unrecorded assets. The possibility of alterations in tidal regimes leading to long-term effects on sediment transport within the WDA will be assessed in the Physical Processes Chapter (see Section 2.2.2 (Metocean) above).

It is highlighted that the assessments for the MORL EDA identified this effect to be of negligible significance. Since effects were considered to be significant within the MORL ES 2012 if they were above moderate significance, this was not considered to be a significant effect.

Indirect effect due to changes to the setting of designated cultural heritage receptors

The proposed development may affect the setting of onshore cultural heritage receptors. Setting effects on cultural heritage receptors are often considered to be indirect. These occur when the visible elements of a developments infrastructure or the effects upon the land or seascape caused by its presence are inter-visible with cultural heritage receptors. Setting includes the way in which the surroundings of a historic asset or place contribute to how it is experienced, understood and appreciated and setting effects are not therefore limited to visual changes.

It is highlighted that the assessments for the MORL EDA identified this effect to be of negligible significance. Since effects were considered to be significant within the MORL ES 2012 if they were above moderate significance, this was not considered to be a significant effect.

4.6.3.3 Potential Effects During the Operational Phase

Indirect effect due to changes to the setting of designated cultural heritage receptors

The operational wind farm may affect the setting of onshore cultural heritage receptors. In the same way as the effects during construction these are considered indirect and not limited to visual changes as a result of development.

It is highlighted that the assessments for the MORL EDA identified this effect to be of negligible significance. Since effects were considered to be significant within the MORL ES 2012 if they were above moderate significance, this was not considered to be a significant effect.

4.6.3.4 Potential Effects During the Decommissioning Phase

At this stage, decommissioning effects are envisaged to be similar to those described for the construction phase.

4.6.4 Approach to EIA

4.6.4.1 Construction Phase

Potential Effect	**Contamination, damage or loss of archaeological remains in or on the seabed**
Study / Survey Proposed	In order to determine the potential for effects on existing archaeological remainsdesk based research of archaeological potential in the WDA will be undertaken. This will utilise pre-existing geophysical survey data for the site.
EIA Methodology	The assessment of archaeological potential and significance will be used to identify the potential archaeological remains within the area and their importance. The potential for an effect upon these features will be assessed using a risk assessment of the direct effects of wind turbine foundations, inter-array cabling and construction methods. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

Potential Effect	**De-stabilisation of sites through changed sedimentary regimes**
Study / Survey Proposed	In order to determine the potential for effects on existing archaeological remains desk based research of archaeological potential in the WDA will be undertaken. This will utilise pre-existing geophysical survey data for the site.
EIA Methodology	The assessment of archaeological potential and significance will be used to identify the potential archaeological remains within the area and their importance. The potential for an effect upon these features will be assessed in relation to the results of the potential for changes in the sediment transport regime (e.g. the potential to cause burial or exposure of features) covered within the Physical Processes Chapter (see Section 2.2.2 (Metocean) above). Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

4.6.4.2 Operation Phase

Potential Effect	**Indirect effect due to changes to the setting of designated cultural heritage receptors**
Study / Survey Proposed	To determine the potential for effects on heritage assets, the following studies will be undertaken: Desk study to map heritage assets within study area and wider context Fieldwork to establish baseline setting of assets in the cable route corridor search area and vicinity of the substation
EIA Methodology	The assessment of setting will be used to identify the potential effect on the settings of heritage assets. The setting assessment will identify where changes in setting have a potential to affect the cultural heritage significance of assets as distinct from the aesthetic land and seascapes. There are no standard criteria for determining the significance of potential effects on heritage assets. The significance will therefore be determined using criteria developed from best practice techniques and expert knowledge in accordance to relevant legislation and guidance. Best practice at the time of assessment will be used along with previous experience gained from the MORL EDA EIAs.

4.6.5 *Cumulative and In-combination Effects*

There is foreseeable potential for the extent or magnitude of any effects identified in Section 4.6.3 above to be cumulatively increased by the simultaneous presence of other existing or proposed activities or developments. The extent to which these cumulative effects may arise will depend upon the design and extent of the infrastructure or the frequency and intensity of the activities.

As discussed in Section 1.3.2.6 above, the method for cumulative impact assessment will be carried out in accordance with the methods outlined within the MFOWDG discussion document 'Moray Firth Offshore Wind Developers Group Cumulative Impact Assessment Discussion Document' (MORL, 2012) unless otherwise agreed with MS-LOT and appropriate stakeholders. This document has been included as Annex 1 to this Scoping Report.

4.6.6 *Potential Mitigation Measures*

Potential mitigation measures for effects on archaeology and cultural heritage include micrositing of turbines and inter-array cabling, choice of construction techniques, use of scour mats around turbine bases (if required) and the use of a written scheme of investigation (WSI) and Protocol for Archaeological Discovery (PAD), for the approval of Marine Scotland in consultation with Historic Scotland, to mitigate any unexpected archaeological discoveries during installation.

The mitigation measures proposed for the development area will be dependent upon the final design of the site and the potential impacts as determined by the EIA studies. Options of mitigation will be discussed with the relevant authorities prior to ES submission.

4.7 Socio-economics

4.7.1 Baseline Characteristics

This section describes the socio-economic interests relevant to the WDA assessment. Information on WDA baseline characteristics are acknowledged to have changed from the MORL ES 2012. The Socio-economics ES Chapter can be accessed via the following link – Chapter 5.6 Socio-Economics, Recreation and Tourism. Table 4.7-1 below lists the proposed datasets that will inform the assessment.

Table 4.7-1 Datasets for the Socio-economics EIA

Dataset	Coverage	Date
Population & employment data (Office of National Statistics)	Scotland, Aberdeen, Aberdeenshire, Moray and Highland	2015 (Dec)
Gross Value Added (GVA) per head (Office of National Statistics)	Scotland, Aberdeen, Aberdeenshire, Moray and Highland	2015 (Dec)
Individual Median Annual Gross Pay (Office of National Statistics)	Scotland, Aberdeen, Aberdeenshire, Moray and Highland	2015 (Dec)
House Prices (Registers of Scotland)	Scotland, Aberdeen, Aberdeenshire, Moray and Highland	Published quarterly
Qualifications (Office of National Statistics)	Scotland, Aberdeen, Aberdeenshire, Moray and Highland	2015
Deprivation (Scottish Neighbourhood Statistics)	Scotland, Aberdeen, Aberdeenshire, Moray and Highland	2016
Employment by sector (Office of National Statistics Business Register and Employment Survey)	Scotland, Aberdeen, Aberdeenshire, Moray and Highland	2015
Tourism Data (Great Britain Tourism Survey and International Passenger survey)	Highland, Aberdeen and Grampian	2015
Ports and Harbours Infrastructure Literature	Specific to each location	2014/15/16
Government publications on the National Renewables Infrastructure Plan.	HIE & SE areas	Various
Budget Statement 2016	UK	2016

Although not within territorial waters the relevant communities for the WDA are the Highlands and North East of Scotland, and for the purposes of socio-economic impact assessment, the local authorities of Highland, Aberdeenshire, Aberdeen City and Moray, have been established through previous work with stakeholders for the MORL ES 2012 as local to the development area. The scale and nature of development mean that socio-economic effects are not limited to those four local authorities, and will be considered on a Scottish and UK basis.

Detailed work was undertaken as part of the MORL ES 2012 to establish baseline socio-economic data. However, there has been change to that baseline as a result of public policy intervention and both micro and macro-economic change.

As a consequence of the development of proposals for offshore wind infrastructure in the Moray Firth (MORL EDA and BOWL), significant work has been undertaken, not only by developers but by local authorities, port authorities, and by the Scottish Government through Highlands and Islands Enterprise (HIE), Scottish Enterprise (SE) and Marine Scotland (Scottish Government, 2015) to identify the economic opportunities offered by the development of offshore wind, and to identify, strengthen and assist enterprises which could take advantage of those opportunities.

This, taken together with the delivery of the BOWL development (2017-2019) and the progress of MORL EDA through the CfD process towards construction, means that the baseline of economic receptors for the WDA is particularly dynamic, and has changed since the EIA for the MORL EDA was undertaken four years ago. In particular, significant investment has been made in local infrastructure, including ports and harbours, and in the skills development opportunities for the local workforce. These dynamics, specific to the offshore wind sector, will be considered in the baseline socio-economic assessment.

In the MORL ES 2012, the oil and gas sector was identified as locally significant; and remains significant, however the impact of the recent fall in oil markets introduces a further dynamic which will be considered in the baseline socio-economic assessment.

4.7.2 Data Gaps

A number of changes have taken place since the MORL ES 2012 was produced which mean that the assumptions used to model the economic effects of the MORL EDA cannot be applied directly to the WDA. These changes include:

- Electricity market reform;
- Cost reduction; and
- Offshore wind market size and confidence.

These changes correlate to data gaps, most significantly in terms of the relationship between Gross Value Added (GVA)[3] and Megawatt (MW) installed. Research and analysis based on market experience will be required to address these issues.

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[3] Gross Value Added (GVA) is an indicator of economic prosperity. It measures the contribution to the economy of each individual producer, industry or sector. Put simply, GVA is the value of goods and services produced by an area, sector or producer minus the cost of the raw materials and other inputs used to produce them. GVA is mainly composed of the income made by employees (earnings) and the business (profits / surplus) as a result of production.

4.7.3 Potential Effects

4.7.3.1 Summary of Potential Effects

Potential Effect	Construction	Operation	Decommissioning	Scoped Out
Employment	✓	✓	✓	×
GVA	✓	✓	✓	×
Tourism	×	×	×	✓
Surfing, Sea-Kayaking and Walking	×	×	×	✓

Whilst a specific assessment will be carried out in relation to the WDA, given the proximity of the MORL EDA and WDA and the similarities in relation to potential effects, the findings of the MORL EDA socio-economics assessment have been included below for context.

4.7.3.2 Potential Effects During the Construction Phase

Employment and GVA Effects

Every project, particularly significant scale projects such as offshore wind farms, have the potential to affect employment and GVA at a local, regional and national scale. The scope of the economic element of the assessment for the WDA will be to estimate the significance of the employment and GVA that would be associated with the expenditure made in the development and construction of the WDA.

It is highlighted that the assessments of the MORL EDA identified these effects as being of major positive significance during construction. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, this was considered to be a significant effect.

These assessments were made through the development of a model which was applied to data which profiled local, Scottish and UK economic conditions.

There have been a number of developments in the offshore wind market since 2012 which may impact some of the baseline assumptions used in the model and therefore the intention is to update the 2012 model with revised assumptions based on these changes for the purposes of the WDA assessment. These developments include the following:

Cost Reduction

The assumptions concerning economic impact per MW offshore wind generation have changed since 2012, as there has been significant change within the economic environment in which offshore wind is developed, for example, the support mechanism in place at the time of MORL ES 2012 has changed from renewables obligation certificates to the competitive CfD auction process.

The correlation between cost reduction per MW and economic effect will therefore be taken into consideration, and the relationship between GVA and MW installed will be adjusted to take into account requirements for cost reduction.

Offshore Market Size and Confidence

At the time of development of the first Round 3 sites proposals the UK Government indicated that there was potential for UK deployment of over 40 GW by 2030 (DECC, 2011c). It was estimated that the offshore wind industry had the potential to bring forward between 10 and 26 GW by 2020 ('industry low' and 'industry high' scenarios), with a central range of up to 18 GW. In light of political and market change since then, this forecasted figure has reduced to 10 GW by 2020 and UK Government support up to another 10 GW in the 2020s (DECC, 2015). This means that baseline assumptions in relation to supply chain pipeline will need to be considered and adjusted as necessary within the model.

Supply Chain Market Conditions

Since 2012, experience has been gained through work with the supply chain for the MORL EDA which will enable economic modelling to be improved.

MORL has worked with SE, HIE, Marine Scotland, local authorities and local ports and harbours throughout the development of the MORL EDA. This ongoing engagement will enable the work done through these agencies to strengthen modelling of the economic effect for the WDA.

From the MORL ES 2012, it was demonstrated that economic effects at local, Scottish, and UK level were highly sensitive as to where individual aspects of project delivery work was to be carried out.

Commercial sensitivities have become even greater; public policy driving competition and cost reduction mean that economic effect in terms of GVA and jobs on a particular area is not simply dependent upon the ability of a particular type of work to be undertaken in that area; but for the ability of that work to be undertaken competitively in that area within a global market.

Modelling will therefore require to take this into consideration when projecting economic effect.

Local Project Pipeline

The proposed construction of the WDA will follow both the construction of BOWL, and the construction of the MORL EDA in the outer Moray Firth. It may also follow the construction of other wind farms on Scotland's East Coast. This could provide continuity for industrial activities established or developed to deliver these wind farms. The economic opportunities of providing additional project 'pipeline' to enterprises already involved in the offshore wind industry through the delivery of these projects will require consideration in assessment of the socio-economic effect of the WDA.

Assessing Employment & GVA Effects for the WDA

For the reasons identified above, the economic model created for the MORL ES 2012 will need to be adjusted to take into account recent developments before it is applied to the WDA. Further, significant work has been undertaken by public authorities, including Marine Scotland, SE and HIE to better understand the likely economic effects of offshore wind development.

It is therefore proposed that the model to be used for assessing the employment and GVA effects for the WDA will be the model created for the MORL ES 2012 updated in consultation with relevant stakeholders to take account of both the changed economic environment and the improved understanding of the socio-economic effects of offshore wind development.

4.7.3.3 Potential Effects During the Operational Phase

Employment and GVA Effects

The ongoing operation and maintenance of an offshore wind farm requires a range of skills and services; the economic modelling in the MORL ES 2012 used the limited market data available to model effects on GVA and jobs for the MORL EDA.

It is highlighted that the assessments of the MORL EDA identified these effects as being of major positive significance during operation. Since effects were considered to be significant within the MORL ES 2012 if they were above minor significance, this was considered to be a significant effect.

Again, the modelling assumptions used in 2012 will require to be revised. Three major factors to be considered are:

Cost Reduction

The offshore wind industry has gained considerable experience in terms of operating and maintaining offshore installations; approximately 30 offshore wind farms have now been deployed around the UK, and operations and maintenance techniques have improved. Improvements in efficiency will therefore require to be considered in projecting economic effects through operations and maintenance for the WDA.

Neighbouring Projects

The proximity of neighbouring projects, particularly MORL's EDA, could provide opportunities of scale in terms of delivering operations and maintenance to the WDA, and will require to be considered when modelling economic effects.

Local Ports and Harbours

MORL has established positive relationships with local ports and harbours, local authorities and local colleges, some of which have undertaken works to enable their facilities to be used for the purposes of operations and maintenance. These factors will require to be given due consideration when assessing the socio-economic effect of operations and maintenance for the WDA.

4.7.3.4 Potential Effects During the Decommissioning Phase

Decommissioning effects are expected to be similar to those associated with construction. Provision was made within the MORL ES 2012 for the consideration of the effects of decommissioning and it is expected that a similar approach can be taken for the WDA.

4.7.3.5 Scoped Out Effects

Tourism Effects

Effects on tourism of the MORL EDA were assessed in the MORL ES 2012 which found that:

i. Although no direct statistical data was available, reviewing previous work indicated the effects of wind farm development on tourism was not significant.

ii. As a function of the location of the development, and its distance from shore, the number of tourism establishments (hotels, Bed and Breakfasts, etc.) which would be directly affected by the development would be minimal.

iii. During the period of construction, there would be a positive effect on this sector of the economy as a result of the new market which would be created by personnel associated with delivery of the MORL EDA infrastructure. This positive effect upon business tourism could be expected to continue, to a lesser degree through the operations and maintenance phase.

The effect on tourism was therefore concluded not to be significant.

The MORL ES 2012 assessment was made on statistics available (to 2010) which indicated tourism-related expenditure had declined since a high-point of 2005 (see Scottish Government, 2016) however in more recent years, tourism in Scotland in general, and in the authorities local to the Moray Firth has generally increased (Figure 4.7-1 below). On the basis of the conclusions of the MORL ES 2012 and taking into account the change in tourism-related expenditure, the WDA is not expected to have a negative effect on tourism and has therefore been scoped out of the WDA EIA.

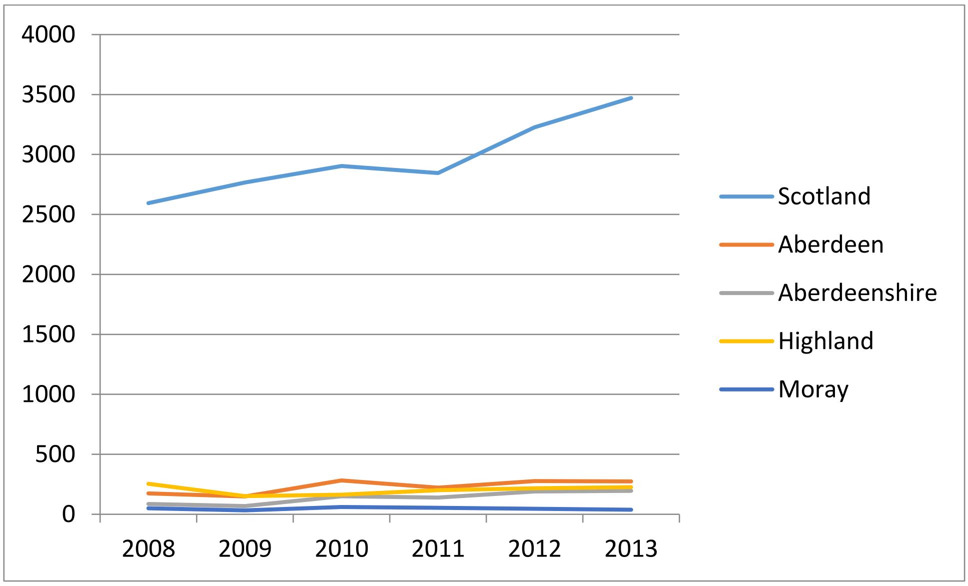


Figure 4.7-1 Sustainable Tourism – GVA (£m). Scottish Government Growth Sector Statistics Database, April 2016

Surfing, Sea-Kayaking and Walking

The MORL ES 2012 for the MORL EDA investigated the effects of development on these receptors and found there to be no significant effects (negligible during construction and decommissioning and minor negative during operation). It is therefore proposed that these are scoped out of the socio-economics assessment.

4.7.4 Approach to EIA

4.7.4.1 Construction Phase

Potential Effect	**Employment and GVA**
Study / Survey Proposed	An economic impact assessment model for the WDA will be updated following consultation with relevant stakeholders. Baseline sectorial economic data will be gathered at local (Aberdeen City, Aberdeenshire, Highland and Moray), Scottish and UK level.
EIA Methodology	Socio-economic effects will be assessed by applying the model to the baseline economic data. A number of the assumptions used in the model in the MORL ES 2012 will be updated including assumptions in relation to supply chain and the industry multipliers used to calculate employment and GVA.

4.7.4.2 Operation Phase

Potential Effect	**Employment and GVA**
Study / Survey Proposed	An economic impact assessment model for the WDA will be updated following consultation with relevant stakeholders. Baseline sectorial economic data will be gathered at local (Aberdeen City, Aberdeenshire, Highland and Moray), Scottish and UK level.
EIA Methodology	Socio-economic effects will be assessed by applying the model to the baseline economic data. A number of the assumptions used in the model in the MORL ES 2012 will be updated including assumptions in relation to supply chain and the industry multipliers used to calculate employment and GVA.

4.7.5 Cumulative and In-combination Effects

The proposal to develop the WDA requires to be considered against the existing pipeline of offshore wind development in the Moray Firth. The construction of the WDA would take place after the construction of BOWL, and after construction of the MORL EDA, and would therefore provide enterprises associated with that work the opportunity of further future markets.

This dynamic requires to be considered as part of the socio-economic impact assessment.

As discussed in Section 1.3.2.6 above, the method for cumulative impact assessment will be carried out in accordance with the methods outlined within the MFOWDG discussion document 'Moray Firth Offshore Wind Developers Group Cumulative Impact Assessment Discussion Document' (MORL, 2012) unless otherwise agreed with MS-LOT and appropriate stakeholders. This document has been included as Annex 1 to this Scoping Report.

4.7.6 Potential Mitigation Measures

No significant negative effects were assessed in the MORL ES 2012 for the MORL EDA, so no mitigation was necessary. MORL is working closely with the local supply chain and with the relevant local and national enterprise agencies, and will continue to do so in order to enable best advantage to be taken of the opportunities which the WDA offers to deliver economic growth.

4.8 Other Human Activities

4.8.1 Baseline Characteristics

This section describes the Other Human Activities baseline environment and potential effects associated with the WDA. Information on the WDA baseline characteristics have been derived mostly from the MORL ES 2012. The Other Human Activities ES Chapter and Technical Appendices can be accessed via the following links – Chapter 5.8 Other Human Activities and Technical Appendix 5.8 A UXO Threat and Risk Assessment. Table 4.8-1 below lists the proposed datasets that will inform the assessment.

Table 4.8-1 Datasets for the Other Human Activities EIA

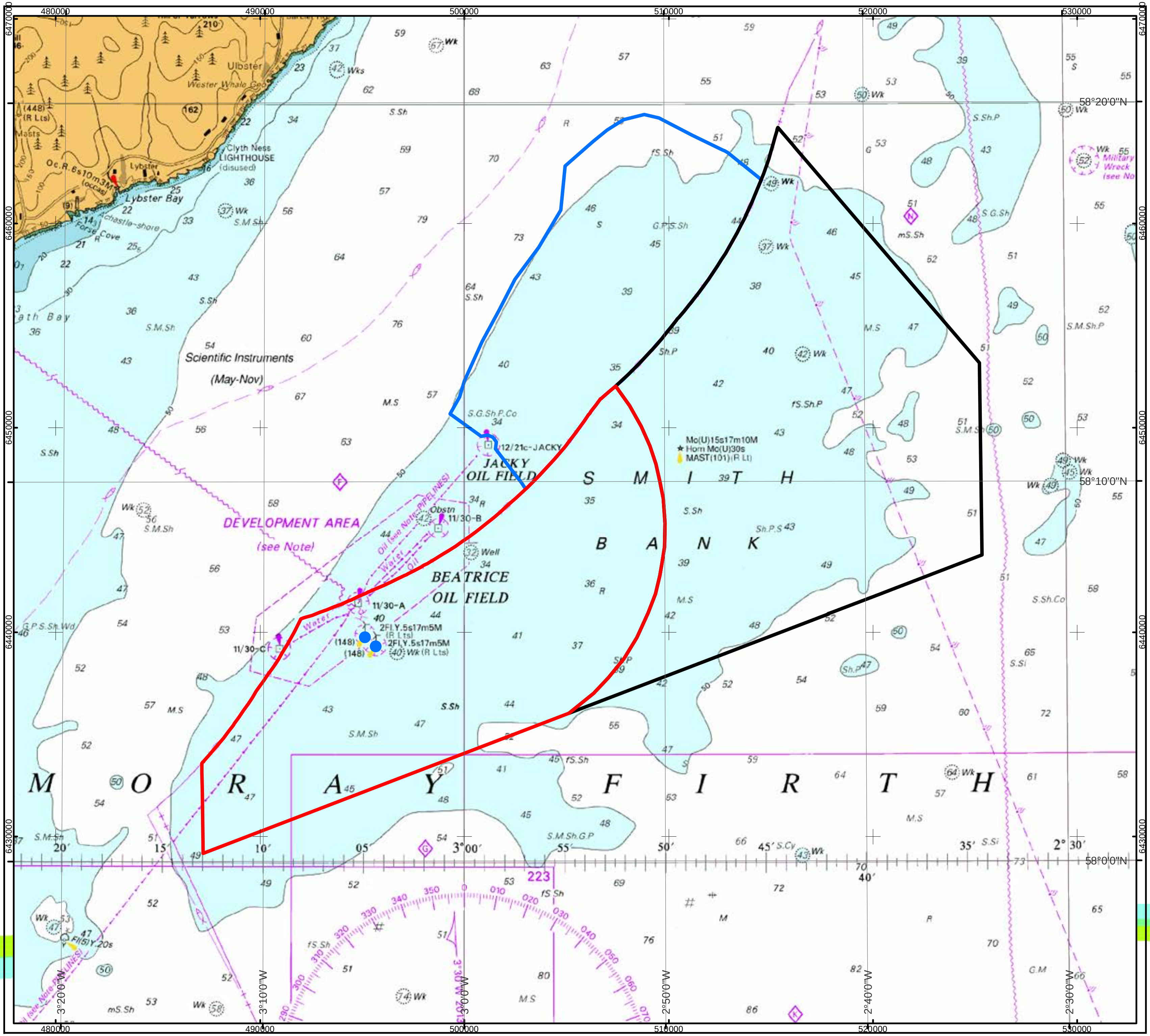
Dataset	**Coverage**	**Date**
High Level Screening Assessment (PagerPower)	MORL Zone	February 2009

It is proposed that the following guidance will inform the Other Human Activities assessment:

- European Subsea Cables Association guidelines;
- Oil and Gas UK best practice guidelines; and
- DECC Strategic Environmental Assessments Guidance (other marine users).

4.8.1.1 Offshore Wind Farms

The Beatrice Wind Farm Demonstrator Project is located within the Beatrice Oil Field, in the north-west of the WDA (see Figure 4.8-1 below). It is comprised of two 5 MW wind turbines and was developed in 2007 by Scottish and Southern Energy (SSE) and Talisman Energy. All electricity generated is fed to a nearby oil platform. It is understood that these turbines will be decommissioned at the same time as the Beatrice Oil Field infrastructure. Decommissioning of the oil and gas infrastructure is expected to start in 2017 with decommissioning activity for the Jacky Platform.



Moray Offshore Renewables Ltd

KEY

- ● Beatrice Demonstrator Turbines
- 🟦 BOWL
- 🟥 Western Development Area
- ⬛ Eastern Development Area

Horizontal Scale: 1:250,000

A4 Chart

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: AH
Approved: SP

Date: 04/05/2016

Revision: A

REF: 8460001-PQW0010-MOR-MAP-035

Figure 4.8-1
Offshore Wind Interests Adjacent to WDA

Moray Offshore Renewables Ltd

In 2014, the joint venture BOWL (initially a partnership of SSE Renewables and Repsol Nuevas Energias, currently owned by SSE Renewables, Copenhagen Infrastructure Partners and State Development and Investment Corporation) was awarded consent to develop the Beatrice Offshore Wind Farm in Scottish Territorial Waters. The BOWL lease area lies adjacent to the north-east boundary of the MORL Zone. MORL and BOWL have agreed that each will maintain a separation distance from the boundary between their respective sites based on five times the rotor diameter that each developer selects for their own site. BOWL has selected Siemens SWT-7.0-154 for use on its site which has a rotor diameter of 154 m (BOWL, 2015a). Accordingly, no turbines will be located within 770 m of the MORL / BOWL boundary on the BOWL site (BOWL 2015). In terms of the MORL EDA consents the rotor diameter MORL is permitted to use on the MORL EDA wind farm sites is between 150 and 172 m. MORL has not reached project definition for the MORL EDA sites and accordingly the separation distance cannot be confirmed other than it will be between 750 m and 860 m. The BOWL wind farm is adjacent to the WDA only in the extreme north-east corner (see Figure 4.8-1 below). The BOWL Wind Farm will comprise up to 84 WTGs with a total capcity of 588 MW (BOWL, 2015a) and construction is programmed to commence in April 2017 (BOWL, 2015b). It is possible that there will be some overlap in the BOWL and MORL EDA construction schedules. However, it is also expected that the BOWL Wind Farm will be fully commissioned before the construction of the WDA commences.

An agreement will be made between the MORL EDA and WDA wind farms for the appropriate separation distance between wind farm boundaries. It is currently anticipated that the MORL EDA will be fully commissioned prior to commencement of construction on the WDA.

4.8.1.2 Offshore Oil and Gas

The WDA overlaps active, but as yet unexplored licence blocks issued in past oil and gas licensing rounds. These recently included the 26th licensing round in 2010 and the 28th licensing round in 2014. Table 4.8-2 below lists the known extant licences within the vicinity of the WDA (DECC, 2016b).

Table 4.8-2 Known extant licences within the vicinity of the WDA (DECC, 2016b)

Licence Name	Block/Quad	Operator	Licence Type	Expiry date
P187	11/30a	Talisman Sinopec Energy UK Ltd	Traditional	15/03/2018
Not yet available	11/30b	Statoil	Traditional	Not yet available (28th Round)
P1031	12/21a	Talisman Sinopec Energy UK Ltd	Traditional	01/08/2037
P1888	12/21b	Zennor Pathway Ltd	Promote	31/01/2038
P1392	12/21c	Ithaca Energy (UK) Ltd	Traditional	21/12/2031
Not yet available	12/21d	Suncor Energy	Traditional	Not yet available on DECC website (28th Round)

Licence Name	**Block/Quad**	**Operator**	**Licence Type**	**Expiry date**
P982	12/26a	Talisman Sinopec Energy UK Ltd	Traditional	22/12/2034
Not yet available	18/1	Suncor Energy	Traditional	Not yet available on DECC website (28th Round)
Not yet available	18/2	Suncor Energy	Traditional	Not yet available on DECC website (28th Round)

Suncor Energy have been awarded licences within the 28th licensing round for blocks 12/21d, 18/1 and 18/2. Details of the licence name and timescales attached to these licences are not yet available. Block 12/21d is within the existing Beatrice Oil Field while blocks 18/1 and 18/2 will not have an effect on the WDA wind farm as they are outwith the area. The blocks could potentially have an effect on the WDA export cable route which is outwith the scope of this Scoping Report.

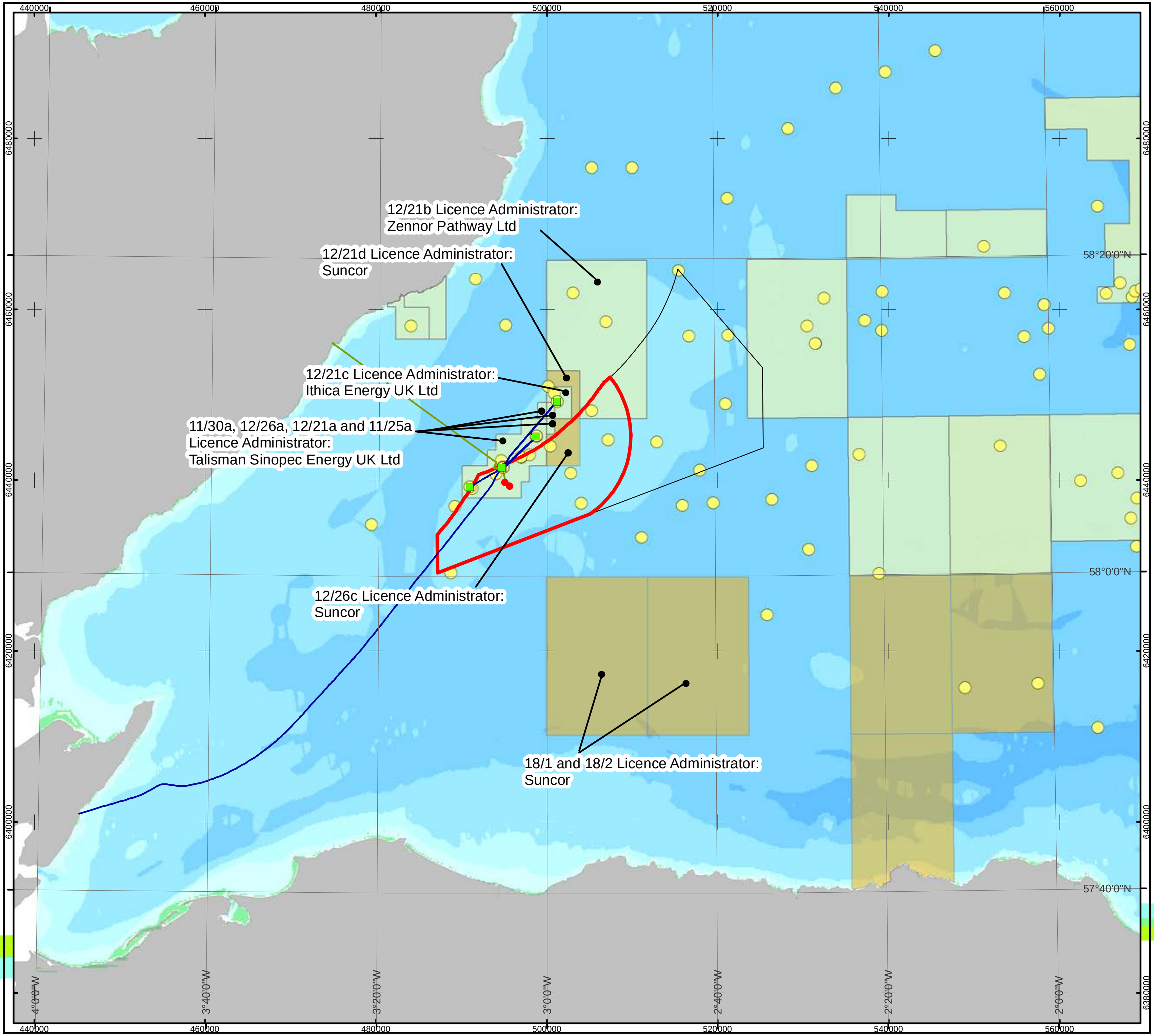
Suncor carried out exploration activity in the inner Moray Firth in 2015 in order to assess the Niobe field (blocks 12/26b and 12/27). Following exploration activities in 2015 this licence has since been surrendered on 01/12/2016 (DECC, 2016b).

Infrastructure currently exists on Block 11/30a (the Beatrice Oil Field) and Block 12/21c (the Jacky Platform) (See Figure 4.8-2 below). The Beatrice Field commenced production in 1981 and is currently owned by Talisman Energy and operated by Ithaca Energy, while the Jacky Platform commenced production in 2009 and is currently owned and operated by Ithaca Energy. The Beatrice Field includes three platforms: Beatrice Alpha, Beatrice Bravo and Beatrice Charlie. There is also a mid-line structure between Beatrice Alpha and the Jacky Platform which was installed in 2008. All infrastructure is located to the north-west of the WDA. The platform distances from the WDA boundary is as follows:

- Jacky Platform – 2870 m outwith the WDA boundary;
- Beatrice Alpha (p) Platform – 246 m within WDA boundary;
- Beatrice Alpha (d) Platform – 275 m within WDA boundary;
- Beatrice Bravo Platform – 1228 m outwith WDA boundary; and
- Beatrice Charlie Platform – 204 m outwith the WDA boundary.

MORL understands that decommissioning of the Beatrice Oil Field is currently anticipated to commence in 2017 and complete in 2021. It is also understood from Ithaca Energy that preparatory works for decommissioning of the Jacky Platform may commence in the summer of 2016 with removal of the platform expected to take place in 2017 subject to receiving DECC consent.

Finally, as shown in Figure 4.8-2 below there are 45 well heads within the WDA, 12 plugged and abandoned, 29 completed and 4 suspended wells.



renewables

Moray Offshore Renewables Ltd

KEY

- 🟩 Beatrice and Jacky Platforms
- ● Beatrice turbine
- — Subsea Cables
- — Pipelines
- ▭ Western Development Area
- ▭ Eastern Development Area
- ○ Wellheads
- 🟩 Blocks currently under licence
- 🟧 28th Round - Second Tranche Provisional Awarded Blocks

Horizontal Scale: 1:600,000
A4 Chart
0 6,000 12,000 Meters
N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
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Date: 04/05/2016
Revision: A

REF: 8460001-PQW0010-MOR-MAP-036

Figure 4.8-2
Oil and Gas Licensing
Moray Firth

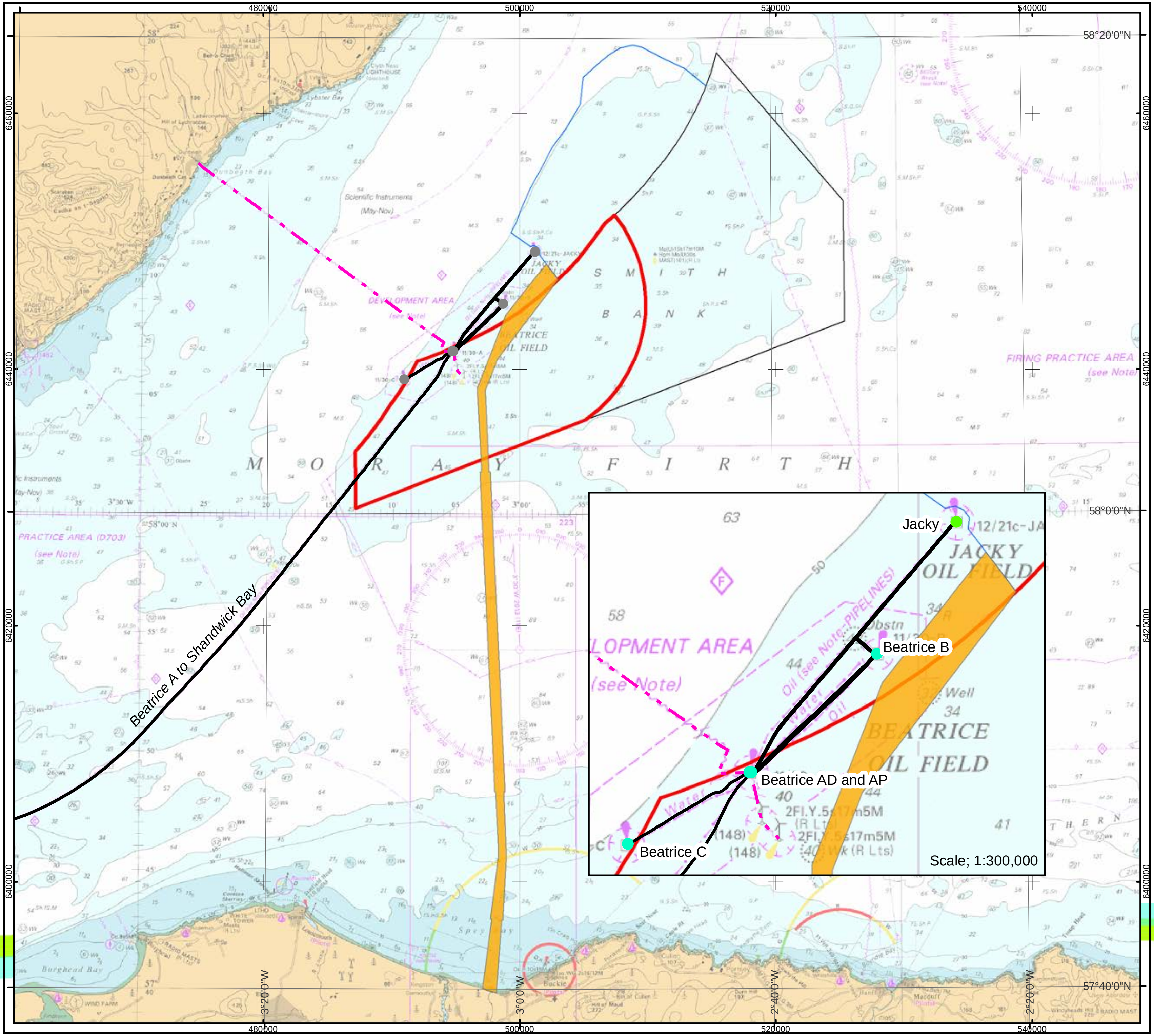
Moray Offshore
Renewables Ltd

4.8.1.3 Subsea Cables and Pipelines

There are no existing sub-sea cables within the WDA boundaries.

The BOWL consented export cable route corridor crosses the centre of the WDA as shown in Figure 4.8-3 below. Up to four cables will be buried within this cable corridor. It is likely that the WDA inter-array cabling will need to cross the BOWL export cable and consultation with BOWL will be undertaken.

Oil and gas extracted from the Beatrice Oil Field is exported to shore via an installed pipeline (see Figure 4.8-3 below). This pipeline crosses the north-west corner of the WDA and runs to shore at Nigg in the Cromarty Firth. As part of the decommissioning activity for the Beatrice oil field the pipeline it is anticipated that this will be plugged and left in situ.



Moray Offshore Renewables Ltd

KEY

- ● Beatrice and Jacky Platforms
- - · - Beatrice Field Subsea Cable
- — Beatrice Field Pipeline
- 🟧 BOWL Export Cable Corridor
- □ BOWL
- 🟥 Western Development Area
- □ Eastern Development Area

Horizontal Scale: 1:400,000

A4 Chart

0 5,000 10,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
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Date: 03/05/2016 Revision: B

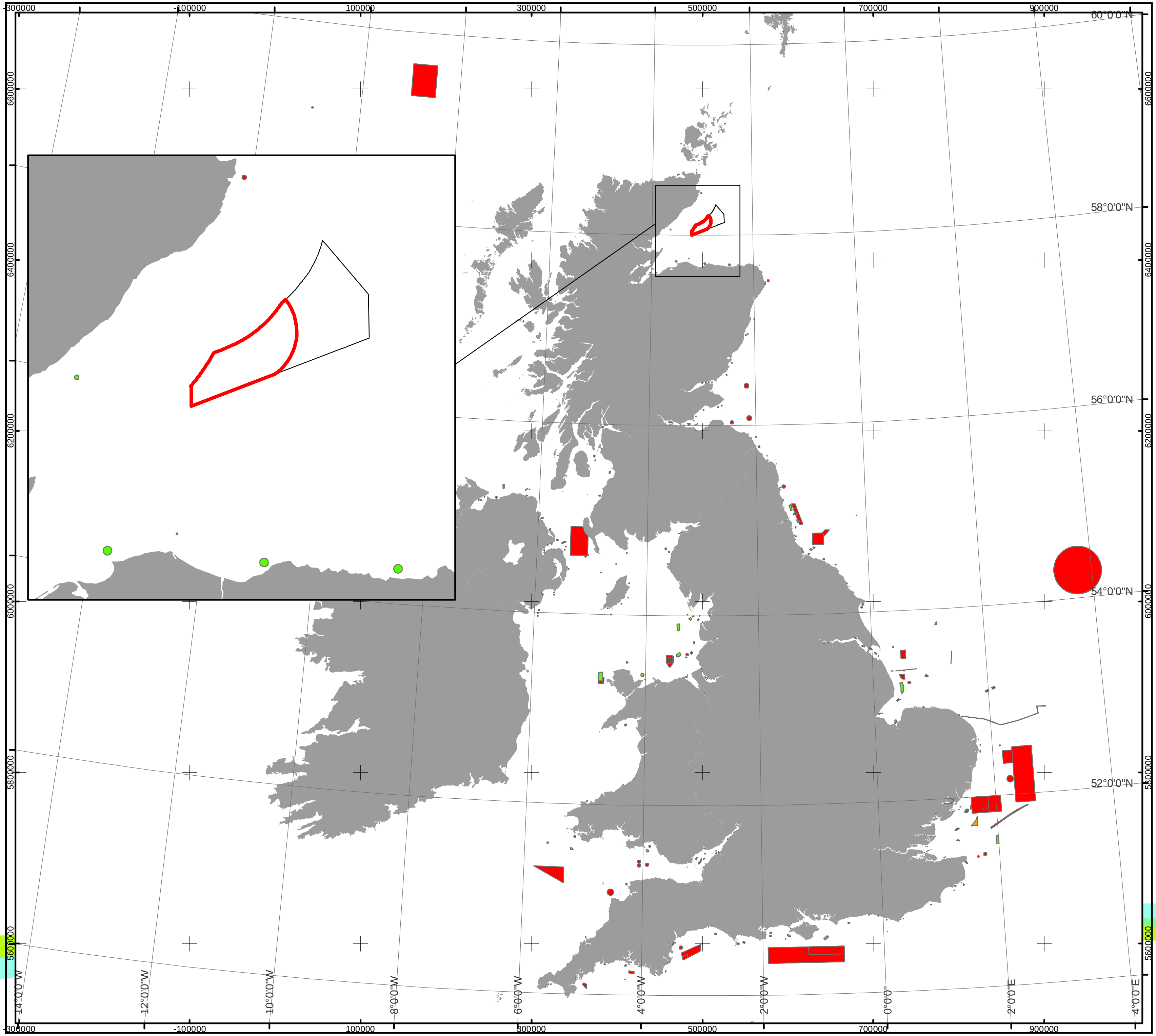
REF: 8460001-PQW0010-MOR-MAP-037

Figure 4.8-3
Subsea Cables and Pipelines Adjacent to WDA

Moray Offshore Renewables Ltd

4.8.1.4 Marine Disposal, Dumping and Dredging

Dredging and disposal activity within the Moray Firth is sporadic and associated with ports, harbours and coastal marine disposal sites (see Figure 4.8-4 below). Activities are therefore located some distance from the WDA. The closest 'open' marine disposal site is Helmsdale 24.5 km west of the WDA. Burghead and Buckie are 35 km and 36 km from the WDA respectively and Macduff is 48 km south-west of the WDA.



edp renewables

Moray Offshore Renewables Ltd

KEY

▭ Western Development Area
▭ Eastern Development Area

Marine Disposal Site Status

🟥 Closed
🟩 Open
🟧 Disused

Horizontal Scale: 1:6,000,000
A4 Chart
0 50,000 100,000 Meters
N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: RH
Reviewed: AH
Approved: SP

Date: 26/04/2016
Revision: A

REF: 8460001-PQW0010-MOR-MAP-038

Figure 4.8-4
Marine Disposal
Moray Firth

Moray Offshore
Renewables Ltd

4.8.1.5 Telecommunications

An initial screening exercise of potential effects of the development of the Moray Firth Round 3 Zone on telecommunications was undertaken in 2009 (Pager Power, 2009). It was concluded that development of the MORL Zone would not interfere with existing microwave links, scanning telemetry or non-aviation radar and would not cause TV or radio interference. Further to this, in April 2013, the BBC Wind Farm Assessment Tool was used to determine effects on TV reception from the MORL EDA wind farm sites. It was concluded that no homes would be affected.

4.8.1.6 Unexploded Ordnance

MORL commissioned a desk-based study (6 Alpha Associated Ltd, 2011) to identify the risk posed to the MORL Zone by UXO, and to identify potential measures by which any risks may be reduced to an acceptable level. The study identified potential UXO sources based on analysis of a variety of data and presents the results of a UXO risk assessment which considered the hazards associated with the potential UXO sources. The study also recommends measures to be taken to minimise the risk posed by potential sources of UXO.

UXO risk within the WDA is primarily the result of munitions and weaponry employed during World War I and World War II: sea-dumped munitions / explosives, shipwrecks carrying munitions / explosives, and sea mines represent the main sources of UXO within the region.

4.8.2 Data Gaps

Sufficient information currently exists for human activity receptors in order to inform EIA. Active dialogue will continue with all relevant organisations.

4.8.3 Potential Effects

4.8.3.1 Summary of Potential Effects

Potential Effect	**Construction**	**Operation**	**Decommissioning**	**Scoped Out**
Effects on Other Offshore Wind Farms	✓	✓	✓	×
Effects on Oil Operations and Structures	✓	✓	✓	×
Effects on Subsea Cables and Pipelines	✓	×	✓	×
Effect on Dredging and Disposal Activity	×	×	×	✓
Health and Safety Risk due to Unexploded Ordnance	✓	✓	✓	×
Effect on Tele-communications	×	×	×	✓

Whilst a specific assessment will be carried out in relation to the WDA, given the proximity of the MORL EDA and WDA and the potential for similarities in relation to potential effects, the findings of the MORL EDA Other Human Activity assessment have been included below for context.

4.8.3.2 Potential Effects During the Construction Phase

Effects on Other Offshore Wind Farms

The Beatrice Demonstrator Turbines are located in the north-west of the WDA. It is MORL's understanding that the Beatrice Demonstrator turbines will be decommissioned at the same time as the Beatrice Oil Field. As such, the Demostrator turbines will not be affected by the construction of the WDA.

The WDA is also directly adjacent to the consented but not yet constructed BOWL project. It is considered unlikely, given the anticipated construction programme of BOWL, that the construction phase of the WDA will coincide. BOWL is anticipated to commence construction in April 2017 with final commissioning scheduled to complete in 2019. It is not anticiplated the construction programmes of the MORL EDA and the WDA will overlap.

It is highlighted that the assessments for the MORL EDA identified that any effect regarding interaction during construction with offshore wind farms would have no significant effect.

Effects on Oil Operations and Structures

Currently the Beatrice Field and Jacky Platform border the WDA boundary. It is understood that a decommissioning programme will commence in 2017 with a view to full decommissiong of all oil and gas infrastructure by 2021. It is also understood that the associated well heads will be plugged and abandoned and the oil and gas pipeline will be plugged and left in situ. MORL will factor the in-situ infrastructure in the final layout design should foundation types such as piled jackets or monoplies be seclected ensuring no development will take place within the immediate vicinity of this infrastsructure. MORL will safely micro-site any wind farm infrastructure to avoid any potential effects.

There are a number of plugged and abandoned well heads within the WDA. As with the infrastructure discussed above, depending on the foundation type selected, no development will take place in the immediate vicinity of the wells, with an anticipated micro-siting distance of up to 50 m. Any structures will be safely micro-sited to ensure all potential effects are avoided.

Oil and gas licence blocks overlapping the WDA have been awarded to several operators (See Table 4.8-1 above). MORL will seek to engage with all liecence holders in order to understand their exploration plans. It is possible that licence holders may wish to undertake seismic surveys within their licence blocks.

It is highlighted that the assessments for the MORL EDA identified that any construction effects regarding oil and gas operations and infrastructure would be of negligible magnitude and therefore minor significance. Since effects were considered significant within the MORL ES 2012 if they were above minor for this receptor, this was not considered to be a significant effect.

Effects on Subsea Cables and Pipelines

At the time of the WDA construction phase it is anticipated that the BOWL export cable will be installed within the WDA site. MORL will enter into a proximity agreement with BOWL (or their OFTO as appropriate) in order to define required separation distances between MORL infrastructure and the BOWL export cable.

It is anticipated that MORL's inter-array cables will be required to cross the BOWL export cable. A crossing agreement will be required for this activity.

It is highlighted that the assessments for the MORL EDA identified that, given no overlap with subsea cables and pipelines and no crossing of cables being required, no significant construction effects were predicted. It is anticipated that the receptor sensitivity will be higher within the WDA.

Health and Safety Risk due to Unexploded Ordnance

There is potential for UXO associated with historic military activity to be encountered on the seabed in the WDA. During construction, activites which have contact with the seabed, either directly (e.g. jack up vessel) or via the placement of material (e.g. foundations / scour protection), run the risk of disturbing UXO. This could potentially have damaging and dangerous effects to both employees and equipment.

It is highlighted that the assessments for the MORL EDA considered that, as human life is potentially at risk, the receptor sensitivity was high. With a magnitude of medium the pre-mitigation effect on this receptor was considered of major significance. Commitment to a pre-construction UXO survey and the production of UXO safety plans reduced this effect to not significant.

4.8.3.3 Potential Effects During the Operational Phase

Effects on Other Offshore Wind Farms

Activity associated with the operation of the WDA wind farm will be significantly reduced relative to the construction / decommissioning phases. There will be a 5 x rotor diameter separation distance between the WDA and BOWL sites. Maintenance vessels will require access to site during the operational phase.

It is highlighted that activity associated with the operation of the EDA wind farms and BOWL in the assessments for the MORL EDA identified that no significant effects are predicted due to the predetermined buffer between the sites and given that two maintenance events occurring concurrently in this area is considered extremely unlikely.

Effects on Oil Operations and Structures

As detailed above, the intentions of current oil and gas licence holders are unknown. Should licence holders seek to commence block exploration any seismic survey will be spatially restricted by the presence of turbines and inter-array cabling.

It is anticipated that all decommissioning activity related to the existing Beatrice Oil Field and Jacky Platform will be completed when the WDA site is operational.

It is highlighted that the assessments for the MORL EDA identified that any effect regarding oil operations would be of medium sensitivity and magnitude with a potential effect deemed of moderate significance.

Since effects were considered significant within the MORL ES 2012 if they were above minor for this receptor, it was considered to have the potential for a significant effect. In order to manage this risk MORL commited to ongoing consultation and co-ordination with operators

Health and Safety Risk due to Unexploded Ordnance

The natural process of the sea i.e. tidal action, movement of sand waves, waves and bad weather all contribute to the movement of objects on the seabed. Human activities such as trawling will also contribute to the movement of objects. Therefore, there is a risk of UXO moving into the wind farm site. This will have implications for maintenance and repair activites of infrastructure.

It is highlighted that the assessments for the MORL EDA identified that the effect will be limited as UXO will have been previously identified during pre-construction surveys. Therefore, no significant effects were predicted.

4.8.3.4 Potential Effects During the Decommissioning Phase

At this stage, decommissioning effects are envisaged to be similar to those described for the construction phase.

4.8.3.5 Potential Effects Scoped Out

Effects on Dredging and Disposal Activity

Given the distance of the WDA from this activity it is not considered that there will be any effects upon dredging and disposal activity or marine disposal sites. Therefore MORL proposes that potential effects on dredging and disposal activity is scoped out.

Effects on Telecommunications

Given the assessment High Level Screening Assessment undertaken in 2009 for the MORL Zone (PagerPower, 2009) and the conclusion of the BBC Wind Farm Assessment tool for the MORL EDA, MORL proposes that potential effects on telecommunications are scoped out.

4.8.4 Approach to EIA

4.8.4.1 Construction Phase

Potential Effect	**Effects on Other Offshore Wind Farms**
Study / Survey Proposed	In order to determine the potential for effects, available information from the relevant offshore wind farm developments will be analysed.
EIA Methodology	The available project information will be used to determine the likelihood of conflicting construction operations and an assessment of risk due to the existence of additional infrastructure.

Potential Effect	**Effects on Oil Operations and Structures**
Study / Survey Proposed	In order to determine the potential for effects available information from oil and gas licence owners will be utilised. Primary data will be available through ongoing consultation with all owners and operators.
EIA Methodology	The available project information will be used to determine the likelihood of conflicting construction / decommissioning operations and an interpretation of risk due to the existence of additional infrastructure and the potential for further exploration.

Potential Effect	**Effects on Subsea Cables and Pipelines**
Study / Survey Proposed	In order to determine the potential for effects available information from the relevant cable and pipeline owners will be utilised. Primary data will be available through ongoing consultation with all owners and operators.
EIA Methodology	The available information will be used to determine the likelihood of conflicting construction operations and an interpretation of risk due to the existence of additional infrastructure.

Potential Effect	**Health and Safety Risk due to Unexploded Ordnance**
Study / Survey Proposed	In order to determine the potential for effects desk based research will be undertaken to understand the past history of military activity on the site and the likelihood of the existence of UXO.
EIA Methodology	The available information will be used to determine the likelihood of UXO discoveries on-site and an interpretation of risk. MORL will commit to undertake a pre-construction UXO identification survey to reduce the risk of an unexpected discovery.

4.8.4.2 Operation Phase

Potential Effect	**Effects on Other Offshore Wind Farms**
Study / Survey Proposed	See table above in 4.8.4.1
EIA Methodology	See table above in 4.8.4.1

Potential Effect	**Effects on Oil Operations and Structures**
Study / Survey Proposed	See table above in 4.8.4.1
EIA Methodology	See table above in 4.8.4.1

Potential Effect	**Health and Safety Risk due to Unexploded Ordnance**
Study / Survey Proposed	See table above in 4.8.4.1
EIA Methodology	See table above in 4.8.4.1

4.8.5 Cumulative and In-combination Effects

There is foreseeable potential for the extent or magnitude of any effects identified in Section 4.8.3 above to be cumulatively increased by the simultaneous presence of other existing or proposed activities or developments. The extent to which these cumulative effects may arise will depend upon the design and extent of the infrastructure or the frequency and intensity of the activities.

As discussed in Section 1.3.2.6 above, the method for cumulative impact assessment will be carried out in accordance with the methods outlined within the MFOWDG discussion document 'Moray Firth Offshore Wind Developers Group Cumulative Impact Assessment Discussion Document' (MORL, 2012) unless otherwise agreed with MS-LOT and appropriate stakeholders. This document has been included as Annex 1 to this Scoping Report.

4.8.6 Potential Mitigation Measures

Mitigation measures proposed for the development area (if required) will be dependent upon the final design of the site and the potential effects as determined by the EIA studies. MORL are committed to standard industry measures and options will be discussed with the relevant authorities prior to ES submission. In line with the EDA it is anticipated that MORL will commit to a pre-construction UXO survey and production of UXO safety plans. MORL will also continue consultation with Oil and Gas operators and licence owners.

5 Structure of EIA

The Environmental Statement is likely to presented in the following format:

Volume 1 – Non-Technical Summary

Volume 2 – Environmental Impact Assessment

(Cumulative and in-combination impact assessments will be presented within each discipline section)

Chapter 1 – Project Background

(Introduction, Policy and Legislation Summary (a separate Planning Statement will accompany the applications setting out in detail a policy assessment of the proposed project), Approach to EIA (including Scoping Responses Gap Analysis) and Stakeholder Consultation will be presented in this section).

Chapter 2 – Project Details

(Site Selection and Alternatives will be presented in this section together with the Project Description).

Chapter 3 – Physical Environment

3.1 Physical Processes - Bathymetry, Metocean, Geology Sedimentary Environment and Water Quality

Chapter 4 – Biological Environment

4.1 Designated Sites

4.2 Benthic Ecology

4.3 Fish and Shellfish Ecology

4.4 Marine Mammals

4.5 Ornithology

Chapter 5 – Human Environment

5.1 Commercial Fisheries

5.2 Shipping and Navigation

5.3 Military and Civil Aviation

5.4 Seascape, Landscape and Visual Assessment

5.5 Archaeology and Cultural Heritage

5.6 Socio-economics

5.7 Other Human Activities

Chapter 6 –Summary

6.1 Summary Chapter

6.2 Habitats Regulations Appraisal (HRA) Summary *(HRA information will be provided in a separate standalone HRA Report and a brief overview will be included within relevant discipline sections and summarised in this chapter).*

Volume 3 – Figures

Volume 4 – SLVIA Photomontages and Visualisations

Volume 5 - Technical Appendices

It is anticipated that each EIA discipline chapter will be structured accordingly:

- **Introduction** – Introduces the topic under discussion and sets out the consultation carried out, the baseline and relevant legislation, policy and guidance;
- **Summary** – Summary table of all impact assessment outputs;
- **Design Envelope parameters** – Sets out the realistic worst case scenario in terms of the WDA parameters relevant to the EIA discipline being assessed;
- **EIA Methodology** – Description of the impact assessment methodology utilised;
- **Impact Assessment** – Assessment of the likely significant effects arising from the WDA;
- **Proposed Monitoring and Mitigation** – Description of proposed mitigation measures during construction, operation and decommissioning phases, based upon likely significant effects;
- **Cumulative Impact Assessment** – Assessment of the likely significant cumulative effects arising as a result of interactions between the WDA and other existing and reasonably foreseeable projects and activities;
- **Habitats Regulations Appraisal (HRA)** – where impact assessment chapters consider the potential for effects on Natura 2000 sites, then a summary of the information to support an Appropriate Assessment is presented. The relevant disciplines to which HRA applies in this ES are Fish and Shellfish Ecology, Marine Mammals and Ornithology. As indicated by the ES structure above an HRA Summary chapter will also be produced, which gathers together the conclusions of all the chapters that have considered HRA; and
- **Whole Project Assessment** – Assessment of the Project as a whole should the Wind Farm EIA be progressed ahead of the OFTO EIA.

6 Summary

Table 6.1-1 below provides a high level summary of the potential effects identified for all physical, biological and human environment receptors. The purpose of this summary table is to indicate where MORL believe the key issues in the WDA have potential to exist based on current knowledge of the site and outcomes of the MORL EDA EIA. In addition, the table highlights areas where potential effects have been scoped out or it is believed there will be no effect. The following categories have been used:

-	**Potentially significant effects identified (pre-mitigation). Parameter to be included in the EIA.**
0	No potential effect.
N/A	Effect scoped out of EIA.
+	Potentially significant positive effects identified. Parameter to be included in the EIA.

Table 6.1-1 Summary of Potential Effects

Potential Effect	**Construction**	**Operation**	**Decommissioning**
Physical Processes			
Increase in suspended sediment concentrations as a result of foundation installation activities	-	0	-
Accumulation of sediment and change of sediment type at the seabed as a result of foundation installation activities	-	0	-
Increase in suspended sediment concentratations as a result of inter-array cable installation	-	0	0
Indentations left on the seabed by jack-up vessels and large anchors	-	-	-
Changes to the tidal regime due to the presence of turbine foundations	0	-	0
Changes to the wave regime due to the presence of turbine foundations	0	-	0
Changes to the sediment transport regime and geomorphology due to the presence of the turbine foudnations	0	-	0
Scour effects due to the presence of the turbine foundations	0	-	0

Potential Effect	**Construction**	**Operation**	**Decommissioning**
Scour effects due to the exposure of inter-array cables and cable protection measures	0	-	0
Air Quality			
No potential effects identified, receptor scoped out of further assessment	N/A	N/A	N/A
Airborne Noise			
No potential effects identified, receptor scoped out of further assessment	N/A	N/A	N/A
Designated Sites			
Potential effect addressed in Benthic Ecology, Fish and Shellfish Ecology, Marine Mammals and Ornithology	N/A	N/A	N/A
Benthic Ecology			
Temporary Direct Seabed Disturbances	-	-	-
Temporary Indirect (Sediment) Disturbances	-	0	-
Seabed Deposition of Sediment Arisings from Drilling of Jacket Piles and Dredge Material from Seabed Preparation	-	0	0
Seabed Contamination as a Result of Accidental Spillage of Chemicals	-	-	-
Net Reduction of Area of Seabed Habitat	0	-	0
Habitat and Associated Community Change	0	-	0
Effects on Physical Processes and Related Biological Changes	0	-	0
Fish and Shellfish Ecology			
Temporary disturbance to the seabed (including smothering)	-	0	-
Underwater noise from piling activity	-	0	-
Loss/ damage/ change of habitat	-	-	-
Introduction of new habitats / habitat creation	0	- / +	0

Potential Effect	**Construction**	**Operation**	**Decommissioning**
Electromagnetic Fields	0	-	0
Operational noise	0	-	0
Changes to fishing activity	0	-	0
Marine Mammals			
Hearing Damage	-	0	-
Disturbance / Displacement	-	0	-
Collision risk from vessels	-	-	-
Reduction in Prey Availability	-	-	-
Reduction in Foraging Ability	-	0	-
Toxic Contamination (Scoped Out)	N/A	N/A	N/A
Long Term Avoidance as a result of Operational Noise (Scoped Out)	N/A	N/A	N/A
Stranding Due to Electromagnetic Fields (Scoped Out)	N/A	N/A	N/A
Ornithology			
Disturbance	-	0	-
Disturbance / Displacement	0	-	0
Collision Risk	0	-	0
Barrier Effects	0	-	0
Commercial Fisheries			
Adverse effects to commercial fish and shellfish populations (indirect effect upon commercial fishing activities)	-	-	-
Adverse effects on recreational fish populations (indirect effect upon recreational activities)	-	-	-
Temporary or complete loss or restricted access to traditional fishing grounds	-	-	-
Safety issues for fishing vessels	-	-	-
Increased steaming times to fishing grounds	-	0	-

Potential Effect	Construction	Operation	Decommissioning
Displacement of fishing vessels into other areas	-	-	-
Interference with fishing activities	-	-	-
Obstacles on the seabed post construction	0	-	-
Shipping and Navigation			
Disruption to commercial shipping	-	-	-
Disruption to fishing vessels	-	-	-
Disruption to recreation vessels	-	-	-
Disruption to SAR operations	-	-	-
Disruption to SAR helicopter operations	-	-	0
Radar interference on marine equipment	0	-	0
Aviation			
Degradation of NERL Allanshill Primary Surveillance Radar	0	-	0
Degradation of RAF Lossiemouth Primary Surveillance Radar	0	-	0
Degradation of ASACS Buchan ADR (Scoped Out)	N/A	N/A	N/A
Effects on operations at Wick Airport	0	-	0
Effects on operation of HMR X-Ray	0	-	0
Effects on operations at offshore installations	0	-	0
Increase in minimum safe altitude	0	-	0
Seascape Landscape and Visual Impact Assessment			
Change in seascape character	-	-	-
Change in visual resource	-	-	-
Archaeology and Cultural Heritage			
Contamination, damage or loss of archaeological remains in or on the seabed	-	0	-

Potential Effect	Construction	Operation	Decommissioning
De-stabilisation of sites through changed sedimentary regimes	-	0	-
Indirect effect due to changes to the setting of designated cultural heritage receptors	-	-	-
Other Human Activities			
Effects on Other Offshore Wind Farms	-	-	-
Effects on Oil Operations and Structures	-	-	-
Effects on Subsea Cables and Pipelines	-	0	-
Effect on Dredging and Disposal Activity (Scoped Out)	N/A	N/A	N/A
Health and Safety Risk due to Unexploded Ordnance	-	-	-
Effect on Tele-communications (Scoped Out)	N/A	N/A	N/A
Socio-economics			
Employment	+	+	+
Gross Value Added	+	+	+
Tourism (Scoped Out)	N/A	N/A	N/A
Surfing, Sea-Kayaking and Walking (Scoped Out)	N/A	N/A	N/A

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Annex 1 - Moray Firth Offshore Wind Developers Group Cumulative Impacts Assessment Discussion Document

Beatrice
Offshore Windfarm Ltd

moray offshore renewables ltd

Moray Firth Offshore Wind Developers Group

Cumulative Impacts Assessment Discussion Document

April 2011

SSE Renewables

SeaEnergy RENEWABLES

edp renewables

This document was produced by ERM on behalf of Moray Offshore Renewables Ltd and Beatrice Offshore Windfarm Ltd

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Glossary

AIS	Automatic Identification System
BWEA	British Wind Energy Association (now known as Renewable UK)
BOWL	Beatrice Offshore Windfarm Limited
CEFAS	Centre for Environment, Fisheries & Aquaculture Science
CIA	Cumulative Impact Assessment
COWRIE	Collaborative Offshore Wind Research into the Environment
CPA	Coast Protection Act
DTI	Department for Trade and Industry
EC	European Commission
EIA	Environmental Impact Assessment
ES	Environmental Statement
FEPA	Food and Environment Protection Agency
FTOWDG	Forth and Tay Offshore Wind Developers Group
FIR	Fishing Industry Representatives
HMR	Helicopter Main Route
ICES	International Council for the Exploration of the Sea
IEMA	Institute of Environmental Management and Assessment
IFG	Inshore Fisheries Groups
IMO	International Maritime Organization
JNCC	Joint Nature Conservation Committee
LSVIA	Landscape and Visual Impact Assessment
MCA	Maritime and Coastguard Agency
MOD	Ministry of Defence
MFOWDG	Moray Firth Offshore Wind Developers Group
MMO	Marine Management Organisation
MORL	Moray Offshore Renewables Limited
MS	Marine Scotland
MSS	Marine Scotland Science
NATS	National Air Traffic Services
OFTO	Offshore Transmission Owner
PHA	Preliminary Hazard Assessment
PSR	Preliminary Surveillance Radar
RSPB	Royal Society for the Protection of Birds
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SFF	Scottish Fishermen Federation
SHETL	Scottish Hydro-Electric Transmission Ltd
SNCAs	Scottish Nature Conservation Authorities
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TMZ	Transponder Mandatory Zone
VMS	Vessel Monitoring System
ZTV	Zone of Theoretical Visibility

Executive Summary

The development of offshore wind within Scottish waters is of an unprecedented scale and the potential for cumulative impacts on environmental features has become one of the most important aspects of the consenting process for offshore wind developments. In recognition of this, the Moray Firth Offshore Wind Developers Group (MFOWDG) was formed by Beatrice Offshore Windfarm Limited (BOWL) and Moray Offshore Renewables Limited (MORL) in partnership with The Crown Estate to work collaboratively on potential regional cumulative impacts arising from their proposed offshore wind development.

Based on the responses of the recent scoping reports released by both companies and using guidance from specialist consultants, the potential cumulative impacts on the physical, biological and human environment have been identified. This report outlines and requests feedback from consultees on the proposed cumulative methodologies or approaches to cumulative methodology development that MFOWDG have developed. The preparation of the cumulative methodologies has taken into account, and incorporated where appropriate, the recent work on cumulative methodologies by the Forth and Tay Offshore Wind Developers Group (FTOWDG). The overall aim of this document is to provide details of how the Moray Firth wind farm developers propose to undertake consistent cumulative impact assessments for their respective developments.

The following table outlines the current status of the proposed methodologies that are included within the following report. MFOWDG would like to encourage stakeholders and consultees to feedback on these proposed methodologies in order to inform the finalisation of the methodologies.

Current Status of the Proposed Methodologies

Receptor	Potential Cumulative Effects	Approach to Assessment
Designated Sites	▪ Effects on site conservation objectives and status	▪ Approach addressed in other relevant sections; see Physical Processes & Geomorphology, Benthic Ecology, Fish Ecology, Marine Mammals and Ornithology
Physical Processes and Geomorphology	▪ Changes to the hydrodynamic environment (waves, tides and currents). ▪ Changes to sedimentary processes and structures (sediment composition, properties, distribution, transport pathways, bedforms). ▪ Changes to suspended sediment concentration (on a variety of spatial and temporal scales). ▪ Indirect effects of the above on other sensitive receptors (e.g. benthic or pelagic ecology, socio-economic resources).	▪ Standardised data gathering ▪ Regional methodology proposed using a standardised modelling approach ▪ One regional assessment to be prepared to be used for individual site EIAs
Benthic Ecology	▪ Permanent net reduction in the total area of original habitat. ▪ Temporary seabed disturbances and effects on fauna. ▪ Increase in abundance of sessile colonial species. ▪ Temporary fining of particulate habitats as well as smothering and scour effects on benthic fauna. ▪ Release and increased bio-availability of sediment contaminants and pollutants from accidental spills.	▪ Standardised data gathering ▪ Regional assessment methodology proposed ▪ Assessments will be done by individual developers
Fish and Shellfish Ecology	▪ Disturbance to spawning activity and juveniles (nursery areas). ▪ Barrier to/change in migratory patterns. ▪ Behavioural changes derived from EMFs associated to cables. ▪ Changes in species composition and displacement of fish and shellfish resource. ▪ Direct impact during construction. ▪ Temporary and permanent loss of habitat. ▪ Changes in prey availability and displacement of food resource.	▪ Standardised data gathering ▪ Regional assessment methodology proposed ▪ One regional assessment to be prepared to be used for individual site EIAs

Receptor	Potential Cumulative Effects	Approach to Assessment
Marine Mammals	▪ Disturbance and potential displacement. ▪ Longer term avoidance of the development area by marine mammals. ▪ Increased collision risk. ▪ Reduction of the feeding resource. ▪ Changes in prey availability.	▪ Collaborative data gathering ▪ Regional methodology proposed ▪ One regional assessment to be prepared to be used for individual site EIAs
Ornithology	▪ Collision with turbines. ▪ Disturbance/displacement. ▪ Barrier effects. ▪ Indirect effects (e.g. changes in habitat or prey supply).	▪ Standardised and collaborative data gathering ▪ Regional methodology proposed ▪ Assessments will be done by individual developers
Seascape, Landscape and Visual Character	▪ Cumulative landscape and seascape effects. ▪ Cumulative landscape and seascape effects on each receptor / character. ▪ Cumulative visual effects.	▪ Approach to regional methodology preparation proposed ▪ Assessments will be done by individual developers
Marine Archaeology and Cultural Heritage	▪ Contamination, damage or loss of archaeological remains in or on the seabed. ▪ Destabilisation of sites through changed sedimentary regimes. ▪ Effects on setting of onshore cultural heritage assets.	▪ Standardised data gathering ▪ Approach to regional methodology preparation proposed ▪ Assessments will be done by individual developers
Aviation & MOD	▪ Clutter on primary radar. ▪ Shadow effect on primary radar. ▪ Obscuration effect on primary radar. ▪ Obstruction of helicopter instrument approach procedures to Beatrice platform. ▪ Obstruction of low level helicopter routes on HMR X-Ray in icing conditions. ▪ Obstruction of search and rescue helicopter operations within the wind farms.	▪ Approach to regional methodology preparation proposed
Shipping and Navigation	▪ Re-routing of shipping. ▪ Increased collision risk (vessel to vessel and vessel to turbine) during operation as well as during high levels of activities during construction operations. ▪ Cable interactions with anchors/fishing gear. ▪ Inhibited search and rescue. ▪ Interference of turbines with marine radar impacting on navigational safety.	▪ Standardised data gathering ▪ Approach to regional methodology preparation proposed

Receptor	Potential Cumulative Effects	Approach to Assessment
Commercial Fisheries	▪ Adverse impact on commercially exploited fish and shellfish populations. ▪ Complete loss or restricted access to traditional fishing grounds. ▪ Safety issues for fishing vessels. ▪ Interference with fisheries activities. ▪ Displacement of fishing vessels ▪ Increased steaming times to fishing grounds. ▪ Presence of seabed obstacles ▪ Adverse impact on recreational fish populations.	▪ Collaborative data gathering ▪ Approach to regional methodology preparation proposed
Underwater Noise	▪ Potential effects resulting from the cumulative effects of underwater noise are considered under the relevant receptor headings; see Section 4.4, fish ecology, Section 4.5, marine mammals and Section 4.6 ornithology.	▪ Collaborative data gathering ▪ Regional methodology proposed ▪ One regional assessment to be prepared to be used for individual site EIAs
Socio-economics	▪ Contribution to renewables targets. ▪ Provision of employment.	▪ Approach to regional methodology preparation proposed
Oil and Gas, Cables & Pipelines	▪ Risk of accidental damage to existing oil and gas infrastructure. ▪ Access to platforms by helicopter. ▪ Access to platforms by vessel. ▪ Direct physical impacts due to anchoring of construction vessels. ▪ Potential cumulative effects on submarine marine cables include burial or exposure due to altered marine sediment dynamics.	▪ Approach to regional methodology preparation proposed
Onshore Traffic & Transport	▪ Changes in traffic flow to and from supply ports during construction and operational phases.	▪ Approach to assessment proposed

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1. INTRODUCTION

1.1 Background to Discussion Document

The Moray Firth Offshore Wind Developers Group (MFOWDG) has been set up as a working group composed of Beatrice Offshore Windfarm Limited (BOWL) and Moray Offshore Renewables Limited (MORL). The aim of the working group is to develop and agree common approaches to environmental data gathering and interpretation to inform the Environmental Impact Assessment (EIA), particularly the Cumulative Impact Assessment (CIA) element and other project related issues. The aim of this document is to present MFOWDG's common approach and methodology to cumulative impact assessment.

BOWL is proposing an offshore wind farm of approximately 920 MW within Scottish Territorial Waters in the outer Moray Firth. MORL was awarded a Zone Development Agreement to develop Zone 1 of the nine UK Round 3 offshore zones. MORL has identified two potential development areas, Eastern and Western. MORL is proposing an installed capacity of between 1.3 – 1.5 GW of offshore wind within the Moray Firth Round 3 zone. The Eastern Development Area is currently considered to have the higher potential for early development and is being progressed first. The BOWL and MORL sites are shown on Figure 1.1 and the anticipated developer programmes are set out in Table 1.1.1.

Given the scale, nature and proximity of these developments, the issue of cumulative impacts will be a key consideration within the Environmental Impact Assessment (EIA) process for each proposed project. This working document has been produced by MFOWDG and presents the proposed approach to undertaking cumulative impact assessment as part of the individual EIAs of the proposed wind farms. The purpose of this document is to facilitate discussion with the regulators in order to come to an agreed approach to assessing cumulative impacts.

It should be noted that both the BOWL and MORL eastern development area proposals have already been subject to formal environmental scoping exercises. This discussion document does not constitute a further formal scoping exercise under the Environmental Assessment (Scotland) Regulations (1999).

The outputs from other offshore wind farm working groups e.g. the Forth and Tay Offshore Wind Developers Group (FTOWDG) have been taken into consideration in the development of this document to ensure that the various developers and sites are applying broadly consistent approaches to assessing cumulative impacts. The FTOWDG will be consulted in relation to potential cumulative impacts.

This document presents MFOWDG's proposed methodology for cumulative impact assessment. This is based on MFOWDG's current understanding and this may change through consultation and data gathering.

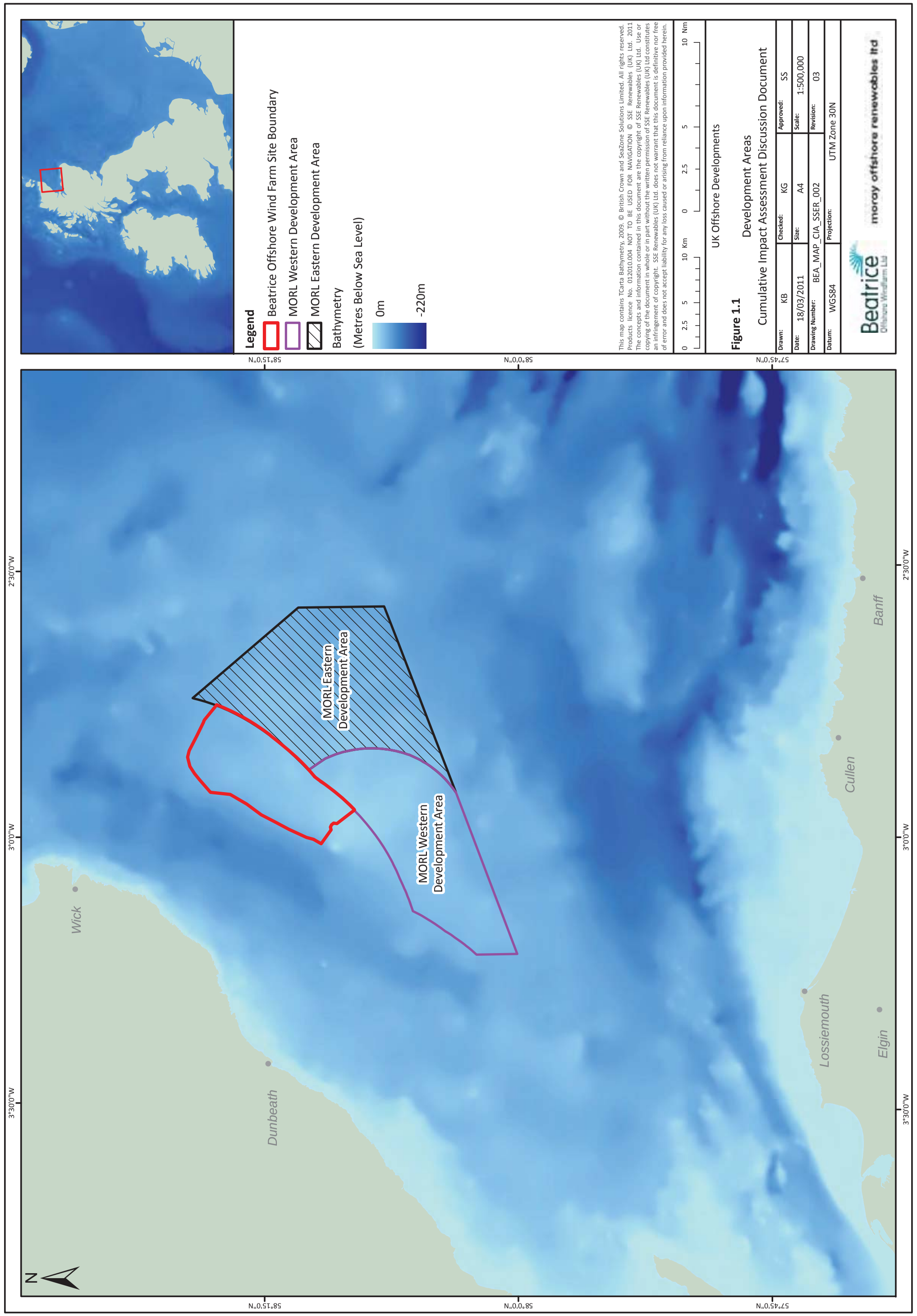


Table 1.1.1 Anticipated MFOWDG Developer Programmes

Milestones	Beatrice Offshore Wind Farm	Round 3 Zone 1, Eastern Development Area (Moray Offshore Renewables Ltd)	Round 3 Zone 1, Western Development Area (Moray Offshore Renewables Ltd)
Size (MW)	Up to 920 MW	Up to 1140 MW	Up to 360MW
MWa (km^2)	131.5	297	226
Scoping	March 2010	August 2010	TBC
EIA Design Freeze	April 2011	Q3 2011	TBC
Planning Application Submission	Q4 2011	Q2 2012	Q2 2014
Planning Decision	Q3 2012	Q2 2013	Q2 2015
Construction commencement	Q2 2014	Q2 2105	Q2 2019
First Export	Q2 2015	Q2 2016	Q2 2019

1.2 Document Objectives

The objectives of this discussion document are as follows:

- To present the approach and methodology proposed by MFOWDG for the collection of data to be used in the cumulative impact assessment;
- To present an approach and methodology to the assessment of cumulative impacts, for use by both MFOWDG developers as part of individual EIAs; and
- To invite comment from statutory and other key consultees and seek agreement of the approaches proposed by MFOWDG.

Section 5 sets out specific questions in relation to the proposed CIA. MFOWDG is particularly interested in your comments in relation to these questions.

1.3 Timescale for Consultation on the Cumulative Assessment Document

The following timeline is proposed for development and finalisation of the document:

- Consultation period – until 2 May 2011;
- Meeting with SNH/JNCC and other consultees as required – mid April 2011; and
- Incorporation of comments from consultees and finalisation of document – 30 May 2011.

1.4 Document Structure

The rest of this document is structured as follows:

Section 2 - Requirement for and definition of cumulative impact assessment
Section 3 - Receptors and potential significant cumulative effects
Section 4 - Assessment of effects
Section 5 - Consultee response template

Annex A – Methodology for Coastal Processes EIA
Annex B – Marine Mammal Data Gathering
Annex C – Ornithology – Autumn 2010 Migration Survey Report
Annex D – Underwater noise modelling method statement

Please note that all Annexes are commercial in confidence and should not be distributed outside of your organisation.

2. REQUIREMENTS AND DEFINITIONS

2.1 Requirement for Cumulative Impact Assessment

An EIA and subsequent Environment Statement must include a description of the likely significant cumulative effects of a development. This is specified in the European Commission EIA Directive (85/337/EEC as amended by 97/11/EC) and has been transposed into the various UK EIA Regulations applying to different consenting regimes.

In addition, for proposals that are likely to have a significant effect on a Natura 2000 site under the Conservation (Natural Habitats &c) Regulations 1994 (as amended) there is a requirement to assess the effects of the proposals alone and in combination with other plans or projects.

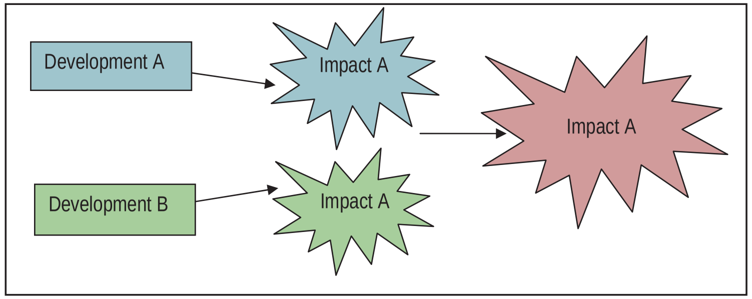
2.2 Definition of Terms

There is no single statutory definition of what a cumulative impact is, however guidance is provided as to how the term should be defined. The terms cumulative and in-combination are considered to be synonymous for the purposes of this document (1). European Commission guidance (2) provides the following definition of cumulative impacts and this is the definition used in this document.

> "Cumulative impacts are impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project"

Box 2.2.1 provides an illustration of this.

Box 2.2.1 Cumulative Impact



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(1)As recommended in the SNH/JNCC response to the FTOWDG second discussion document - cumulative impacts

(2)European Commission, May 1999. Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions

"Examples of cumulative impacts are as follows:

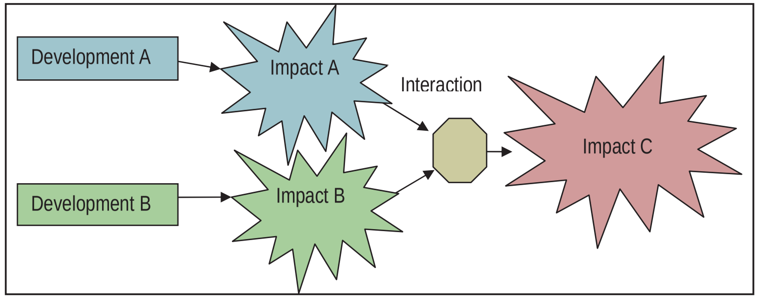
- Incremental noise from a number of separate developments;
- Combined effect of individual impacts, e.g. noise, dust and visual, from one development on a particular receptor; and
- Several developments with insignificant impacts individually but which together have a cumulative effect".

Additionally, the EC guidance refers to 'impact interactions' which themselves can combine to create a cumulative effect, defined as follows.

> "Impact interactions are the reactions between impacts whether between the impacts of just one project or between the impacts of other projects in the area".

Box 2.2.2 provides an illustration of this.

Box 2.2.2 Impact Interaction



Do you agree that the terms in-combination and cumulative impacts should be considered to have the same meaning in relation to HRA and EIA respectively?

2.3 The Differences Between Habitat Regulations Assessment and EIA

EIA requires each developer to identify both positive and negative impacts on the environment resulting from a development and to identify those impacts that are considered significant.

Habitats Regulations Appraisal (HRA) requires each developer to provide specific information to support decisions about whether their development, alone or in-combination, is likely to have a significant effect on the qualifying features of a European or Ramsar site or a European Protected Species. The decision must be based on whether the proposed development could undermine the conservation objectives of the site and affect site integrity. The information provided would then focus on these issues.

The approach proposed for the assessment of cumulative effects as part of both the HRA and EIA processes are set out in relevant topic sections (see Section 4.2 physical processes and geomorphology, Section 4.3 benthic ecology, Section 4.4 fish and shellfish ecology, Section 4.5 marine mammals and Section 4.6 ornithology.

2.4 EIA Assessment Criteria

A set of standardised cumulative impact assessment criteria will be defined by the MFOWDG in consultation with relevant consultees.

Relevant guidance will be used if available on a receptor by receptor basis. If guidance is not available, standard criteria will be used. These criteria will be agreed through specific consultations with relevant consultees.

2.5 Rochdale Envelope Approach and Project Extents

It is recognised by regulators that within the offshore wind industry some final design details will not be available to the EIA team at the time of application submission. For example, due to technological advances it is not certain what specific type or size of wind turbine would be best suited to a site until closer to the construction phase. Given this uncertainty it is accepted by regulators and consenting bodies that a ‘Rochdale envelope’ can be created, within which an EIA team can assess the maximum extents of the design parameters within which a consenting body can constrain a developer.

Both BOWL and MORL are working to define their individual Rochdale envelopes from which to undertake each EIA and HRA supporting documentation. Each of these envelopes will be used to progress the cumulative assessments.

The development of the offshore transmission infrastructure (i.e. export cable and onshore substations) works required to support the respective generating stations being proposed by BOWL and MORL is still in an early stage for both companies. However, MFOWDG recognise that these works will contribute to the overall cumulative impact of the proposed developments. These works will therefore be considered within the cumulative assessment methodologies to be presented within the Environmental Statements. Further information on the offshore transmission infrastructure process is available in the BOWL and MORL generating station scoping reports (1).

2.6 Developments and Activities to be Taken into Account in Cumulative Impact Assessment

Developments and activities that will be taken into account in the cumulative impact assessment are as listed below. The area of search will vary depending on each environmental topic.

---

(1) Beatrice Offshore Windfarm Ltd, Environmental Scoping Report, 12 March 2010
Moray Offshore Renewables Ltd, Environmental Impact Assessment Scoping Report, 2010

- Existing developments or ongoing activities;
- Any development under construction;
- Any development or activity which has been consented by the relevant Competent Authority but is not yet under construction or ongoing; and
- Any specific development or activity which is proposed, but has not yet been submitted for consenting (e.g. a proposed offshore wind farm which is at the pre-application stage).

It is the intention that the cumulative impact assessments will be undertaken and reported within each separate ES submitted by BOWL and MORL.

EIAs are undertaken at a fixed point in time and cannot take into account possible future developments for which information is not available. It is for the proponents of any future developments or activities to undertake an assessment of impacts of activities along with cumulative impacts arising from developments which are operational, under construction, consented or known to be in planning at that time.

Other developments that may be constructed in the vicinity of BOWL/MORL will not be as advanced in the development or planning process but will be reasonably foreseeable. These projects will be included at a commentary level only in ES, as detailed information on these projects is unlikely to be available.

Excluded from the assessment are possible future developments or activities which are not yet proposed (i.e. the consenting process has not been initiated) or for which there is insufficient information to allow an assessment to be undertaken (e.g. potential future licensing rounds for offshore wind or potential future oil and gas industry activities).

Specific developments and activities to be considered are expected to include the following.

- Marine Renewables Projects
    - Beatrice Offshore Wind Farm
    - Individual sites within the MORL Eastern Development Area
    - MORL Western Development Area
    - Marine energy developments in the Pentland Firth and Orkney waters as relevant to the receptor under assessment
    - Proposed SHETL hub
    - Forth and Tay offshore wind developments
    - Aberdeen Offshore Wind Farm
    - Beatrice Demonstrator Turbines

- Cables
    - MORL Offshore Export Cable and onshore infrastructure (OFTO)
    - BOWL Offshore Export Cable and onshore infrastructure (OFTO)
    - Proposed Viking SHETL cable and onshore infrastructure
    - SHEFA telecoms cable

- Oil and gas Industry Infrastructure
  - Beatrice and Jacky platforms and associated infrastructure
  - The proposed Polly well
  - The proposed Caithness and PA Resources infrastructure for existing leases

- Other marine stakeholders in the Moray Firth
  - Navigation and shipping
  - Military activities
  - Aviation
  - Commercial fisheries: UK scallop fisheries, Moray Firth seine net fishery, etc
  - Marine and port developments within the Moray Firth
  - Dredging and sea disposal within the Moray Firth

- Other onshore elements of the MORL and BOWL projects relevant to the offshore environment
  - MORL onshore met mast
  - Other onshore renewables projects within defined and agreed study area (see Section 4.6 Ornithology and Section 4.7 SLVIA)

The purpose of Table 2.6.1 is to summarise activities to be considered according to the receptor and to provide a starting point for discussions to agree study area extent. Clearly, both the MORL and BOWL wind farm proposals will feature as cumulative developments in respective EIAs, these are not presented in the table.

Along the horizontal axis of the table are existing, proposed or reasonably foreseeable development types and activities that may result in a cumulative impact when considered alongside the BOWL or MORL wind farms. Receptors are set out along the vertical axis. Boxes are shaded when a cumulative impact is considered possible. Where appropriate, some initial comment is provided on the extent of the study areas.

Do you agree with the developments and activities to be considered during the cumulative impact assessment? Are there additional developments that should be considered?

Table 2.6.1 Activities to be Taken Into Account in Cumulative Impact Assessment

▨ *Developments and Activities to be included in Cumulative Impact Assessment*

Receptor	Developments and Activities										
	Other offshore wind farms	Subsea Cables	Pentland Firth Marine Energy	Military Activities (excl Aviation)	Shipping	Civil and Military Aviation	Commercial Fisheries	Marine and Port Development	Dredging and Sea Disposal	Oil and Gas Development	Onshore wind farms
Physical Processes and Geomorphology								Within 8 km of site or cable route (i.e. <1 tidal excursion)	Within 8 km of site or cable route (i.e. <1 tidal excursion)	Should consider new infrastructure if planned (if none scope out). Contaminants may also need to be considered.	
Benthic Ecology	Unlikely to be necessary given species found at BOWL and MORL sites		Unlikely to be necessary given species found at BOWL and MORL sites					Within 8 km of site or cable route (i.e. <1 tidal excursion)	Within 8 km of site or cable route (i.e. <1 tidal excursion)		
Fish and Shellfish Ecology	Depending on species under consideration		Depending on Species under consideration					Area depending on species and specific location of the development	Moray Firth Area		
Marine Mammals								Study area dependent on species and will reflect species mobility	Study area dependent on species and will reflect species mobility		

Receptor	Developments and Activities										
	Other offshore wind farms	Subsea Cables	Pentland Firth Marine Energy	Military Activities (excl Aviation)	Shipping	Civil and Military Aviation	Commercial Fisheries	Marine and Port Development	Dredging and Sea Disposal	Oil and Gas Development	Onshore wind farms
Ornithology	▨ Depending on species under consideration	▨	▨ Depending on Species under consideration		▨		▨	Area depending on species and specific location of the development	Area depending on species and specific location of the development	Consider new infrastructure if any is planned	▨
Seascape, landscape and visual character	▨									▨	▨
Marine Archaeology and Cultural Heritage		▨							▨	▨	▨
Aviation and MOD Including Radar						▨					▨
Shipping and Navigation	▨	▨	▨	▨		▨			▨	▨	
Commercial Fisheries	▨ Limited to specific fisheries and operational range of vessels	▨	▨ Limited to specific fisheries and operational range of vessels	▨	▨			▨	Extent of study area dependent upon location of sites relative to fishing grounds	▨	
Underwater Noise	▨	▨	▨	▨	▨		▨	▨		▨	
Socio-economics	▨	▨		▨	▨		▨	▨		▨	
Oil and Gas infrastructure, sub sea cables		▨									
Onshore traffic and Transport		▨						▨		▨	

Do you have any comments on Table 2.6.1?

2.7 Information Sharing

Table 2.7.1 presents a matrix illustrating where the MORL and BOWL projects are collaborating in terms of information sharing.

Table 2.7.1 Collaborative Approaches and Opportunities Matrix

Topic Area	Same contractor for both BOWL and MORL	Agreement on data collection methodology & assessment	Agreement on data standards	Undertake work package as one team?	
				Share data collected	Share results
	Yes No	Yes No	Yes No	Yes No	Yes No
CONSENTING TASKS - Wind Farm EIA					
Physical Environment					
Physical Processes / Sediment and Water Quality	Yes	Yes	Yes	Yes	Yes
Biological Environment					
Ornithology - boat based survey	No	Yes	Yes	Yes	Yes
Ornithology - other survey type	No	Yes	Yes	Yes	Survey type dependent
Benthic Ecology	No	Yes	Yes	If relevant	If relevant
Fisheries studies (natural)	Yes	Yes	Yes	Yes	Yes
Marine Mammals - boat based	No	Yes	Yes	Yes	Yes
Marine mammals - other survey type	Yes	Yes	Yes	Yes	Yes
Underwater Noise Assessment	Yes	Yes	Yes	Yes	Yes
Human Environment					
Shipping, Navigation & Safety	Yes	Yes	Yes	Yes	Yes
Fisheries studies (commercial)	Yes	Yes	Yes	Yes	Yes
Seascape, Landscape and Visual Study	Possible	Yes	Yes	Possible	Possible
Socioeconomics & Tourism Desk Study	Possible	Yes	n/a	Possible	Possible
Marine Archaeology and Cultural Heritage	Yes	Yes	Yes	Yes	Yes
Aviation and MoD	No	n/a	n/a	Yes	Yes

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3. POTENTIAL RECEPTORS AND EFFECTS

There is the potential for specific receptors to experience significant cumulative effects. These are set out in Table 3.1.1 alongside potential cumulative effects. Section 4 provides the proposed approach and methodology for assessment of potential cumulative effects.

Table 3.1.1 Receptors and Potential Cumulative Effects

Receptor	Potential Cumulative Effects
Physical	
Physical Processes and Geomorphology	▪ Changes to the hydrodynamic environment (waves, tides and currents). ▪ Changes to sedimentary processes and structures (sediment composition, properties, distribution, transport pathways, bedforms). ▪ Changes to suspended sediment concentration (on a variety of spatial and temporal scales). ▪ Indirect effects of the above on other sensitive receptors (e.g. benthic or pelagic ecology, socio-economic resources).
Underwater Noise	▪ Potential effects resulting from the cumulative effects of underwater noise are considered under the relevant receptor headings; see Section 4.4, fish ecology, Section 4.5, marine mammals and Section 4.6 ornithology.
Biological Environment	
Marine mammals	▪ Disturbance and potential displacement. ▪ Longer term avoidance of the development area by marine mammals. ▪ Increased collision risk. ▪ Reduction of the feeding resource. ▪ Changes in prey availability.
Ornithology	▪ Collision with turbines. ▪ Disturbance/displacement. ▪ Barrier effects. ▪ Indirect effects (e.g. changes in habitat or prey supply).
Benthic ecology	▪ Permanent net reduction in the total area of original habitat. ▪ Temporary seabed disturbances and effects on fauna. ▪ Increase in abundance of sessile colonial species. ▪ Temporary fining of particulate habitats as well as smothering and scour effects on benthic fauna. ▪ Release and increased bio-availability of sediment contaminants and pollutants from accidental spills.
Fish and Shellfish Ecology	▪ Disturbance to spawning activity and juveniles (nursery areas). ▪ Barrier to/change in migratory patterns. ▪ Behavioural changes derived from EMFs associated with cables. ▪ Changes in species composition and displacement of fish and shellfish resource. ▪ Direct impact during construction. ▪ Temporary and permanent loss of habitat. ▪ Changes in prey availability and displacement of food resource.
Nature Conservation Designated Areas	▪ Potential effects on the qualifying features of these sites are discussed under the relevant sections of this document. ▪ Effects on sub-tidal and intertidal habitats – see Section 4.3. ▪ Effects on migratory fish – see Section 4.4. ▪ Effects on marine mammals – see Section 4.5. ▪ Effects on birds – see Section 4.6.
Human Environment	
Landscape, seascape and visual impacts	▪ Cumulative landscape and seascape effects. ▪ Cumulative landscape and seascape effects on each receptor / character. ▪ Cumulative visual effects.
Archaeology and cultural heritage	▪ Contamination, damage or loss of archaeological remains in or on the seabed. ▪ Destabilisation of sites through changed sedimentary regimes. ▪ Effects on setting of onshore cultural heritage assets.
Commercial fisheries	▪ Adverse impact on commercially exploited fish and shellfish populations. ▪ Complete loss or restricted access to traditional fishing grounds. ▪ Safety issues for fishing vessels. ▪ Interference with fisheries activities. ▪ Displacement of fishing vessels. ▪ Increased steaming times to fishing grounds. ▪ Presence of seabed obstacles. ▪ Adverse impact on recreational fish populations.
Shipping and navigation	▪ Re-routing of shipping. ▪ Increased collision risk (vessel to vessel and vessel to turbine) during operation as well as during high levels of activities during construction operations. ▪ Cable interactions with anchors/fishing gear. ▪ Inhibited search and rescue. ▪ Interference of turbines with marine radar impacting on navigational safety.
Aviation / MOD	▪ Clutter on primary radar. ▪ Shadow effect on primary radar. ▪ Obscuration effect on primary radar. ▪ Obstruction of helicopter instrument approach procedures to Beatrice platform. ▪ Obstruction of low level helicopter routes on HMR X-Ray in icing conditions. ▪ Obstruction of search and rescue helicopter operations within the wind farms.
Socio- economics	▪ Contribution to renewables targets. ▪ Provision of employment.
Onshore traffic and transport	▪ Changes in traffic flow to and from supply ports during construction and operational phases.
Oil and gas infrastructure including aviation and subsea cables	▪ Risk of accidental damage to existing oil and gas infrastructure. ▪ Access to platforms by helicopter. ▪ Access to platforms by vessel. ▪ Direct physical impacts due to anchoring of construction vessels. ▪ Potential cumulative effects on submarine marine cables include burial or exposure due to altered marine sediment dynamics.

Are the effects identified in Table 3.1.1 appropriate and are you aware of any other effects that should be considered?

Two receptors have been of removed from the cumulative assessment as it is considered that they will not experience significant cumulative effects. These are provided in Table 3.2.1.

Table 3.2.1 Proposed Receptors to be Removed

Receptor	Reason removed
Marine Waste Disposal	There are four marine disposal sites between Burghead and Macduff to the south of the Beatrice oil field. Due to the coastal locations and the distances from the wind farm sites it is considered that there will be no significant impacts on/from these sites during construction, operation or decommissioning of the Wind Farm. It is therefore considered that this topic area be scoped out of the CIA.
Radio and Microwave Telecommunications	No impacts on radio and microwave telecommunication links are anticipated.

Do you agree with the receptors that have been removed from the cumulative impact assessment?

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4. ASSESSMENT OF EFFECTS

4.1 Nature Conservation Designated Sites

The development of the wind farm sites has the potential to impact upon the integrity and conservation objectives of existing Natura 2000 sites and Ramsar sites. These are illustrated on Figure 4.1. Sites of Special Scientific Interest (SSSI) will also be taken into account where relevant to receptor studies.

Potential effects on the qualifying features of these sites are discussed under the relevant sections of this document:

- Effects on sub-tidal and intertidal habitats – see Section 4.2 & 4.3;
- Effects on migratory fish – see Section 4.4;
- Effects on marine mammals – see Section 4.5; and
- Effects on birds – see Section 4.6.

Special Areas of Conservation, Special Protected Areas, Ramsar sites and SSSIs that will be taken into account during the cumulative impact assessment are set out in Table 4.1.1.

Table 4.1.1 Designated Sites Relevant to Cumulative Impact Assessment

SACs	SPAs	Ramsar	SSSIs
Moray Firth	Loch of Strathbeg	Loch of Strathbeg	Loch Fleet
Dornoch Firth	Troup, Pennan and Lion's Head	The Moray and Nairn Coast	Morrich More
Berriedale and Langwell,	The Moray and Nairn Coast	The Inner Moray Firth	Tarbat Ness
Culbin Bar	The Inner Moray Firth	Cromarty Firth	Culbin Sands, Culbin Forest and Findhorn Bay
River Oykel	Cromarty Firth	The Dornoch Firth	Spey Bay
River Moriston	Dornoch Firth and Loch Fleet		Cullen to Stakeness Coast
River Spey	East Caithness Cliffs		Cromarty Firth
River Evelix	North Caithness Cliffs		Loch of Strathbeg
River Thurso			Gamrie and Pennan Coast
			Berriedale Cliffs

4.2 Physical Processes and Geomorphology

4.2.1 Specialist Advisor

Both MORL and BOWL have commissioned the services of ABPmer to complete the EIA exercise and provide advisory services.

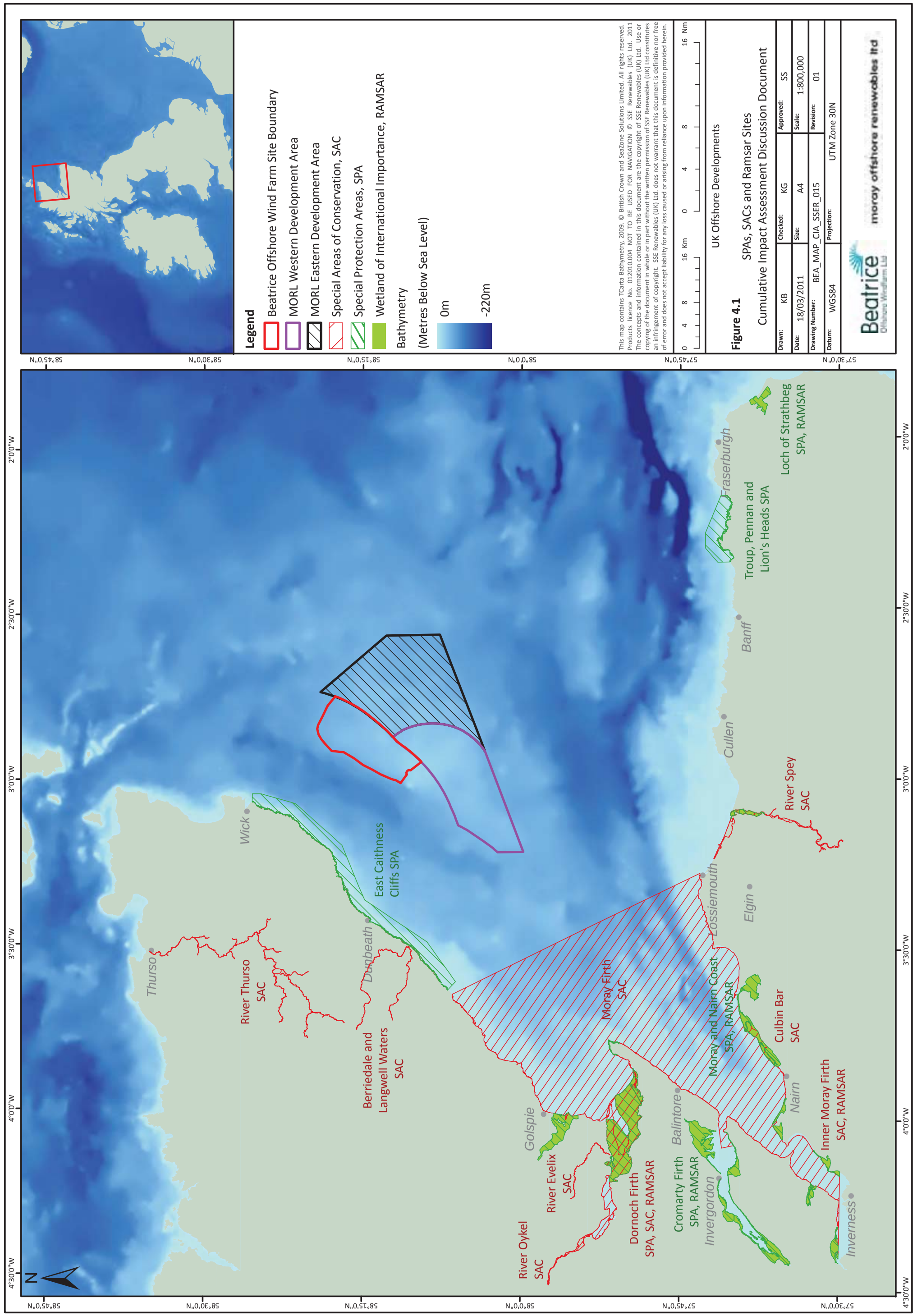

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Figure 4.1

SPAs, SACs and Ramsar Sites

Cumulative Impact Assessment Discussion Document

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4.2.2 Guidance Documents

There are currently a number of specific guidance documents available to inform the approach and these will be considered during the cumulative impact assessment on physical processes. The guidance that will be considered will include the following:

- Cefas, 2004. Offshore Wind Farms: Guidance note for Environmental Impact Assessment in respect of FEPA and CPA requirements, Version 2, June 2004 (1);
- Cefas, 2010. Strategic Review of Offshore Wind Farm Monitoring Data Associated with FEPA Licence Conditions (2);
- ABPmer and HR Wallingford for COWRIE, 2009. Coastal Process Modelling for Offshore Wind farm Environmental Impact Assessment: Best Practice Guide (3);
- ABPmer, HR Wallingford and CEFAS for COWRIE, 2010. Further review of sediment monitoring data (4);
- EMEC and Xodus AURORA, 2010. Consenting, EIA and HRA Guidance for Marine Renewable Energy Developments in Scotland. Parts 1-4 (5);
- MCA, August 2008. Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response Issues. MCA Guidance Note MGN371 (6); and
- Surfers Against Sewage, 2009. Guidance on Environmental Impact Assessment of offshore renewable energy development on surfing resources and recreation. pp 63 (7).

4.2.3 Baseline

The EIA scoping reports from both MORL and BOWL present a summary baseline description of the following as they occur naturally:

- Wind and wave climate;
- Tidal regime (water levels and currents);
- Predicted effects of climate change;
- Geology and seabed sedimentary deposits;
- Seabed sediment mobility; and
- Suspended sediment concentrations.

Desk-top studies undertaken by BOWL and MORL as part of the individual EIA requirements have indicated that the internal structure of the Smith Bank comprises erosion resistant glacial till deposits (poorly sorted gravels and sands) and other relatively stable geological sequences (e.g. as reported in Holmes *et al.,* 2004 (8)). This means that the bank as a morphological feature is largely relic and inherently stable. A relatively thin sand veneer is observed across parts of the bank (order tens of centimetres to a few meters thick).

The historical and newly measured tidal and wave climate data show that the tidal regime is largely insufficient to induce frequent mobility of these sands but that intermittent storm wave action may cause energetic sediment resuspension (but not necessarily directional sediment transport). Measurements of suspended sediment concentrations have been observed to significantly increase during storm events, but not in response to the spring-neap tidal cycle.

The draft findings of geophysical surveys undertaken for the BOWL site and separately for the MORL Round 3 zone (OSIRIS, pers. comm.) also did not indicate the significant presence of active tidal current related sedimentary bedforms. Instead, the indicators of long-term sediment transport direction (buried slope angles in the sub-surface geophysical data) suggest that, once resuspended by waves, sediment tends to move down slope under gravity and off the crest of the bank, rather than in the direction of the tidal axis or the dominant wave directions. Megaripple bedforms were identified in a limited area in the south of the MORL Round 3 zone but are considered likely to be relic.

4.2.4 Proposed Consultees

It is proposed that the following organisations will be consulted during the scope refinement and ongoing cumulative impact assessment:

- Marine Scotland;
- SNH;
- JNCC;
- Historic Scotland;
- RSPB;
- The RYA; and
- Ports and Harbours Authorities within the Moray Firth.

4.2.5 Potential Effects

The potential effects of an offshore wind farm development on the physical environment are generally considered to result from periods of construction or decommissioning activities and over the operation lifetime of the wind farm from direct interaction between the submerged part of the wind turbine structures and the physical environment. Guidance in this respect (CEFAS, 2004) summarises the potential effects of primary concern as set out below:

- Changes to the hydrodynamic environment (waves, tides and currents);
- Changes to sedimentary processes and structures (sediment composition, properties, distribution, transport pathways, bedforms);
- Changes to suspended sediment concentration (on a variety of spatial and temporal scales); and
- Indirect effects of the above on other sensitive receptors (e.g. benthic or pelagic ecology, socio-economic resources).

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(1)Available online http://www.cefas.co.uk/publications/files/windfarm-guidance.pdf (accessed 14th January 2011).

(2)Available online http://www.cefas.co.uk/publications/miscellaneous-publications/strategic-review-of-offshore-wind-farm-monitoring-data-associated-with-fepa-licence-conditions.aspx (accessed 14th January 2011).

(3)Available online http://www.offshorewindfarms.co.uk/Pages/Publications/Archive/Other/Coastal_process_modell6f6d2c53/ (accessed 14th January 2011).

(4) Available online http://www.offshorewindfarms.co.uk/Pages/Publications/Latest_Reports/Data/A_further_review_of_se2087e393/ (accessed 14th January 2011).

(5)Available online http://www.scotland.gov.uk/ (accessed 14th January 2011).

(6)Available online http://www.mcga.gov.uk/c4mca/mgn371.pdf (accessed 14th January 2011).

(7)Available online http://www.sas.org.uk/pr/2009/pdf09/eia-1.pdf (accessed 14th January 2011).

(8)Holmes R., Bul;at J., Henni P., Holt J., James C., Kenyon N., Leslie A., Lond D., Morri C., Musson R., Pearson s., and Stewart H. (2004) DTI Strategic Environmental Assessment Area % (SEA5): Seabed and Superficial Geology and Processes. Commercial Report CR/04/064N.

The impacts and the specific receptors identified for this cumulative impact assessment are the same as those identified at a site specific level. The impacts are summarised in Table 4.2.1 below.

Table 4.2.1 Summary of Identified Cumulative Coastal Process Impacts

Issue	Potential impact
Effect on tidal currents and waves: Changes to patterns of tidal currents and wave activity as a result of the presence of the turbine foundations.	Change in sediment transport pathways (suspended or bedload) affecting the form and function of the Smith Bank or other named SACs or SPAs.
	Reduction in recreational surfing wave resource in the lee of the development.
	Modification of tidal currents or wave climate affecting navigation in the area
Sediment resuspension: Increase in suspended sediment concentration during installation/seabed preparation/removal of foundations or cables, or the initial phases of seabed scouring around newly installed foundations resulting in short-term locally elevated levels of suspended sediment concentrations.	Elevated levels of suspended sediment concentration on sensitive receptors. Subsequent deposition of sediment on sensitive receptors
Footprint of turbines and installation vessels: Seabed compaction or smothering in the footprint of foundations and of any jack-up vessels used.	Mortality of sensitive marine life in directly affected areas.
Scour around turbine foundations: Scour around foundations leading to local changes in seabed sediment type and morphology.	Impact upon the stability of the turbine foundation.
	Localised loss of seabed habitat through seabed modification.

Following a programme of sediment sampling and analysis, there is no evidence of sediment contamination (e.g. metals or hydrocarbons) in either the BOWL site or MORL Round 3 zone. Therefore, potential resuspension of contaminated sediments will not be considered within the EIA with respect to the main wind farm development. However, surveys of the proposed export cable route(s) are still required and if sediment contamination is found, additional assessment of resulting impacts on water quality will be made. Assessment methodologies will be determined at a later date.

In addition to statutory requirements to maintain water quality in some locations within the wider Moray Firth, the potential for direct or indirect impacts on sensitive ecological or socio-economic receptors will also be considered.

4.2.6 Study Area

The study area within which effects and impacts will be considered from a coastal processes perspective will include the wider Moray Firth region in order to take into consideration any likely far-field effects on wave and tidal processes and the potential for dispersion and settlement of sediments re-suspended during the construction phases of the projects. In the modelling, the highest spatial resolution will be applied to the near field area, i.e. within and immediately adjacent to the wind farm site boundaries and along any cable route options. An adequate level of spatial detail, following best practice in this regard, will be maintained in other far field areas to investigate potential transmission of effects to the location of identified sensitive receptors (e.g. SAC's, SPA's, etc).

4.2.7 Data Gathering

Requirements for new data collection have been determined on the basis of a detailed historical data gap analysis. This study concluded that sufficient data exist to characterise the wider Moray Firth region in terms of coastal processes; however, it was also found that additional data are needed to inform the more detailed understanding of processes required within the site boundaries. Other types of receptor and scheme information are also required to guide and inform the impact assessment process.

In addition to collating the identified historic data, specific new data collection and information gathering has been undertaken as follows. Metocean deployments are shown on Figure 4.2.

- Metocean survey (winds, waves and tides, including the locations shown in Tables 4.2.2 and 4.2.3);
- Geophysical surveys (bathymetry and seabed characterisation);
- Sedimentary characterisation surveys (sediment type, naturally occurring levels of sediment resuspension and sediment contamination levels);
- Information regarding the location and nature of any sensitive receptors that might be affected by changes to the physical marine environment; and
- A project design specification from each developer, detailing the most realistic estimate of the type, number and locations of turbine foundations and the likely methods and scheduling of construction, etc.

Table 4.2.2 BOWL Metocean Survey Equipment Deployment

Location	Equipment	Lat	Lon	Deployment Date	Recovered
1	Wave buoy	58° 19.00' N	002° 50.75' W	11/02/2010	Presently ongoing
2	AWAC*	58° 17.80' N	002° 46.60' W	10/02/2010	15/06/2010
3	AWAC*	58° 10.75' N	002° 57.00' W	10/02/2010	15/06/2010

* Acoustic Wave And Current (AWAC) devices provide measurements of the tidal current profile, tidal water levels and waves. AWAC's were also deployed in conjunction with nearbed suspended sediment monitors.

Table 4.2.3 MORL Metocean Survey Equipment Deployment

Location	Equipment	Lat	Lon	Deployment Date	Recovered
1	Wave buoy	58° 9.94' N	002° 38.05' W	15/06/2010	Presently ongoing
2	AWAC*	58° 14.89' N	002° 44.73' W	27/07/2010	13/12/2010
3	AWAC*	58° 8.39' N	002° 41.70' W	27/07/2010	27/01/2011
4	AWAC*	58° 2.17' N	002° 9.12' W	27/07/2010	7/01/2011
5	AWAC*	58° 10.02' N	002° 54.02' W	27/07/2010	14/02/2011

* Acoustic Wave And Current (AWAC) devices provide measurements of the tidal current profile, tidal water levels and waves. AWAC's were also deployed in conjunction with nearbed suspended sediment monitors.

Are you aware of any additional data sources that should be considered in the assessment?

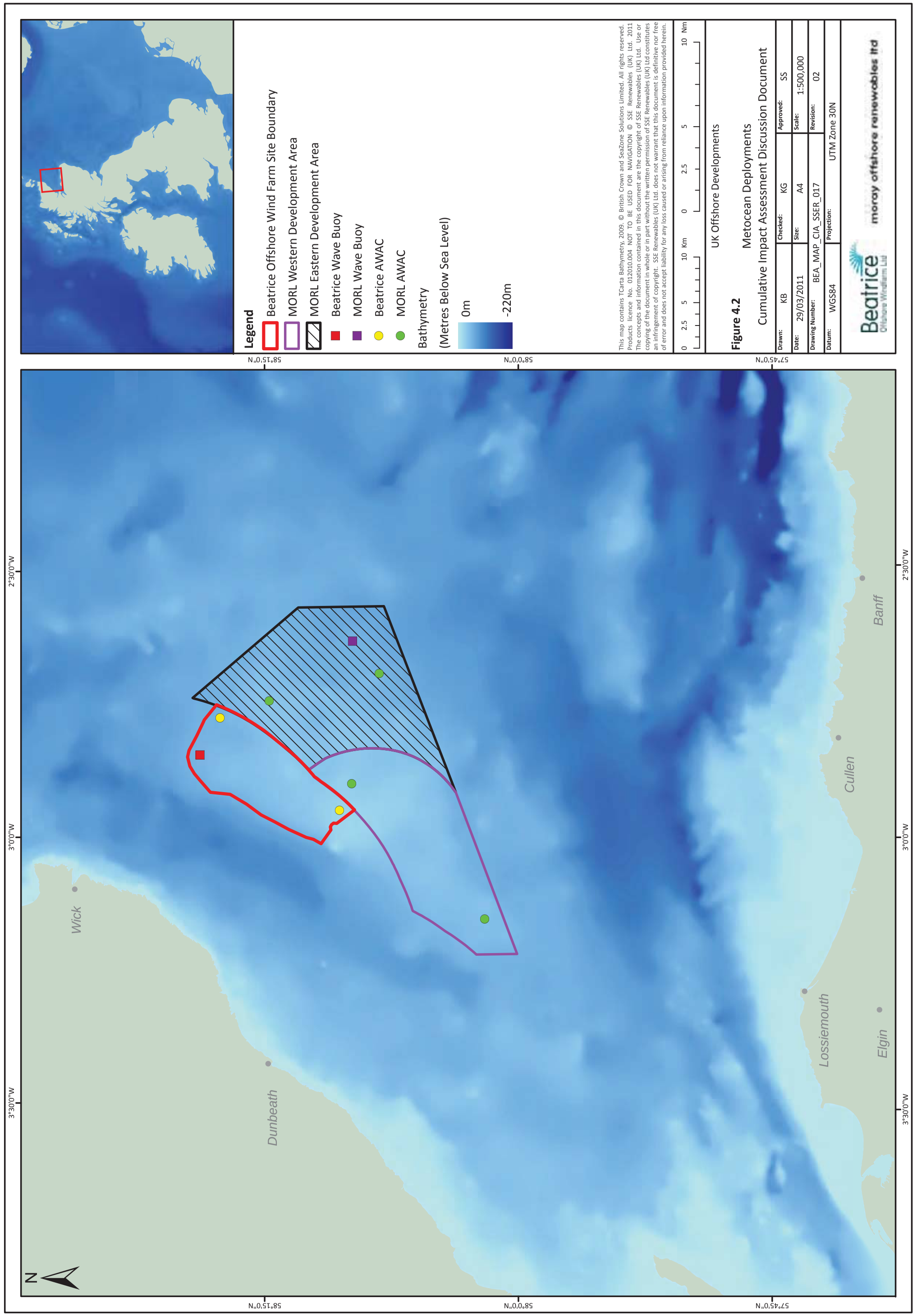

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Figure 4.2

Metocean Deployments

Cumulative Impact Assessment Discussion Document

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4.2.8 Assessment Methodology

The cumulative assessment is expected to assess the cumulative impact of the following developments:

- BOWL generating station;
- MORL western development area generating stations;
- MORL eastern development area generating stations;
- BOWL OFTO cable;
- MORL OFTO cable;
- Proposed SHETL cable;
- Proposed SHETL hub;
- Any relevant port and harbour developments in the Moray Firth;
- Proposed Polly well;
- Dredging and sea disposal in the Moray Firth; and
- Pentland Firth marine energy developments.

A detailed methodology has been developed in conjunction with Marine Scotland and its advisors to address the identified coastal process issues (presented in Annex A). A revised draft of this methodology including all scoping responses is under preparation. Methodologies have been developed, in accordance with the available best practice guidance, for the following:

- The collection of new environmental data to supplement gaps identified in the historical data record;
- The creation and use of numerical modelling tools to inform baseline environmental understanding and quantitative assessment of development impacts; and
- The analysis and interpretation of model results to quantify the identified potential impacts of the scheme on sensitive receptors.

The modelling tools and proposed methodologies are appropriate for and will be consistently applied to both single scheme and cumulative studies. To facilitate this, the model will be developed using the metocean data collected by both MORL and BOWL.

All assessments will be quantitatively made using numerical modelling tools (the DHI MIKE software suite) that encompass a regional scale extent (see Figure 4.3). These tools will be informed by and tested against the historic and newly collected data presently being compiled. A 'present day' condition will provide a baseline against which to measure the magnitude of any impacts. Activities with the potential to cause an impact associated with phases of construction, operation, re-powering and decommissioning will also be simulated, including single scheme, cumulative and in-combination scenarios. Figure 4.3 illustrates the underlying mesh cells used in the formation of the tidal model.

4.2.9 Presentation of Results

Assessments of cumulative and in-combination studies, as well as individual schemes, will be presented in the ES's as the predicted effect of the scheme(s) on the identified sensitive receptors, in the context of their particular sensitivity and the naturally occurring variability in the baseline environment. Assessments in the ES's will be supported by more detailed technical annex reports, which will also provide more details of the data, modelling tools and methodologies used.

4.3 Benthic Ecology

4.3.1 Specialist Advisor

CMACS Ltd has been commissioned by BOWL to assess potential effects of the proposed Beatrice Offshore Wind Farm on benthic communities. EMU Ltd has been commissioned by MORL to undertake the respective assessment. This is clearly a topic area where both specialist consultancies would liaise to ensure a consistent approach to the respective wind farm assessments and the cumulative impact assessment.

4.3.2 Guidance Documents

The methods outlined by King *et al.* (2000) (1) for cumulative impact assessment on birds were identified by Blythe Skyrme (2010) (2) to be generally of use for cumulative impact assessment of fisheries. They appear likely also to be broadly applicable for benthic ecology and will be used as appropriate. As suggested for many subject areas within the above studies, most or all of the impacts anticipated here (see Section 4.3.5) are likely to be assessable using simple additive effects. Other guidance documents to standardise data gathering and assessment methodologies across the developments include the following:

- Cefas, 2004. Offshore Wind Farms: Guidance note for Environmental Impact Assessment in respect of FEPA and CPA requirements, Version 2, June 2004 (3);
- Cefas, 2010. Strategic Review of Offshore Wind Farm Monitoring Data Associated with FEPA Licence Conditions (4);
- IEEM (2010). Guidelines for Ecological Impact Assessment in Britain and Ireland. Marine and Coastal (5); and
- Boyd, S.E. (compiler) (2002) Guidelines for the conduct of benthic studies at aggregate dredging sites. U.K. Department for Transport, Local Government and the Regions, London and Cefas, Lowestoft.

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(1)King, S., Maclean, I., Norman, T. and A. Prior, 2009. Developing guidance on ornithological cumulative impact assessment for offshore wind farm developers. COWRIE Ltd.

(2)Rob Blyth-Skyrme, Ichthys Marine Ecological Consulting Ltd, 2010. Developing guidance on fisheries cumulative impact assessment for wind farm developers. Available online http://www.offshorewindfarms.co.uk/Assets/Fisheries%20cumulative%20impacts%20asse

(3)Available online http://www.cefas.co.uk/publications/files/windfarm-guidance.pdf (accessed 14th January 2011).

(4)Available online http://www.cefas.co.uk/publications/miscellaneous-publications/strategic-review-of-offshore-wind-farm-monitoring-data-associated-with-fepa-licence-conditions.aspx (accessed 14th January 2011).

(5)Available online http://www.ieem.net/ecia.asp

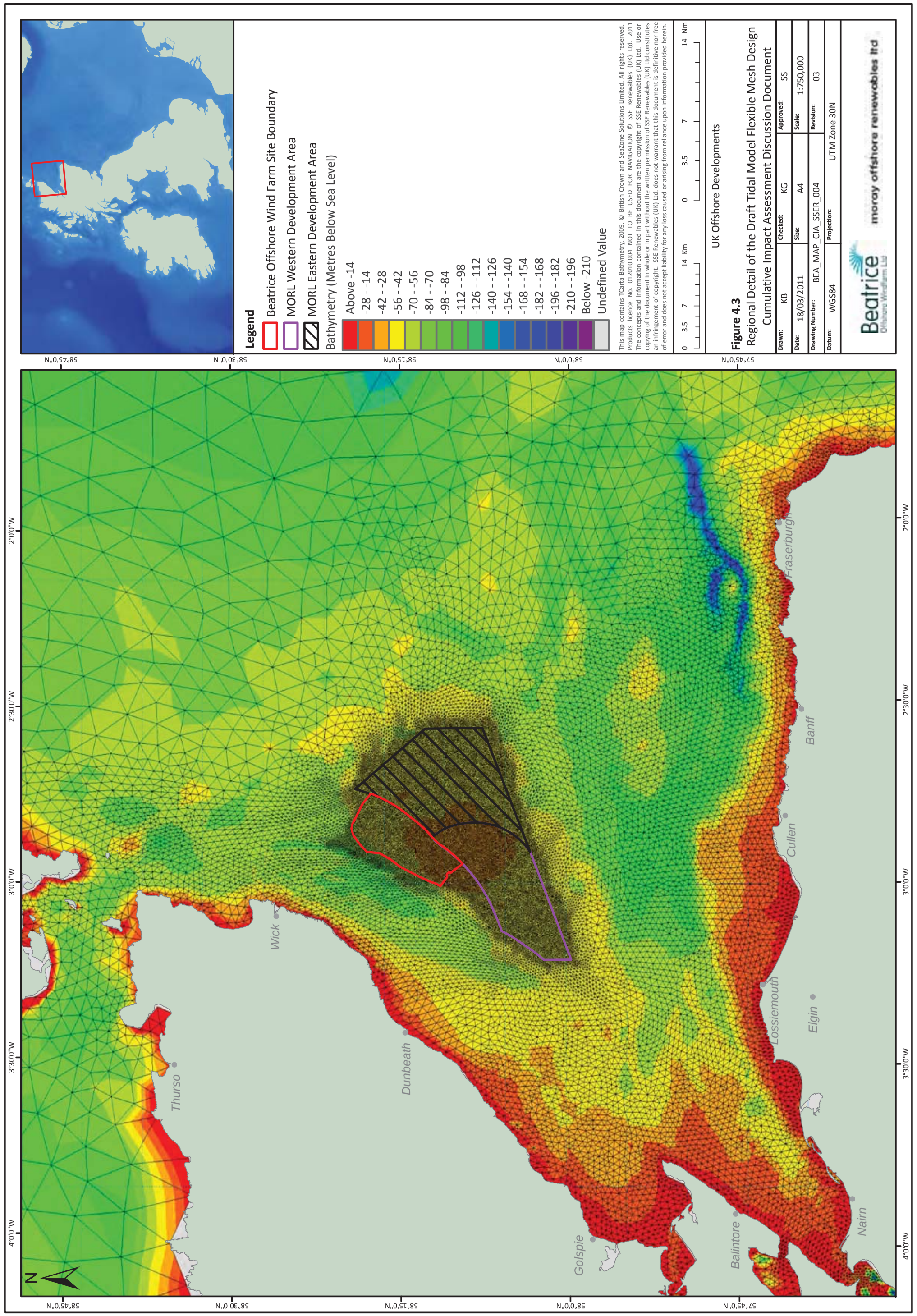


Figure 4.3
Regional Detail of the Draft Tidal Model Flexible Mesh Design
Cumulative Impact Assessment Discussion Document

4.3.3 Baseline

Baseline benthic ecological conditions have been described within the MORL scoping study (MORL, 2010 (1)) and the pre-survey data review and gap analysis (Emu Ltd., 2010 (2)) and the BOWL scoping study (BOWL, 2010 (3)) and pre-survey method statement (CMACS, 2010 (4)) as summarised below. Benthic surveys have been completed for the BOWL site and the MORL Eastern Development Area. Survey data for the MORL and BOWL export cable routes is expected to be collected during 2011. Initial collaboration between the BOWL and MORL specialist advisors was undertaken to ensure that data collection techniques would be compatible and that a consistent approach to site characterisation across both developments would be achieved.

Water depths throughout the Moray Firth are less than 80 m with shallowest areas occurring over the Smith Bank. The local waters are generally well mixed throughout the year with surface and bottom temperatures fluctuating between roughly 7˚C and 12˚C during winter and summer respectively although surface temperatures may be 1-1.5˚C higher during summer months. Surface and bottom salinity levels are relatively consistent throughout the year fluctuating in the outer Firth between 34.8 and 35.0 parts per thousand.

Tidal currents across the MORL and BOWL sites reach a maximum of 2 knots during mid flood and mid ebb occasions with the principal currents aligned along a north-east / south west axis (5).

Principal seabed sediment habitat types in the outer Moray Firth are shown in Figure 4.4 and include the following:

- Circalittoral and deep circalittoral coarse sediment;
- Circalittoral fine sand or circalittoral muddy sand;
- Deep circalittoral sand;
- Deep circalittoral mud; and
- Infralittoral coarse sediment.

Local sediments comprise coarse and medium sand together with shelly gravel with occasional outcrops of rock. These support typical faunal assemblages including the urchin *Echinocyamus pusillus*, the bivalve *Tellina pygmaea*, and the polychaetes *Travisia forbesi* and *Ophelia borealis* (6).

Annelids are the dominant phylum present in terms of numbers of species represented at the Smith Bank followed by molluscs, crustaceans, and echinoderms. Epifaunal communities are characterised by sponges, the keel worm *Pomatoceros* sp., barnacles, the erect bryozoan *Flustra foliacea*, the anemone *Bolocera tuediae* and the crab *Hyas coarctatus*.

---

(1)MORL (2010). Developing Wind Energy in the Outer Moray Firth. Environmental Impact Assessment Scoping Report. Eastern Development Area.

(2)Moray Firth Offshore Wind Farm Zone Benthic Ecology Data Review and Gap Analysis. Report No. 10/J/1/03/1730/1043 to Moray Offshore Renewables Ltd. dated Sept 2010.

(3)ERM Ltd (2010) Beatrice Offshore Windfarm Ltd Environmental Scoping Report, 12 March 2010.

(4)CMACS Ltd (2010). Beatrice Offshore Wind Farm Benthic Characterisation Survey. Method Statement. J3151 BOWL (Benthic Survey Statement) v5.

(5)Adams, J.A. & Martin, J.H.A. (1986). The hydrography and plankton of the Moray Firth. Proceedings of the Royal Society of Edinburgh, 91B, 37-56.

(6)Talisman Energy UK Ltd. (2006). Beatrice wind farm demonstrator project. Environmental Statement. DTI Reference No. D/2875/2005.

The site specific surveys will further enhance the current understanding of the distribution of seabed sediment habitats and associated communities present to support the respective EIA processes. They have been designed to also investigate (including mapping) the degree to which coarser material, including boulders, overlie the predominantly sandy/gravelly seabed, and to describe the associated epifaunal communities.

4.3.4 Proposed Consultees

Cumulative effects methodologies relevant to the consideration of benthic ecology will be developed in consultation with the following consultees.

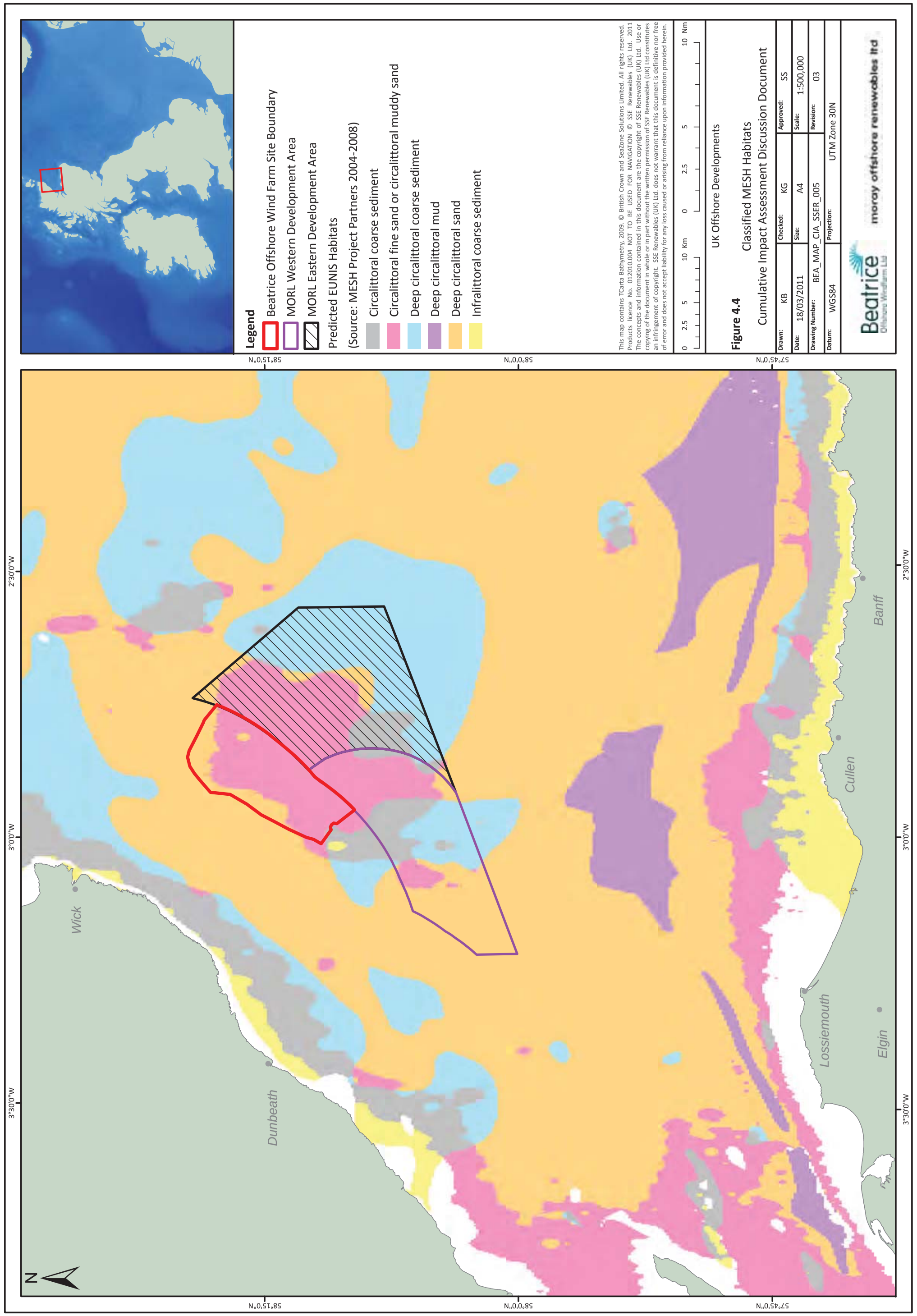
- Marine Scotland;
- SNH; and
- JNCC.

4.3.5 Potential Effects

Table 4.3.1 presents a summary of potential direct and indirect impacts of offshore wind farms on benthic ecology.

Table 4.3.1 Impact Types and Anticipated Related Effects on Benthos

Project Activity	Potential Effect
Direct – ▪ Installation of turbine foundations, ▪ Scour protection material ▪ Installation of inter-turbine cables. ▪ Placement of spud legs and/or anchors on the seabed.	▪ Permanent net reduction in the total area of original habitat as a result of the placement of the turbine and associated scour protection material on to the seabed.
	▪ Temporary seabed disturbances and effects on fauna as a result of cable laying activities. Recovery of habitat and species is forecast to occur following cessation of the disturbance.
	▪ Increase in abundance of sessile colonial species as a result of colonisation of hard structures.
Indirect - ▪ Re-distribution of fine sediments rising from construction activities ▪ Changes to hydrodynamic regime / erosion & accretion rates.	▪ Temporary fining of particulate habitats as well as smothering and scour effects on benthic fauna.
	▪ Habitat and associated community change as the result of the introduction of hard structures and subsequent colonisation by encrusting and attaching fauna.
	▪ Release and increased bio-availability of sediment contaminants and pollutants from accidental spills.



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UK Offshore Developments

Figure 4.4 Classified MESH Habitats

Cumulative Impact Assessment Discussion Document

Drawn:	KB	**Checked:**	KG
Date:	18/03/2011	**Size:**	A4
Drawing Number:	BEA_MAP_CIA_SSER_005		
Datum:	WGS84	**Projection:**	UTM Zone 30N

Approved:	SS
Scale:	1:500,000
Revision:	03

Beatrice Offshore Windfarm Ltd moray offshore renewables ltd

Noise and vibration associated with piling and vessel movement activities are not known to affect benthic macro-invertebrates: there is no evidence to suggest significant adverse effects on seabed invertebrate communities.

Accidental spillages of pollutants into the marine environment will be addressed within each specific EIA and mitigated through the respective construction and operational environmental management plans. It is therefore proposed that effects associated with accidental spillages into marine waters can be scoped out of the cumulative assessment.

Heating effects of cables have not been shown to be capable of noticeably affecting seabed communities and it is therefore proposed that this is also scoped out of the cumulative assessment.

Levels of sediment contaminants are low across the MORL and BOWL development areas suggesting no adverse effect on benthos as a result of the release contaminants arising from construction activities. It is therefore proposed that sediment contaminants are also scoped out of the cumulative assessment process although site specific concerns for the BOWL development cannot yet be ruled out.

Do you agree that the potential release of contaminants and accidental spillages can be scoped out of the cumulative impact assessment?

4.3.6 Study Area

There needs to be an agreement with the regulators on the spatial limits to be included within the CIA. MFOWDG's preliminary suggestion for benthic ecology spatial limit is the whole Moray Firth but this is likely to be refined following review of the results of the assessment of potential cumulative effects on sediment and coastal processes.

There is clearly a close tie between benthic ecology and sediments. Given this, much of the assessment of wider effects on sediments will be taken from the physical processes assessment. This benthic assessment will subsequently assess the effects of any identified potential changes to sediments upon the benthic ecology.

Do you have any comments on the proposed study area?

4.3.7 Data Gathering

Definitely needed:

The benthic ecology surveys for both developments have been undertaken following Cefas Guidelines (Cefas, 2004 (1)) and guidelines to the aggregate industry (Boyd *et al.*, 2002 (2)). Geophysical survey data and the findings of the gap analyses were used to underpin a series

(1)Cefas (2004). Offshore wind farms. Guidance note for environmental impact assessment in respect to FEPA and CPA requirements. V2 June 2004. Prepared by Cefas on behalf of MCEU.

(2)Boyd, S.E. (compiler) (2002) Guidelines for the conduct of benthic studies at aggregate dredging sites. U.K. Department for Transport, Local Government and the Regions, London and Cefas, Lowestoft.

of impact hypotheses and to inform the survey arrays. Field sampling methods, final survey design and sample treatments have been agreed with Marine Scotland.

The surveys for the BOWL site and the MORL Eastern Development Area were undertaken in October 2010 with the exception of BOWL beam trawl surveys which were carried out in November 2010 along with a very small amount of additional camera survey. The survey locations are illustrated on Figure 4.5.

Community structure will be investigated using industry standard statistical multivariate routines (PRIMER v6.0). Biological relationships with the physical environment and processes will be assessed to help explain the key physical influences on seabed communities. The intention is for each MFOWDG developer to share benthic datasets for the purposes of the cumulative assessment.

It is anticipated that a key data output from this process will be the distribution and extents of classified biotopes. Developers will liaise closely on standardising classification and mapping techniques to ensure a consistent approach for cumulative assessment (see Section 4.3.8).

The broad location and scale of each of the main seabed communities identified in all of the proposed development areas and, if possible, the surrounding areas will be described. It will be determined at an early stage whether each of the specialist advisors will be describing the seabed in similar or compatible terms (e.g. biotopes or Eunis codes). Initial discussions have now suggested that biotopes are the preferred method (see Section 4.3.8).

The area of each seabed community that is likely to be impacted will need to be estimated for each development. The main impacts are likely to be: a) permanent loss to turbine foundations and scour protection; and b) disturbance due to installation activities such as anchoring or cable laying.

Possibly needed:

Depending upon what is found in the site specific surveys: distribution of important, rare, or sensitive species (if not already covered adequately by assessment at the community level; for example, biogenic reef forming species such as *Sabellaria spinulosa* or *Modiolus modiolus*, if present in significant amounts, can be expected to be adequately assessed at the biotope level). No evidence of biogenic reef forming organisms has so far been found during the BOWL or MORL surveys.

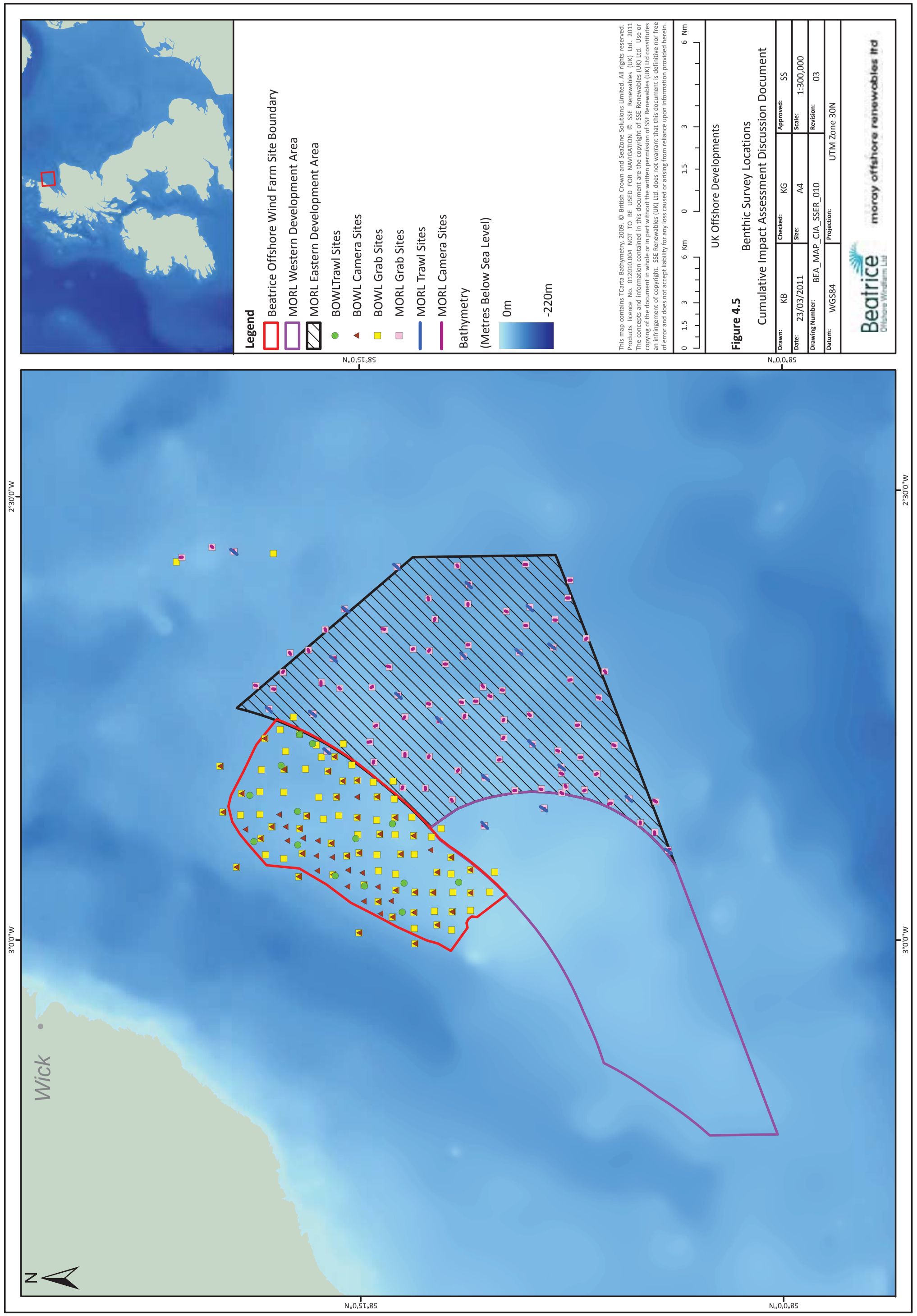

Figure 4.5
Benthic Survey Locations
Cumulative Impact Assessment Discussion Document

If any significant wider effects upon sediments are identified by the coastal processes assessment then these will also be taken into account, hence coastal processes assessment may be needed to feed into this assessment. The likely colonisation potential of the proposed turbine foundations and substructure and any scour protection features would be valuable. Some insight into this is provided by Picken (1986) (1) who investigated fouling organisms on artificial structures within the Moray Firth including structures at the Beatrice Field. Picken described a rich and diverse community comprising 33 species of algae, barnacles, hydroids, tubeworms and ascidians and provides an account of the succession of the different groups of encrusting and attaching species. These studies are useful as they provide opportunity to predict the rate and nature of colonisation of monopiles and other structures by fouling organisms at the wind farm sites.

Data from the wider area that would be required from literature search – seabed communities in the wider Moray Firth, principally from Hartley and Bishop (1986) (2) and from any more recent Beatrice oil-field related studies; SEA studies DTI (2004), SAC related surveys (SNH) and the STW SEA (3) .

Data from the commercial fisheries specialists on the levels and the nature of fishing activity in the area will also be used.

Table 4.3.2 Ecological Survey Requirements

Survey Requirement	Implementation
$0.1m^2$ grab sampling	Acquisition of quantitative data for sediment particle size and biological analyses
2 m scientific beam trawl	Collection of semi-quantitative data for assessment of sessile and mobile megafaunal assemblages.
Drop down video	Assessment of hard seabed substrates or sensitive features where grab sampling is inappropriate.
$0.04m^2$ Shipek sampling or $0.1m^2$ Hamon grab sampling	Collection of surface seabed sediment samples for contaminants analyses

Are you aware of any additional data sources that should be considered in the assessment?

4.3.8 Assessment Methodology

Biotope and Habitat Maps

Biotopes will be the principal biological unit for assessment of predicted cumulative effects. Considerable species and biotope level sensitivity information exist on the MarLin website and this will be a principal data source underpinning cumulative effects assessment.

Biotopes will be defined from a synthesis of the physical and biological data and comparison with the UK Marine Habitat Classification system (Connor *et al.,* 2004) (4). Classified biotopes, including infaunal and overlying epifaunal biotopes, will be mapped within a GIS with the extents of the boundaries interpolated using available acoustic data drawn from the geophysical surveys. There will be considerable liaison between the MORL and BOWL specialist advisors to ensure consistent approach to biotope classification and mapping. It has been agreed that a single biotope map will be produced covering the MORL and BOWL developments.

To assist standardisation of the final biotope classifications between developers it is proposed to investigate the possible use of the MEPF ALSF 'Bioscribe' tool (Hooper *et al*., 2011) (1). The advantage of this tool is that it will remove any subjectivity from the classification process enabling a standard and confident approach to biotope identification across both developments.

Project Details

The project details including specifications for the proposed installed infrastructure will be available at the initial EIA stage to inform each site specific assessment. It is proposed that developers will share design project details to inform the cumulative assessment.

Overall, the developments to be considered in the cumulative impact assessment are expected to be as the following;

- BOWL generating station;
- MORL Eastern Development area;
- MORL Western Development area;
- BOWL OFTO cable;
- MORL OFTO cable;
- Proposed SHETL cable;
- Proposed SHETL hub;
- Any relevant port and harbour developments in the Moray Firth;
- Relevant oil and gas activites;
- Dredging and sea disposal in the Moray Firth; and
- Commercial fisheries.

Assessing the Potential Effects of Direct Impacts

The overall extent of direct cumulative impacts will be quantified on the basis of the project design specifications and proposed installed infrastructure. This quantifiable footprint will then be used to determine the total area of habitat lost or temporarily disturbed and assessed within the context of the wider habitat availability. Only those habitats or biotopes common to both BOWL and MORL sites will be taken forward for cumulative assessment.

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(1)Picken, G.B. (1986). Moray Firth marine fouling communities. Proceedings of the Royal Society of Edinburgh, 91B, 213-220.

(2)Hartley, J.P. and Bishop, J.D.D. 1986. The macrobenthos of the Beatrice Oilfield, Moray Firth. Scotland. Proceedings of the Royal Society of Edinburgh.

(3)Strategic Environmental Assessment (SEA) of the Draft Plan for Offshore Wind Energy in Scottish Territorial Waters, Scottish Government 2010

(4)Connor, D.W. Allen, J.H., Golding, N., Howell, K.L., Lieberknecht, L.M., Northen, K.O. & Reker, J.B., (2004). The Marine Habitat Classification for Britain and Ireland. Version 04.05. [On-line] Peterborough: Joint Nature Conservation Committee.

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(1) Hooper, G.J., Barfield, P.D., Thomas N.S. and Capasso, E. Redefining biotopes at a regional scale and development of a Biotope matching decision support tool. First published 2011. Published by the MALSF. Emu Ltd Report No. 11/J/1/03/1552/1103.

Assessing the Potential for Indirect Effects

Outputs of the predictive modelling from the sediment and coastal processes assessment will be used to identify those areas that are likely to be affected by indirect effects. These include areas predicted to be influenced by the re-distribution of disturbed sediments or predicted to be affected in terms of changes to sediment processes. These areas will be quantified and mapped within a GIS with those benthic ecological features encompassed therein taken forward for cumulative impact assessment.

The developers will collaborate as to their understanding of the extents of indirect effects and sharing of model and GIS mapping outputs.

Assessing the Potential Impact of Colonisation

Historic studies have already characterised the rate and succession of colonisation of hard structures by biofouling organisms within the locale. The sensitivity of local biotopes to similar colonisation of infrastructure by these biofouling communities will be assessed.

Table 4.3.3 Summary of Benthic Ecology Methods and Activities Agreed Between Developers

Method/Activity	Status
Benthic survey	Comparable methods to be used for field data acquisition. Data to be shared between developers. Use of the same reference area.
Biotope and habitat mapping	Collaborative mapping exercise for the purposes of the cumulative assessment and using the ALSF database tool to standardise classification across developments.
Assessment of direct effects	Developers to share project design specifications to inform the assessment.
Assessment of indirect effects	Developers to share results of the sediment processes assessment and model outputs.
Assessment of potential colonisation	Developers to share project design specifications to inform the assessment.

Do you have any comments on the proposed assessment methodology?

4.3.9 Presentation of Results

Each identified cumulative effect will be described and assessed within the ES for each site. Standard IEEM guidelines will be used to determine impact significance and certainty criteria in collaboration with MFOWDG, Marine Scotland, SNH and JNCC.

Receptors will be assessed in terms of their tolerance and recoverability to each impact type using data drawn from MarLIN as well as previous experience from other industries, such as the aggregates industry, to further enhance the EIA.

4.4 Fish and Shellfish Ecology

4.4.1 Specialist Advisor

Both MORL and BOWL have commissioned the services of Brown and May Marine Ltd. to undertake the fish ecology impact assessments.

4.4.2 Guidance Documents

Guidance specific to fish ecology CIA is not currently available. As is suggested in the benthic ecology section (see Section 4.3), the methods described in King *et al.,* (2009) for birds will be adapted and broadly used for fish ecology, providing a form of general guidance. It is recommended, however, that in the absence of specific guidance, the final approach and methodology be agreed with Marine Scotland Science.

4.4.3 Designated Sites Relevant to Cumulative Impact Assessment

As described in section 4.1 above, the development of the MORL and BOWL sites have the potential to cumulatively impact upon the integrity and conservation objectives of two Special Areas of Conservation. Details of these Natura 2000 sites are provided below in Table 4.4.1.

Table 4.4.1 Designated Sites Relevant to Marine Mammal Cumulative Assessment

SAC	Qualifying Species Relevant to the Assessment
Berriedale & Langwell Waters	Salmon
River Oykel	Salmon and freshwater pearl mussel
River Evelix	Freshwater pearl mussel
Spey River	Salmon, sea lamprey and freshwater pearl mussel

Under the European Habitats Directive, any 'plan or project' that has the potential to adversely affect the conservation objectives of a Natura 2000 site will be subject to an Appropriate Assessment that is carried out by the Competent Authority (in this case Marine Scotland). Both MORL and BOWL are collecting baseline data to inform an Appropriate Assessment for migratory fish species and associated species as part of the cumulative impact assessment.

4.4.4 Baseline

The Moray Firth provides a suitable habitat and sustains a wide range of important fish and shellfish species, both ecologically and commercially in a local and national context.

Migratory fish and species of conservation importance (salmon, sea trout, eels, sea and river lamprey) could potentially transit the area and in some cases use it as a feeding ground.

It should be noted the importance of the sandeel populations in the area, as they are a key prey item, not only for fish species but also for birds and marine mammals. In addition, as shown in Table 4.4.2*,* the Moray Firth is considered an area of high intensity in terms of spawning for this species (Ellis *et al*., 2010).

Similarly, the potential for impacts on spawning herring in the grounds to the north of the BOWL and MORL sites, will be considered, given the high sensitivity of this species to noise, and the fact that herring depend on the presence of an adequate substrate (preferably coarse gravel) on which to spawn.

The Moray Firth is also known to be used by a number of species as a spawning and / or a nursery ground. The species using the area for these purposes are listed in Table 4.4.2 below. This includes spawning times (Coull *et al*., 1998) and intensity of spawning/nursery activity (Ellis *et al*., 2010). The spawning grounds of some of these species are illustrated in Figure 4.6.

Table 4.4.2 Species with Spawning and Nursery Grounds in the Moray Firth

Species	Spawning Area												Nursery Area
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Plaice	🟩 *	🟩 *	🟩									🟩	🟩
Sandeels	🟥	🟥									🟥	🟥	🟩
Whiting		🟩	🟩	🟩	🟩	🟩							🟥
Cod	🟩	🟩 *	🟩 *	🟩									🟥
Herring								🟧	🟧				🟥
Nephrops	🟧	🟧	🟧	🟧 *	🟧 *	🟧 *	🟧	🟧	🟧	🟧	🟧	🟧	🟧
Lemon Sole				🟧	🟧	🟧	🟧	🟧	🟧				🟧
Sprat					🟧 *	🟧 *	🟧	🟧					🟧
Spotted Ray	n/a												🟩
Thornback Ray	n/a												🟩
Spurdog	n/a												🟩
Blue Whiting	n/a												🟩
Ling	n/a												🟩
Hake	n/a												🟩
Anglerfish	n/a												🟥
Mackerel	n/a												🟩
Haddock	n/a												🟧
Saithe	n/a												🟧

Source: Coull *et al*., 1998 and Ellis *et al*., 2010
(red=high intensity; green=low intensity; orange: undefined intensity;(*)=peak spawning)

An indication of the relative abundance and importance of the principal commercial species in the Moray Firth, based on landings values by weight (tonnes) from the ICES rectangle where the Beatrice Offshore Wind Farm and the Moray Firth Round 3 zone are located (45E6 & 45E7) is provided in Table 4.4 3 below.

Table 4.4.3 Annual Landings by Weight (tonnes) from ICES Rectangle 45E6 & 45E7

Species Group	Annual Landings by Weight (tonnes) (average 2000-2009)	Species	Annual Landings by Weight (tonnes) (average 2000-2009)
Shellfish	1297.0	Scallops	809.8
		Edible Crab	178.9
		Nephrops	127.9
		Whelks	55.5
		Squid	53.3
		Velvet Crab	45.9
		Lobsters	19.7
		Other	5.9
Bony Fish (Teleosts)	491.3	Haddock	318.4
		Monks or Anglers	50.0
		Herring	44.3
		Whiting	19.8
		Cod	15.4
		Megrim	9.3
		Horse Mackerel	8.2
		Plaice	8.0
		Other	17.9
Elasmobranches	5.3	Spurdog	2.7
		Skates and Rays	2.3
		Portuguese Dogfish	0.1
		Other	0.2
Other	2.7	Other or mixed Demersal	2.4
		Roes	0.4

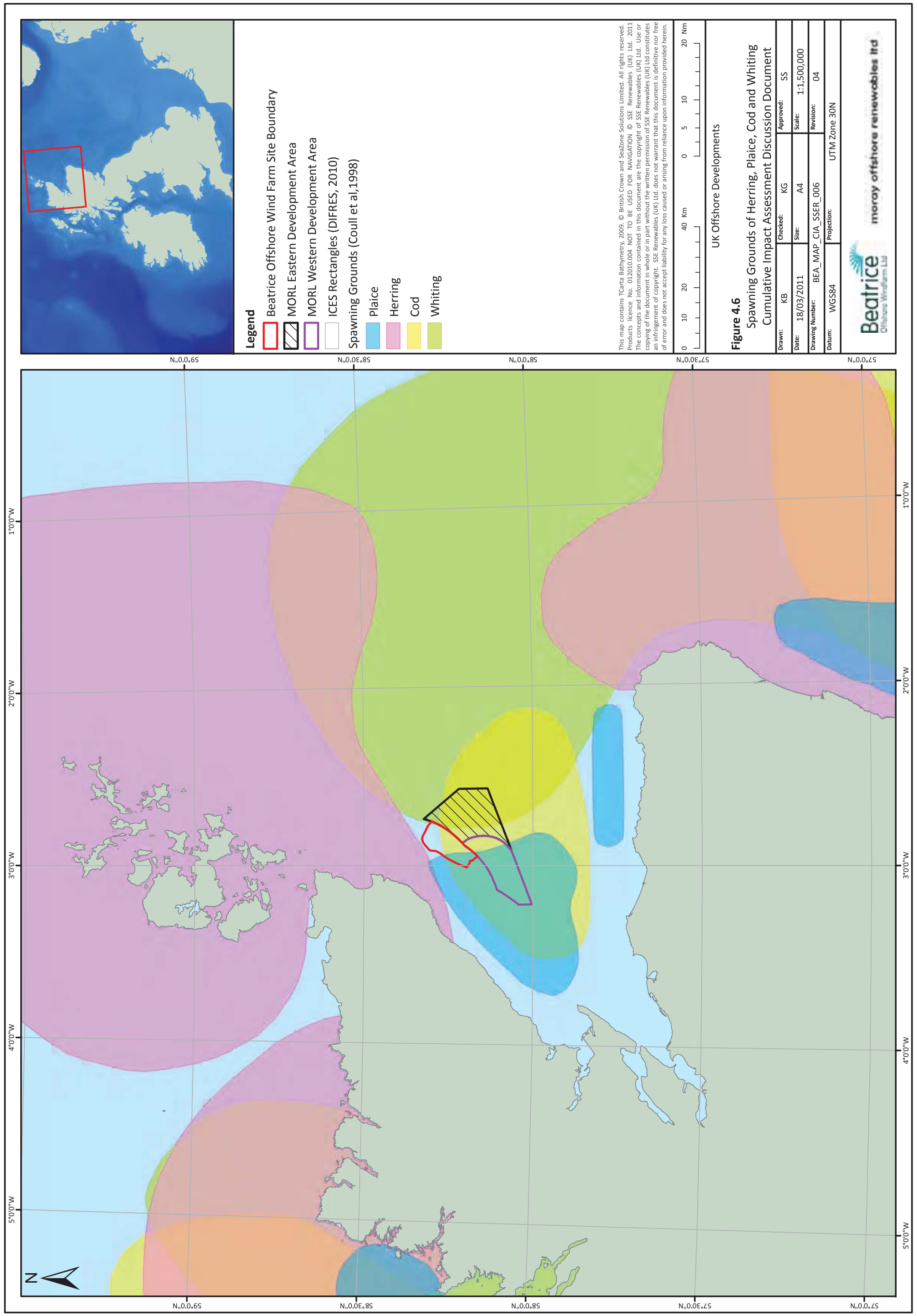

Figure 4.6
Spawning Grounds of Herring, Plaice, Cod and Whiting
Cumulative Impact Assessment Discussion Document

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4.4.5 Proposed Consultees

The following organisations will be consulted to seek agreement of species to be assessed, identification of key grounds, definition of populations and distributions and likely sources of cumulative impact:

- Marine Scotland;
- SNH;
- JNCC; and
- District Salmon Fishery Boards and Trusts.

4.4.6 Potential Effects

The principal potential effects to be considered from a cumulative point of view are as follows:

- Disturbance to spawning activity and juveniles (nursery areas);
- Barrier to/ change in migratory patterns;
- Behavioural changes derived from EMFs associated to cables;
- Changes in species composition and displacement of fish and shellfish resource;
- Direct impact during construction;
- Temporary and permanent loss of habitat; and
- Changes in prey availability and displacement of food resource.

4.4.7 Study Area

There needs to be an agreement with the regulators on the spatial limits to be included within the cumulative impact assessment. MFOWDG's preliminary suggestion for fish ecology spatial limit is the whole Moray Firth but this is likely to be refined following review of the results of the impact assessment.

A summary of the potential spatial extent of key impacts for the principal species groups and individual species likely to require assessment from a cumulative point of view is given in Table 4.4.4 below.

It should be noted that the potential spatial extent of cumulative impact will in many cases vary depending on species specific sensitivities, location of spawning/nursery/feeding grounds, species specific lifecycles, etc. In addition, at this early stage, with baseline and impact assessments for the individual MORL and BOWL sites yet to be completed, the information provided below should only be taken as a rough guide to the potential spatial extent of impacts.

Table 4.4.4 Predicted Potential Spatial Extent of Cumulative Impact

Receptor	Potential Impacts	Potential Sources: Construction/Operation	Potential Spatial Extent of Impact
Salmon and Sea trout	Disturbance/barrier to migration	EMFs	Regional (East and North coast of Scotland)
		Construction noise and vibration (piling)	
		Physical presence of turbines	
	Temporary and permanent change in prey availability/loss disturbance of feeding grounds	Construction noise and vibration (piling)	
		Changes in habitat/substrate	
		EMFs	
		Increased sediment concentrations/sediment deposition	
Herring	Disturbance during spawning	Construction noise and vibration (piling)	Regional (Buchan/Shetland sub-stock)
		Increased sediment concentrations	
		Changes in substrate/loss of spawning area	
Sandeels	Temporary loss of habitat	Direct Impact (e.g. jack up legs)	Moray Firth
	Permanent loss of habitat	Changes in habitat/substrate	
	Disturbance to spawning	Construction noise and vibration (piling)	
		Increased sediment concentrations/sediment deposition	
Shellfish species	Permanent or temporary loss of habitat/displacement	Construction noise and vibration (piling)	Moray Firth
		Increased sediment concentrations/sediment deposition	
		Changes in substrate	
		EMFs (little evidence for most species)	
		Direct impact (e.g. jack up legs)	
	Changes in larval dispersion and spat settlement?	Presence of turbines (changes in hydrodynamic regime, coastal processes?)	
Elasmobranches	Behavioural impacts: effects on migration? feeding?	EMFs	Moray Firth
Other migratory species and species of conservation importance	Disturbance/barrier to migration? Permanent or temporary loss of feeding grounds, nursery areas?	Construction noise and vibration (piling)	Moray Firth
		EMFs	
Other species with spawning grounds	Disturbance during spawning	Construction noise and vibration (piling)	Moray Firth
		Increased sediment concentrations/deposition of sediment	
Species with nursery grounds	Disturbance, temporary/permanent loss of nursery area	Increased sediment concentrations/sediment deposition	Moray Firth
		Noise and vibration (piling)	

4.4.8 Data Gathering

The principal data and information used to assess potential cumulative impacts on the fish ecology will be the same as those required for the site specific impact assessments. These can be summarised as follows:

- MMO Fisheries Statistics: landings by value and weight;
- Review of the ecology, distribution and importance of the principal fish and shellfish species;
- Review of the species potentially using the area as a spawning/nursery ground, feeding ground and overwintering area. Assessment of the importance of the grounds and the potential for equally suitable grounds to be accessible to these species;
- Review of potential routes and behaviour of migratory species;
- Review of data and results from fish and shellfish surveys undertaken in the area, including adult and juvenile fish surveys, larval and egg surveys, etc;
- The benthic ecology baseline and impact assessments;
- The commercial fisheries baseline and impact assessments; and
- The results of the noise modelling.

In addition to the information detailed above, the results of any site specific surveys that may be undertaken by MORL and BOWL (e.g. benthic surveys, commercial fisheries observer trips, etc) will be reviewed.

Depending on the species and the specific effect under consideration, information may be needed from additional developers as well as MORL and BOWL. As explained in Section 4.4.6, the study area under consideration will vary depending on a number of factors. The number of additional developments which may have to be considered in the cumulative impact assessment is dependent on the scale of the study area defined for each potential effect and/or species sensitivity.

Are you aware of any additional data sources that should be considered in the assessment?

4.4.9 Assessment Methodology

The different construction / decommissioning and operation schedules of development projects with potential to result in a cumulative effect will greatly affect the assessment of cumulative impacts. Depending on these, cumulative impacts could occur on a spatial or on temporal scale. On a spatial scale, impacts could occur where different developments are being constructed at the same time, causing a cumulative impact upon the fish and shellfish ecology in terms of the extent of the area and the fish and shellfish resource being simultaneously disturbed; temporal cumulative effects could occur with the construction of different developments taking place in successive years, on the basis of the continuous extent of time that fish and shellfish species are being disturbed.

The basis of the assessment process is anticipated to include the following:

- Identification of activities / developments potentially resulting in a cumulative effect upon each receptor;
- Identification of the aspects of each activity/development that may result in an effect (e.g. underwater noise) upon each receptor (e.g. migratory species, spawning herring, etc);
- Definition of the extension of cumulative impact study areas for each effect on a receptor specific basis; and
- Review of site specific and cumulative impact assessment is undertaken for each activity / development, where available.

The developments to be considered in the cumulative impact assessment are expected to be as follows:

- BOWL generating station;
- MORL Eastern Development area;
- MORL Western Development area;
- BOWL OFTO cable;
- MORL OFTO cable;
- Proposed SHETL cable;
- Proposed SHETL offshore hub;
- Any relevant port and harbour developments in the Moray Firth;
- Relevant oil and gas activities;
- Dredging and sea disposal in the Moray Firth;
- Commercial fisheries;
- Marine energy development in the Pentland Firth and Orkney waters; and
- Relevant military activities.

4.4.10 Data Analysis and Standardised Assessment of Effects in EIA

For the potential cumulative effects be addressed and assessed it will be required that standard procedures on information gathering, data analysis (e.g. noise modelling) and survey methodologies (e.g. gear used) be implemented by the developers.

Site specific impact assessments carried out for BOWL and MORL will, where possible, be integrated to facilitate the assessment of cumulative effects by each developer. In order to enable this, MORL and BOWL will be required to do the following:

- Take a common, standardised approach to assessing the effects of the projects in the EIA; and
- Share project information and programmes as such information becomes available.

Do you have any comments on the proposed assessment methodology?

4.4.11 Presentation of Results

The presentation of findings will be standardised for the MORL and BOWL projects in order to facilitate assessment of cumulative effects. Cumulative effects will be considered using standardised impact assessment criteria, which will be agreed by the MORL and BOWL project teams, and in consultation with Marine Scotland.

4.5 Marine Mammals

4.5.1 Specialist Advisor

BOWL and MORL are working closely with each other and specialist groups such as the University of Aberdeen (Lighthouse Field Station) and SMRU, in order to ensure a consistent approach to the impact assessments for marine mammals. BOWL and MORL are working with University of Aberdeen and SMRU Ltd on wider research in the Moray Firth in order to fill data gaps. The details of this work are described below in Section 4.5.8.

Natural Power has been commissioned by MORL to work with the University of Aberdeen and SMRU Ltd in assessing the impact of the proposed development at the MORL Round 3 Zone on marine mammals, and to produce the marine mammal chapter of their EIA. BOWL is yet to appoint a consultant for this role.

Liaison with those groups carrying out assessments at neighbouring sites, e.g. the FTOWDG and the wave and tidal developers within the Pentland Firth and Orkney waters will also be crucial.

4.5.2 Guidance Documents

The methods outlined by King *et al*., (2009) (1) for cumulative impact assessment on birds are of general use for cumulative impact assessment as are the IEEM guidelines (2). MFOWDG are also aware that Marine Scotland is currently drafting guidance on European Protected Species within Scottish Territorial Waters with input from SNH. Similarly, JNCC are currently preparing guidance applicable to Round 3 Zones (3). All four guidance documents will be used as appropriate.

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(1)King, S., Maclean, I.M.D., Norman, T. and Prior, A. 2009. Developing guidance on ornithological cumulative impact assessment for offshore wind farm developers. COWRIE.

(2)Guidelines for ecological impact assessment in Britain and Ireland. Marine and coastal. IEEM 2010.

(3)The protection of marine European Protected Species from injury and disturbance: Guidance for the marine area in England and Wales and the UK offshore marine area. DRAFT report by the Joint Nature Conservation Committee, Natural England and Countryside Council for Wales. October 2010.

4.5.3 Designated Sites Relevant to Cumulative Impact Assessment

As described in section 4.1 above, the development of the MORL and BOWL sites have the potential to cumulatively impact upon the integrity and conservation objectives of two Special Areas of Conservation. Details of these Natura 2000 sites are provided below in Table 4.5.1.

Table 4.5.1 Designated Sites Relevant to Marine Mammal Cumulative Assessment

SAC	Qualifying Species Relevant to the Assessment
Inner Moray Firth	Bottlenose dolphin
Dornoch Firth and Morrich More	Common/harbour seal and otter

Under the European Habitats Directive, any 'plan or project' that has the potential to adversely affect the conservation objectives of a Natura 2000 site will be subject to an Appropriate Assessment that is carried out by the Competent Authority (in this case Marine Scotland). Both MORL and BOWL are collecting baseline data to inform an Appropriate Assessment upon bottlenose dolphin and common / harbour seal as part of the cumulative impact assessment.

4.5.4 Baseline

The Moray Firth is home to two resident cetacean species (harbour porpoise and bottlenose dolphin), one species which is seasonally abundant (minke whale), and a further ten or so species which occur on a less predictable basis (1). Of these ten species, some (common dolphin, white-beaked dolphin, Risso's dolphin) are sighted in the Moray Firth more often than others (white-sided dolphin, killer whale, long-finned pilot whale, humpback whale, fin whale, sperm whale, northern bottlenose whale). As detailed above, the Inner Moray Firth has been designated as an SAC for bottlenose dolphins. Generalisations can be made about the distribution patterns of the three key cetacean species:

- Harbour porpoises are the most commonly encountered species, being seen throughout inshore and offshore waters of the Moray Firth;
- Minke whales are the second most commonly sighted species in offshore waters, although there is some evidence that this may be a relatively recent situation; and
- Almost all bottlenose dolphin sightings occur within 15 km of the coast within the Inner Moray Firth SAC or in the coastal strip along the southern Moray Firth coast. Most sightings of dolphins in the offshore waters of the outer Moray Firth are common, white-beaked or Risso's dolphins.

Two pinniped species are resident in the Moray Firth (grey and common/harbour seals). Grey seals haul out at intertidal sites between foraging trips and breed on beaches (or in caves) above the high water mark along the Helmsdale coastline in autumn. Common/harbour seals use intertidal haul out sites to rest between foraging trips, breed (June / July) and moult (August / September). Part of the Dornoch Firth has been designated as an SAC for common/harbour seals.

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(1)Reid, J.B., Evans, P.G.H. and Northridge, S.P. 2003. Atlas of cetacean distribution in north-west European waters. JNCC. 76 pp.

4.5.5 Proposed Consultees

It is proposed that the following organisations will be consulted during the scope refinement and ongoing cumulative impact assessment:

- Marine Scotland;
- SNH;
- JNCC;
- Whale and Dolphin Conservation Society (WDCS); and
- Ministry of Defence.

4.5.6 Potential Effects

The following are perceived to be the main potential impacts on marine mammals as a result of wind farms in the marine environment:

- Disturbance and potential displacement as a result of elevated construction and operational noise;
- Increased collision risk due to construction and maintenance traffic;
- Reduction of the feeding resource due to effects on prey of noise, vibration and habitat disturbance; and
- Changes in prey availability due to infrastructure presence and changes in fishing activity.

These impacts may be site-specific, but they also have the potential to be cumulative. Long term avoidance is not considered to be a potential cumulative effect

Do you agree that long term avoidance is not likely to be a potential cumulative impact?

4.5.7 Study Area

The area over which cumulative impacts will be considered will develop during this consultation process. As well as encompassing the MORL and BOWL sites, and a suitable "buffer", it will be necessary to consider the area over which animals that use the Moray Firth range. For example, bottlenose dolphins using the Moray Firth range as far afield as the Firths of Forth and Tay, and sometimes even further afield. For harbour porpoises, all animals occurring in the North Sea may be considered as being part of one population/stock (1). As a consequence, MFOWDG propose that the initial study area extend out with the Moray Firth for these highly mobile species.

These considerations will affect which other developments need to be included within the scope of the cumulative impact assessment.

Do you have any comments on the proposed study area?

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(1)Hammond, P.S., Berggren, P., Benke, H., Borchers, D.L., Collet, A., Heide-Jørgensen, M.P., Heimlich, S., Hiby, A.R., Leopold, M.F. and Øien, N. 2002. Abundance of harbour porpoises and other cetaceans in the North Sea and adjacent waters. Journal of Applied Ecology 39: 361-376.

4.5.8 Data Gathering

Desk-based reviews have been commissioned by both BOWL and MORL to inform their respective scoping documents and approach to data gathering to establish the use of the Moray Firth by marine mammals.

As a consequence of these studies, the University of Aberdeen and SMRU Ltd have been commissioned by MFOWDG to carry out specific research to fill the data gaps which were identified. The details of the work commissioned and an interim progress report are provided in Annex B of this document. While some of the work is based solely on data collected as part of the MORL / BOWL funded studies (2010 - 2011), data collected during the Beatrice Demonstrator (2005 - 2007) and DECC (2009 - 2010) studies carried out by the University of Aberdeen are also being used. The work relates to the provision of data to facilitate the following objectives:

- Characterising the sites with respect to the marine mammal species present and detailing seasonality and year to year variability in occurrence;
- Assessing the density of animals at the proposed sites; and
- Assessing the likelihood of exchange between local SACs and the proposed wind farm sites.

The site characterisation objective is being met through analysis of existing University of Aberdeen data and collection of new data from passive acoustic monitoring devices (C-PODs). C-POD locations are illustrated on Figure 4.7.

The density assessment objective is being met through an intensive series of aerial line-transect surveys which were carried out by the University of Aberdeen in August and September 2010. These data will allow direct estimates of cetacean density within the BOWL and MORL sites. Use of these data in regional-scale habitat association models will allow the density of cetaceans in surrounding areas to be predicted.

Assessing the likelihood of exchange between local SACs and the proposed MORL and BOWL wind farm sites is relevant for bottlenose dolphins and common/harbour seals, both of which have local SACs as described above. SMRU/SMRU Ltd are developing a new approach using data from Ecological Acoustic Recorders (EARs) deployed at the proposed wind farm sites. The acoustic recordings made by these devices can be analysed to determine which species emitted the noise and thus the proportion of dolphin whistles across the Moray Firth that can be attributed to bottlenose dolphins vs. other dolphin species. Data collected during deployment of six EARs across the Moray Firth will be used to assess the probability that dolphins detected are bottlenose dolphins/other candidate dolphin species. This work will be complemented by an analysis of visual sightings from aerial and boat surveys.

In a separate package of works, the likelihood of exchange between the common/harbour seal SAC and the proposed wind farm sites is being assessed by SMRU Ltd using existing seal telemetry and habitat data.

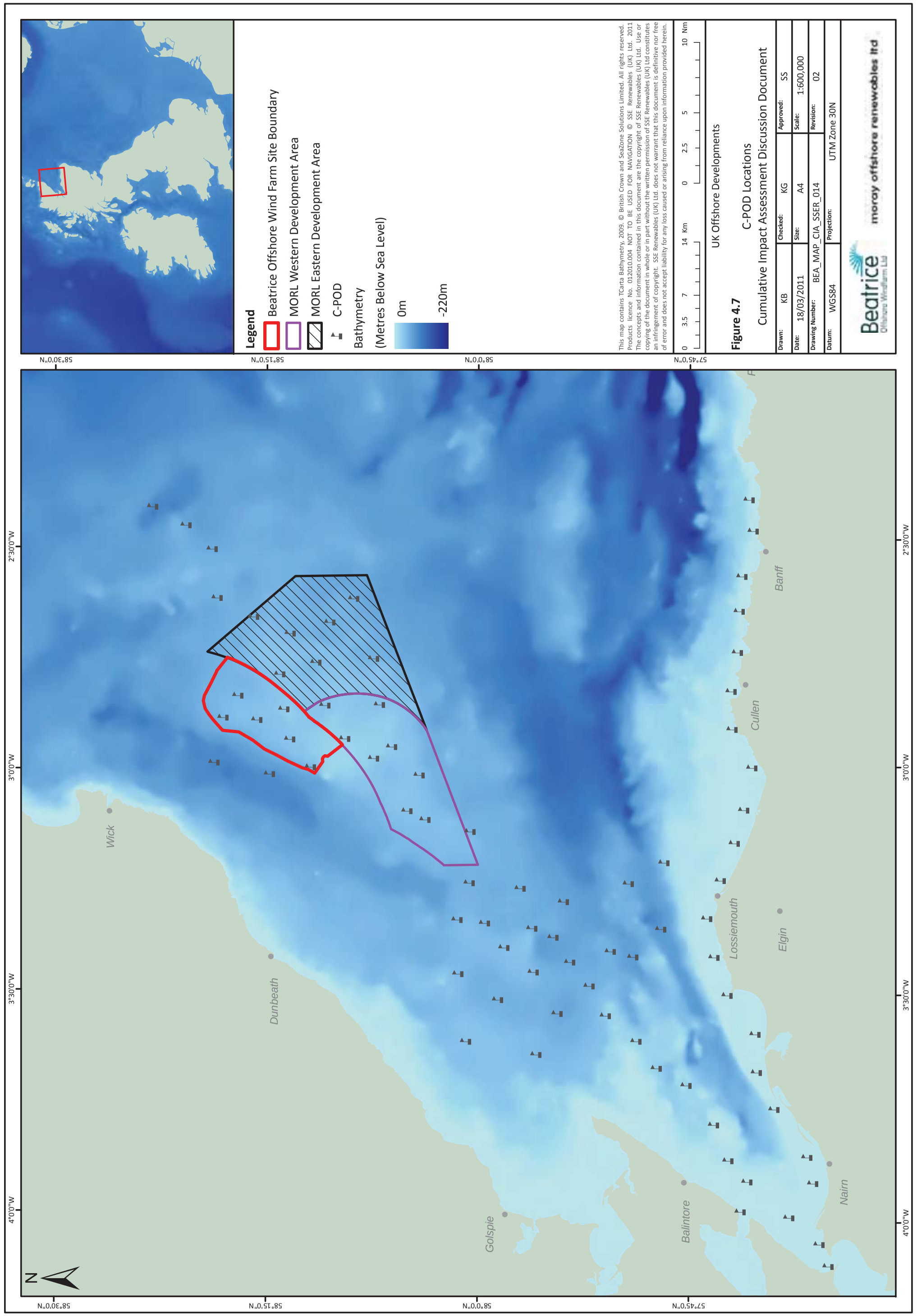

Figure 4.7

UK Offshore Developments

C-POD Locations

Cumulative Impact Assessment Discussion Document

In addition to the work described above, dedicated marine mammals observers are present during boat-based surveys being carried out on a monthly basis over the BOWL and MORL development sites (plus relevant buffer zones). IECS has been commissioned to undertake the marine mammal part of surveys of the BOWL development site; Natural Power has been commissioned to do the same for the MORL Eastern Development Area sites. Surveys of the sites are being carried out separately but the data will be pooled. Transect routes are illustrated on Figure 4.8. Boat survey data from both BOWL and MORL surveys are also being integrated with available aerial survey data for the cetacean habitat association modelling being conducted by the University of Aberdeen.

An integrated approach will be taken to modelling underwater noise to assess the potential impacts of construction and operation at both the BOWL and MORL sites. Details of the modelling to be undertaken by Subacoustech can be found in Section 4.12 and Annex D. The extensive series of noise measurements made during the construction of the Beatrice Demonstrator (1) will be used in the construction and calibration of the model.

Are you aware of any additional data sources that should be considered in the assessment?

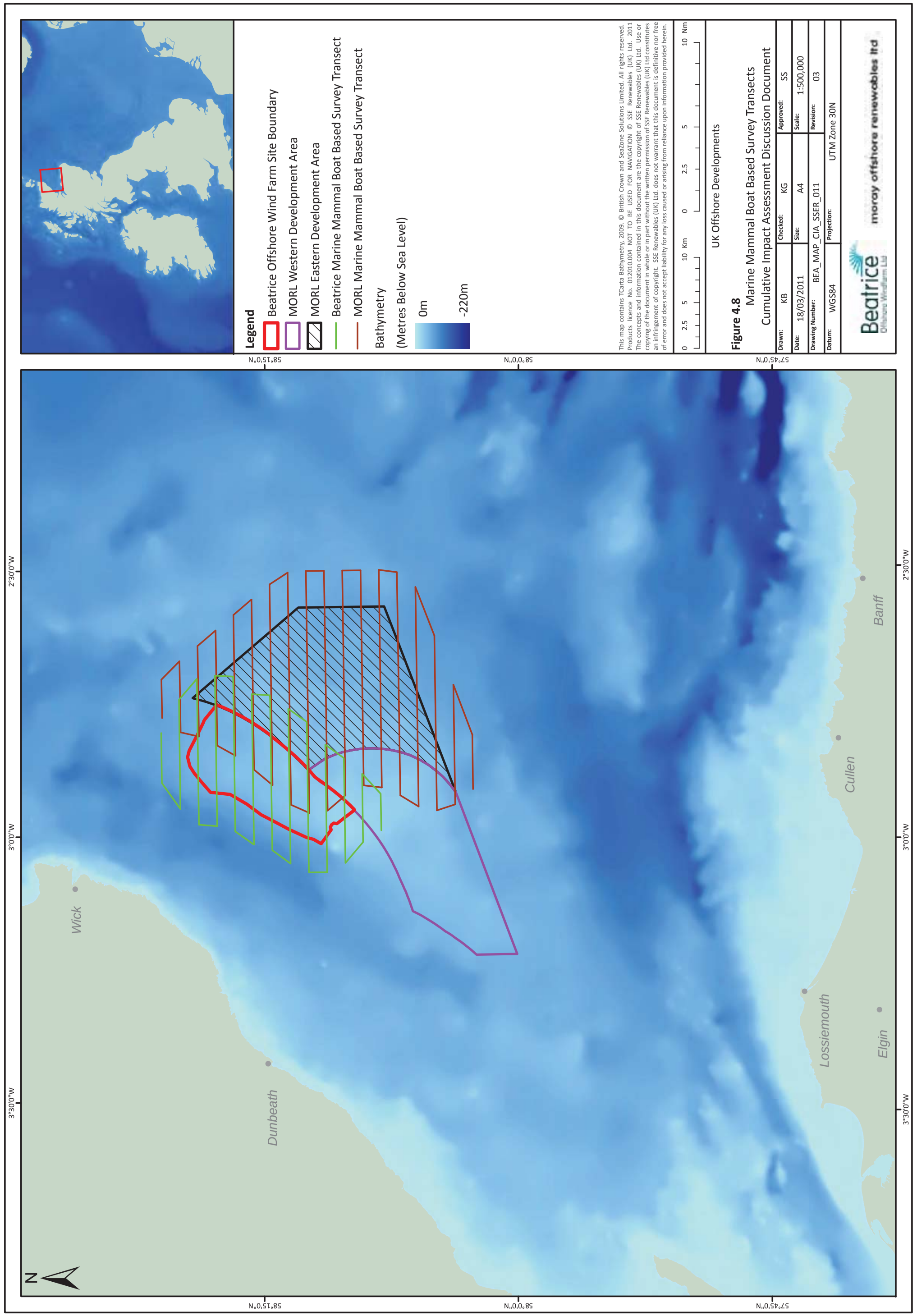

Figure 4.8
Marine Mammal Boat Based Survey Transects
Cumulative Impact Assessment Discussion Document

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(1)Bailey, H., Senior, B., Simmons, D., Rusin, J., Picken, G. and Thompson, P.M. 2010. Assessing underwater noise levels during pile-driving at an offshore windfarm and its potential effects on marine mammals. Marine Pollution Bulletin 60: 888-897.

4.5.9 Assessment Methodology

The survey data and information discussed above will be shared by both BOWL and MORL.

For each of the potential impacts outlined above, the following methods of assessment are being developed for site EIA work. The outcomes will input into the cumulative and in-combination impact assessment work (when the impacts will be extended to large scale phased construction and operational impacts).

Disturbance and Potential Displacement as a Result of Elevated Construction and Operational Noise

Marine mammal species density and distribution data will be used to model population densities across the MORL and BOWL sites over time. Information on noise levels from previous piling activity from other wind farm sites and relevant activities will be used to model the severity of noise of piling operations over distance within the Moray Firth. These model outputs will be assessed in relation to audiograms and species density to quantify the potential level of impact on species during multiple phased construction and operational works. The potential for impacts will also be assessed with regard to the time of year so that levels of impact may be assumed with regard to different seasonal patterns of use.

This assessment will also take into account any potential displacement resulting from noise from the following:

- BOWL generating station;
- MORL Eastern Development area;
- MORL Western Development area;
- BOWL OFTO cable;
- MORL OFTO cable;
- Relevant oil and gas activities;
- Proposed SHETL hub;
- Proposed SHETL cable
- Port and harbour developments in the Moray Firth;
- Relevant military activity;
- Other relevant offshore renewable development outside the Moray Firth;
- Dredging and sea disposal in the Moray Firth; and
- Marine energy developments in the Pentland Firth and Orkney waters.

Increased Collision Risk Due to Construction and Maintenance Traffic

Marine mammal species density and distribution data will be used to model population densities across the MORL and BOWL sites. The number of vessels required during construction and operation will be estimated. These data will be used to estimate collision risk with regard to the time of year so that levels of impact may be assumed with regard to different seasonal patterns of use. Where available, the results of the study will be cross-referenced against information from existing wind farms, and information on baseline traffic levels in the Moray Firth.

This study will also take into account any traffic associated with proposed petroleum industry development, the planned OFTO cables, SHETL cable and hub.

Reduction of the Feeding Resource Due to Effects on Prey of Noise, Vibration and Habitat Disturbance

The extent to which marine mammal species feed within the MORL and BOWL sites will be assessed using marine mammal distribution and density data, data on and literature accounts of foraging habits (there are more data for seals than cetaceans), habitat maps and data/literature on the density and distribution of prey within the sites. The potential impact of construction and operation on habitats and prey distribution and availability will be determined using information from the literature (including audiograms for noise-sensitive fish and marine benthic species, where they are available) and specialist knowledge. This information will then be used to assess the potential impact on the foraging habits of marine mammals.

Other developments to be included in this study will include the following:

- OFTO cables for BOWL and MORL;
- SHETL cable;
- Proposed SHETL hub;
- Proposed petroleum industry development;
- Other wind farms not in the Moray Firth; and
- Marine energy developments in Pentland and Orkney waters.

Changes in Prey Availability Due to Infrastructure Presence and Changes in Fishing Activity

The potential for bio-fouling and long-term changes in prey availability for marine mammals will be estimated using baseline survey information on biota and evidence gathered for the Fish Ecology assessment (see Section 4.4). The potential for changes in fishing activity and the density and abundance of fish species within the wind farm sites will also be estimated from baseline data and evidence gathered for the commercial fisheries assessment (see Section 4.11). The potential for interaction between the impacts of changes in commercial fishing activity and bio-fouling will also be assessed. The potential impacts on prey species will be related to known foraging behaviour of marine mammal species recorded within the proposed development area.

In addition to the proposed wind farms within the Moray Firth, other developments to be included are:

- Existing and proposed oil and gas industry infrastructure;
- Proposed SHETL hub; and
- Commercial fisheries.

Do you have any comments on the proposed assessment methodology?

4.5.10 Presentation of Results

Findings from the research activities described above will be presented in technical reports to BOWL and MORL in order to inform the EIA process.

4.6 Ornithology

4.6.1 Specialist Advisors

BOWL has commissioned RPS as their lead ornithological advisors (which will include production of the ES chapter and technical report) and IECS to undertake seabird surveys of the development site plus a relevant buffer zone. MORL has commissioned Natural Power to undertake the ornithological assessment for their site. RPS and Natural Power are working together on common aspects of the assessment of ornithology, including cumulative impacts.

4.6.2 Guidance Documents

The key guidance document for cumulative impacts on birds is King *et al.,* (2009). This document sets out the current best practice approach for determining which species, protected sites (e.g. SPAs) and developments should be considered.

4.6.3 Baseline

The Moray Firth is host to internationally-important numbers of breeding seabirds, over-wintering waterbirds (seaducks, diving ducks, divers, grebes and waders), and provides important feeding areas for species on passage during spring and autumn migration. As recognition of this, there are a number of areas designated for their nature conservation value with respect to ornithological interests throughout the firth. These include international-level Special Protection Areas (SPAs) and Ramsar sites, and national Sites of Special Scientific Interest (SSSIs). The nearest designated site to both proposed developments is the East Caithness Cliffs SPA, which lies approximately 10.7 and 19.95 km to the north-west of the Beatrice site and MORL Eastern Development Area respectively. Further information is provided in the scoping reports.

4.6.4 Proposed Consultees

It is proposed that the following will be consulted during the scope refinement and ongoing cumulative impact assessment:

- SNH;
- JNCC; and
- RPSB.

4.6.5 Potential Effects

The potential effects of offshore wind farms on birds can be summarised as:

- Collision with turbines;
- Disturbance/displacement, including that produced due to construction noise;
- Barrier effects; and
- Indirect effects (e.g. changes in habitat or prey supply).

These effects may operate at individual offshore wind farm sites, cumulatively between a number of offshore and possibly onshore wind projects or in-combination with other non-wind farm activities (e.g. the oil and gas industry).

4.6.6 Study Area

The cumulative study area will be species-dependant, but for wide ranging species it may cover waters from Orkney in the north to the Firth of Forth in the south to take account of bird migration and general species mobility. The region may need to be extended for certain species (e.g. individual migratory species or those with a large foraging range) and may also include onshore areas where appropriate.

'Reasonably foreseeable' projects to be taken into account have been identified as follows:

- BOWL generating station;
- MORL western development area generating stations;
- MORL eastern development area generating stations;
- BOWL OFTO cable;
- MORL OFTO cable;
- Proposed SHETL cable;
- Proposed SHETL hub;
- Marine energy development in the Pentland Firth and Orkney waters;
- Dredging and sea disposal in the Moray Firth;
- Relevant oil and gas activities;
- Firth of Forth and Tay (all projects); and
- Aberdeen Offshore Wind Farm.

It should be noted that Bell Rock, Forth Array and the 'medium term' options outlined in Marine Scotland's current Strategic Environmental Assessment (SEA) of the Draft Plan for Offshore Wind Energy in Scottish Territorial Waters have been scoped out of this assessment as these are not considered to be 'reasonably foreseeable' i.e. no data are likely to be available.

For particularly wide-ranging species such as gannet, or migratory species such as geese and swans, where the effects of other wind farms, including onshore developments and other Round 3 zones, may need to be taken into account additional sites will be considered on a case by case basis.

Advice will be sought from the Statutory Nature Conservation Agencies (SNCAs) regarding the identification of any major onshore projects which are constructed 'but have yet to exert a predicted effect'.

Collision and barrier effects are fairly specific to wind farms, therefore no non-wind farm projects will be considered in the cumulative assessment of these effects.

In relation to disturbance/displacement and indirect effects on habitat and prey species, there could be potential for cumulative effects with non wind farm projects, such as other marine renewable projects (e.g. wave and tidal), although this has yet to be demonstrated. This will be kept under review and considered in relation to particular species on a case-by-case basis. Information on the availability of data and/or site assessments undertaken in time for consideration in the MORL / BOWL CIA will be sought from the Pentland Firth Developers Group. Dredging and sea disposal, marine and port development, oil and gas development and commercial fishing will also be considered where relevant.

Data Gathering

Data collected for the MORL and BOWL EIAs will form the basis of cumulative impact assessment and additional data gathering will not be required. The data that is being collected includes the following:

- Boat-based survey data collected at least once per month over a two-year period;
- Aerial survey data during 2009-10;
- Additional migration surveys using coastal and boat-based observations;
- Bird tagging; and
- Wider Moray Firth aerial surveys (MORL only at present).

The Crown Estate enabling actions have already ensured that aerial bird survey data are collected in a consistent manner across the Moray Firth Round 3 zone and the Beatrice site. The methodology used for the Moray Firth zone has varied: in the first instance HiDef conducted digital video surveys (Summer 2009), while the 2009 - 10 winter surveys were carried out by WWT using visual observations.

The boat-based methodologies used for the two sites follow the same methods based on European Seabirds At Sea (ESAS) methods as modified for offshore wind farms (Camphuysen *et al.*, 2004, Maclean *et al.*, 2009). The methods for the two sites are described in detail in the scoping reports. The datasets and resulting assessments arising from the surveys will be shared between MORL and BOWL. Ornithology boat based survey transects are illustrated on Figure 4.9.

The migration surveys were undertaken during autumn 2010 (mid-September to mid-November) and will be repeated in Spring 2011 (mid-March to mid-May). The boat-based observations were/will be undertaken during the above ESAS-based surveys. The coastal observations were/will be undertaken for a total of 16 days per season from each of four locations (Sarclet Head, Duncasby Head, Rosehearty, and Whitehills). Full details of the methodologies are provided in the autumn 2010 Migration Survey Reports (see Annex C). The data arising from these surveys has been shared by MORL and BOWL.

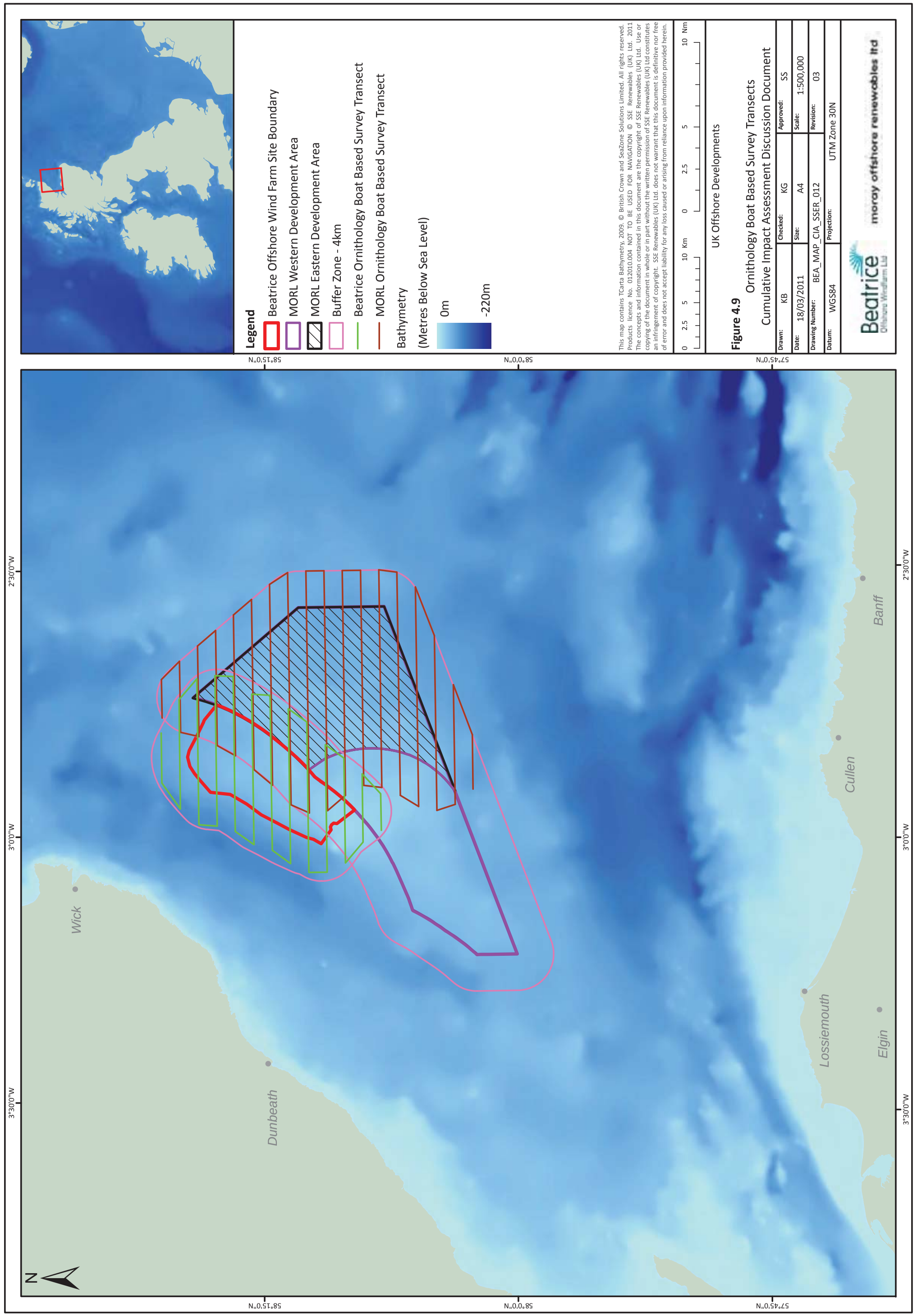

Figure 4.9
Ornithology Boat Based Survey Transects
Cumulative Impact Assessment Discussion Document

4.6.7 Assessment Methodology

The significance of each impact will be assessed according to the number of birds affected as a proportion of the relevant population and taking account of the species' conservation status.

Population estimates for SPA species will be taken from the Natura 2000 standard data form unless more recent and robust data are available. Agreement will be sought from SNCAs on the use of these latter data. It is accepted that the process of assigning birds to SPA populations across the study region is likely to be complex owing to the number of SPAs with the same qualifying and assemblage species.

Advice will also be sought from SNCAs on how to determine the local and regional population size for non-SPA species. For these species, it may be possible, using population modelling, for thresholds of impact to be agreed with SNCAs. For SPA species, this may not be possible and this is discussed further in Section 4.6.9.

Collision Risks

Cumulative collision risk can be calculated by summing collision numbers from each individual wind farm. The total number would then be presented as a percentage of the relevant population or populations (e.g. local, regional, national) and also a percentage change in background mortality rate. Where effects are expected to be significant, they should be discussed in the context of the life history of the species. In some cases a population modelling approach may be required.

In order that collision risk estimates are comparable, similar methods of calculation should be used for the two sites. The approach to be used will be discussed with SNCAs but is likely to follow a variation of the SNH's Band Model (http://www.snh.gov.uk/strategy/renewable/sr-we00a1.asp).

Disturbance and Displacement

Disturbance and displacement will be assessed by summing the number of individuals of each species which may be disturbed or displaced for consideration in relation to the relevant population (e.g. local, regional, national) and discussed in the context of the species conservation status. These assessments will require predictions of the levels of disturbance and displacement which may occur. These predictions will be informed by studies conducted elsewhere and in discussion with SNCAs. The assessment will consider the potential for disturbance and displacement which may arise due to construction, operation and decommissioning activities. Agreement will also be needed on the level at which the impact is deemed to become insignificant (e.g. the percentage of the population affected).

Barrier Effects

Barrier effects are likely to be minimal for most migratory species, with many taking far-field avoidance of wind farms with minimal effects on energy budgets (Speakman *et al*., 2009). For these species it is anticipated that qualitative assessments will be sufficient. Where effects are expected to be significant (e.g. for avoidance of multiple wind farms on a migration route or regular avoidance such as where the wind farms lie between feeding areas and roosting sites) quantitative assessments, incorporating estimates of elevated energy demands may be appropriate (e.g. Masden *et al.,* 2009). These will be undertaken on a species specific basis (Masden *et al.,* 2010).

Indirect Effects

Construction effects on seabird prey species may have indirect effects on birds, an effect which may be more pronounced if there is concurrent construction over large areas. The potential for such effects will be assessed following an approach similar to that used for estimating disturbance and displacement. This will incorporate assessments of the possible changes to prey distributions and abundance, derived from studies conducted elsewhere and in discussion with SNCAs. Details of appropriate species and techniques would be discussed and agreed at each stage with the relevant stakeholders. Noise modelling is being undertaken by Subacoustech, this will include an assessment of the potential impacts of noise on diving seabird species.

4.6.8 SPAs, Impact Assessment and Habitats Regulations Appraisal

For SPAs relevant to the Moray Firth region, both developers will provide specific information as part of Habitats Regulations Appraisals. This information will support decisions about whether their development(s), alone or in-combination, is likely to have a significant effect on the qualifying features of an SPA and any adverse impact on site integrity. This will be based on whether the proposed development will undermine the conservation objectives of the site.

Table 4.6.1 Summary of Ornithology Methods and Activities Agreed Between Developers

Method/Activity	Status
Boat-based survey methods	Common methods based on Camphuysen *et al.*, 2004 and Maclean *et al*., 2009. The datasets arising from the surveys and resulting assessments will be shared between MORL and BOWL.
Aerial surveys	WWT information collected for The Crown Estate will be shared.
Migration surveys	Undertaken collaboratively and data shared.
Density calculations	Common approaches to be agreed.
Collision risk modelling	Common approaches to be agreed. The subsequent assessment will be shared between MORL and BOWL.
Disturbance/displacement assessment	Common approaches to be agreed. The subsequent assessment will be shared between MORL and BOWL.
Barrier effects assessment	Common approaches to be agreed. The subsequent assessment will be shared between MORL and BOWL.
Indirect effects assessment	Common approaches to be agreed. The subsequent assessment will be shared between MORL and BOWL.

*The sharing of assessments will depend on submission timetables: the assessment shared by MORL may comprise a draft assessment.

4.6.9 Presentation of Results

Tables summarising the significance of cumulative effects for each sensitive receptor at each site will be produced to summarise each category of effect, i.e. collision risk, disturbance/displacement etc. The cumulative effects should be discussed based on the magnitude of the impact in relation to the local, regional, and national populations and should reach a summary conclusion stating whether the cumulative effect is significant or not significant. In order for results to be comparable, it will be important for MORL, BOWL and the SNCAs to agree on definitions of sensitivity, magnitude of effect and impact significance.

These final tables will be produced during EIA for the two projects. A draft 'long list' of bird receptors for initial consideration of cumulative impacts is provided in Table 4.8. This list will be refined following the approach detailed in King *et al*. (2010), based on a step-by-step assessment of risks. This will result in the determination of a final list of sensitive bird receptors from the 'long list', for which a full assessment will be conducted.

Table 4.6.2 Long List of Bird Receptors

Species	Displacement/ disturbance	Collision	Barrier effects	Indirect effects	SPA feature with site-interaction potential?+	Use of site*
Whooper swan	none	low-medium	low	none	yes	W, P
Pink-footed goose	none	low-medium	low	none	yes	W, P
Greylag goose	none	low-medium	low	none	yes	W, P
Barnacle goose	none	low	low	none	yes	W, P
Wigeon	none	low	low	none	no	W, P
Teal	none	low	low	none	no	W, P
Pintail	none	low	low	none	no	W, P
Eider	none	low	low	none	no	B, P, W
Scaup	none	low	low	low	yes	W, P
Long-tailed duck	low-medium	low	low	low-medium	yes	W, P
Common scoter	low-medium	low	low	low-medium	yes	W, P
Velvet scoter	low-medium	low	low	low-medium	yes	W, P
Goldeneye	none	low	low	none	no	W, P
Red-breasted merganser	none	low	low	none	no	W, P
Goosander	none	low	low	none	no	W, P
Red-throated diver	low-medium	medium	low	low-medium	no	W, P
Black-throated diver	low-medium	medium	low	low-medium	no	W, P
Great northern diver	low-medium	medium	low	low-medium	n/a	W, P
Northern fulmar	medium/high	low	low	medium/ high	yes	B, W
Sooty shearwater	low-medium	low	low	low-medium	n/a	p
Manx shearwater	low-medium	low	low	low-medium	yes	P
Storm petrel	low-medium	low	low	low-medium	n/a	P
Northern gannet	medium	medium	low	medium	yes	B, P
Cormorant	low	low	low	low	no	B, W
European shag	low	low	low	low	no	B, W
Slavonian grebe	low	low	low	low	no	W
Osprey	none	low	low	none	no	P
Peregrine falcon	none	low	low	low	no	P
Oystercatcher	none	low	low	none	no	P
Knot	none	low	low	none	no	P
Dunlin	none	low	low	none	no	P
Bar-tailed godwit	none	low	low	none	no	P
Curlew	none	low	low	none	no	P
Redshank	none	low	low	none	no	P
Pomarine skua	low	low	low	low	n/a	P
Arctic skua	low	low	low	low	no	P, B
Great skua	low	low	low	low	yes	B, P
Black-legged kittiwake	medium-high	medium-high	low-medium	medium-high	yes	P, B, W
Black-headed gull	low	low	low	low	no	P
Common gull	low	low	low	low	no	P
Lesser black-backed gull	low	medium	low	low	no	B, P, W
Herring gull	low	medium	low	low	yes	B, P, W
Iceland gull	low	low	low	low	n/a	W
Glaucous gull	low	low	low	low	n/a	W
Great black-backed gull	low	medium	low	low	yes	B, P, W
Common tern	low	low	low	low	no	P
Arctic tern	medium	low	low	medium	no	P
Common guillemot	medium-high	low	low-medium	medium-high	yes	B, P, W
Razorbill	medium-high	low	low-medium	medium-high	yes	B, P
Black guillemot	low	low	low	low	n/a	B, W
Little auk	low	low	low	low	n/a	P
Atlantic puffin	medium	Low	low-medium	medium	yes	B, P

*B: breeding; W: wintering; P: passage.
+ n/a specifies that there are no SPA designated for this species

Do you have any comments on the proposed assessment methodology?

4.7 Seascape, Landscape and Visual Character

4.7.1 Specialist Advisors

LDA Design has been appointed by BOWL to undertake the seascape, landscape, visual and cumulative advisory services for the Beatrice development. MORL has yet to appoint an advisor to undertake the respective assessment. This section therefore describes best practice and highlights where the BOWL and MORL advisors will need to coordinate their approach.

4.7.2 Guidance Documents

There presently exist a range of methodology guidance documents relating to the assessment of seascape, landscape and visual impacts. Some of these, such as the 'Guidelines for Landscape and Visual Impact Assessment' (IEMA, LI, second edition 2002) are generic to development, whilst others are specific to offshore wind farm developments. Key methodology guidance on cumulative assessment and the production of associated visualisation material will include the following:

- SNH, 2005. Cumulative effect of Wind farms;
- DTI, 2005. Guidance on the Assessment of Impacts of Offshore Wind Farms. Seascape and Visual Impact Report;
- SNH, 2006, albeit published in May 2007. Visual representation of Wind farms – Best Practice Guidance; and
- SNH, 2009. Siting and Designing Wind farms in the Landscape.

With the exception of the SNH 2005 document, which will be the core methodology reference for the cumulative assessment, there is limited detailed coverage of cumulative issues within other associated guidance. Neither does the SNH 2006 document on the presentation of visualisation material specifically address cumulative matters.

In addition to the above, there are a range of other sensitivity and characterisation reference documents which will be drawn upon in the undertaking of the cumulative assessment. It is also known that SNH, in conjunction with Natural England, is producing new guidance on seascape characterisation and it is anticipated that this will be available in draft in early 2011 and may thus be utilised to inform the baseline seascape character against which the cumulative assessment will be undertaken. The current seascape guidance - Maritime Ireland / Wales Interreg 1994 – 1999 Guidance 'Guide to Best Practice in Seascape Assessment' (GSA), published in March 2001 will be superseded by this emerging guidance.

The MORL and BOWL landscape consultants will coordinate to ensure that both assessments follow the same methodologies, especially in light of the recent and emerging changes to guidance.

4.7.3 Baseline

The Beatrice Offshore Wind Farm and Moray Round 3 zone lie in the outer Moray Firth. The SLVIA process for the Beatrice Offshore Wind Farm site has already started and as the Moray Round 3 zone will be shortly commencing, it is planned that discussions with consultees on final study areas will be coordinated.

An assessment of the sensitivity and capacity of the Scottish seascape in relation to wind farms (SNH 2006) indicates that both proposed wind farm sites within the Moray Firth lie within a seascape area of medium to low sensitivity (Beatrice wind farm site) and low to negligible visibility (MORL zone). The area has a moderate to high capacity for wind farm development. This is attributed to turbines relating well to the openness of the sea and large scale seascape.

The emerging SNH/NE seascape characterisation guidance is currently being used for the Beatrice assessment following discussion and agreement with SNH and Highland Council. MORL has also been present at these meetings and it is therefore expected that that the Moray Round 3 Zone assessment will also follow the new seascape characterisation guidance, taking into account the character types established through the Beatrice assessment. Discussions between the BOWL and MORL landscape consultants will ensure a consistent approach.
On land, the SNH landscape character assessment series covers the whole of Scotland and in particular the Caithness and Sutherland (1998), Ross and Cromarty (1999), Moray and Nairn (1998), Banff and Buchan (1994) and Orkney (1998) landscape character assessments will potentially be useful in the assessment for the Beatrice Offshore Wind Farm and Moray Round 3 Zone.

The assessment of both wind farms will need to consider local residents, travellers, and workers as potentially sensitive receptors, especially for sequential cumulative effects, during the course of the SLVIA. Hill walkers and tourists are also important visual receptors in the surrounding landscapes. Other key visual receptors include those out at sea; fishing vessels, oil workers, ferry passengers, recreational sailors and those closer to the coast such as wind surfers and surfers. All of these, except those working on an oil platform, are transitory receptors, i.e., they are moving through the seascape, so sensitivity towards the types of development proposed may be reduced, although they may experience more sequential cumulative effects.

There are a number of other onshore wind farms operating, approved or currently lodged within the planning system which will need to be considered in the cumulative assessment for both sites. Also, within the vicinity of the wind farm sites the existing Beatrice demonstrator turbines, Jacky platform and Beatrice platforms add to the baseline conditions of views and seascape character.

4.7.4 Proposed Consultees

It is proposed that the following organisations will be consulted by BOWL and/or MORL depending upon the extent of the agreed respective study areas to agree the scope of the cumulative assessment:

- SNH;
- Highland Council;
- Moray Council;
- Orkney Council; and

- Aberdeenshire Council.

4.7.5 Potential Effects

Cumulative Landscape and Seascape Effects

As with the methodology for assessing landscape and seascape effects, the magnitude and significance of cumulative effects on the identified landscape designations, landscape features and seascape character units / areas are a function of the baseline sensitivity of each receptor, the number and scale of the proposed wind farms in that area and the overall size and shape of the receptor / character area. Cumulative landscape and seascape effects will be assessed for each receptor / character unit where they are affected by more than one of the proposed wind farms.

Cumulative Visual Effects

There are two principal types of cumulative effects on visual amenity, namely effects arising from combined and sequential views. In accordance with the SNH publication Cumulative Effect of Wind Farms version 2 (April 2005) these comprise the following:

- Combined views which 'occur where the observer is able to see two or more developments from one viewpoint. Combined visibility may either be in combination (where several wind farms are within the observer's arc of vision at the same time) or in succession (where the observer has to turn to see the various wind farms)'; and
- Sequential views which 'occur when the observer has to move to another viewpoint to see different developments.'

Cumulative visual effects will vary in degree depending on the factors below:

- Number and sensitivity of visual receptors;
- Duration, frequency and nature of views; and
- Relative effect of each individual wind farm with regard to visual amenity.

4.7.6 Study Area

The methodology to be employed for the cumulative assessment will follow recognised guidance. The purpose of the cumulative assessment is to consider the potential effects arising from the addition of the proposed development upon the seascape, landscape and visual environments in relation to the existing wind farm developments and other known consented and proposed wind farm developments in the area. It raises questions over thresholds of acceptable change (both spatial and temporal) and the landscape/seascape's capacity to accept change. The Guidelines for Landscape and Visual Effect Assessment (2nd edition, 2002) advises that:

> *'cumulative landscape and visual effects result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future'.*

The study areas for the Beatrice Offshore Wind Farm and the Moray Round 3 Zone will be agreed with the key consultees listed above. Within the agreed radius, the consultees listed above will be contacted to identify existing and consented wind turbine developments, both on and offshore, as well as applications yet to be determined. For each of these schemes agreement will be reached as to whether they should be included within the cumulative assessment.

Figure 4.10 illustrates a 60 km radius study area for each of the three development areas: Beatrice Offshore Wind Farm, MORL Eastern development area, and MORL Western development area. A 60 km radius study area follows current best practice guidance(1) and should be a flexible area that may be reduced or extended where necessary depending on initial assessments and consultation.

Do you have any comments on the proposed study area?

4.7.7 Data Gathering

The SLVIA will be undertaken with reference to best practice guidance as discussed above. Data gathering for the cumulative assessment will build upon the data gathered for the main SLVIA and include the following:

- Data trawl for other wind farm sites within the agreed study area;
- Data trawl for other major projects (i.e. oil platforms) within the agreed study area;
- Identification of cumulative viewpoints;
- Production of cumulative Zone of Theoretical Visibility (ZTV) plans, wireframes and photomontages; and
- Fieldwork to confirm desk-based study and viewpoint descriptions.

The cumulative assessment does not address the magnitude or significance of the effects arising from each of the individual developments themselves, but looks at the seascape, landscape and visual effects arising from the combination of the turbines at the proposed offshore wind farm with one or more other wind farm developments within the parameters identified.

The cumulative assessment examines the same groups of seascape / landscape and visual receptors as the assessment for the main scheme, though different viewpoints may be used in order to better represent the likely range of effects arising from the combination of schemes. The assessment will be informed by cumulative ZTVs, showing the extent of visual effects of the schemes in different colours to illustrate where visibility of more than one development may theoretically arise. Cumulative wireframes will be prepared which show each of the developments in different colours so that they are each readily identifiable. Cumulative

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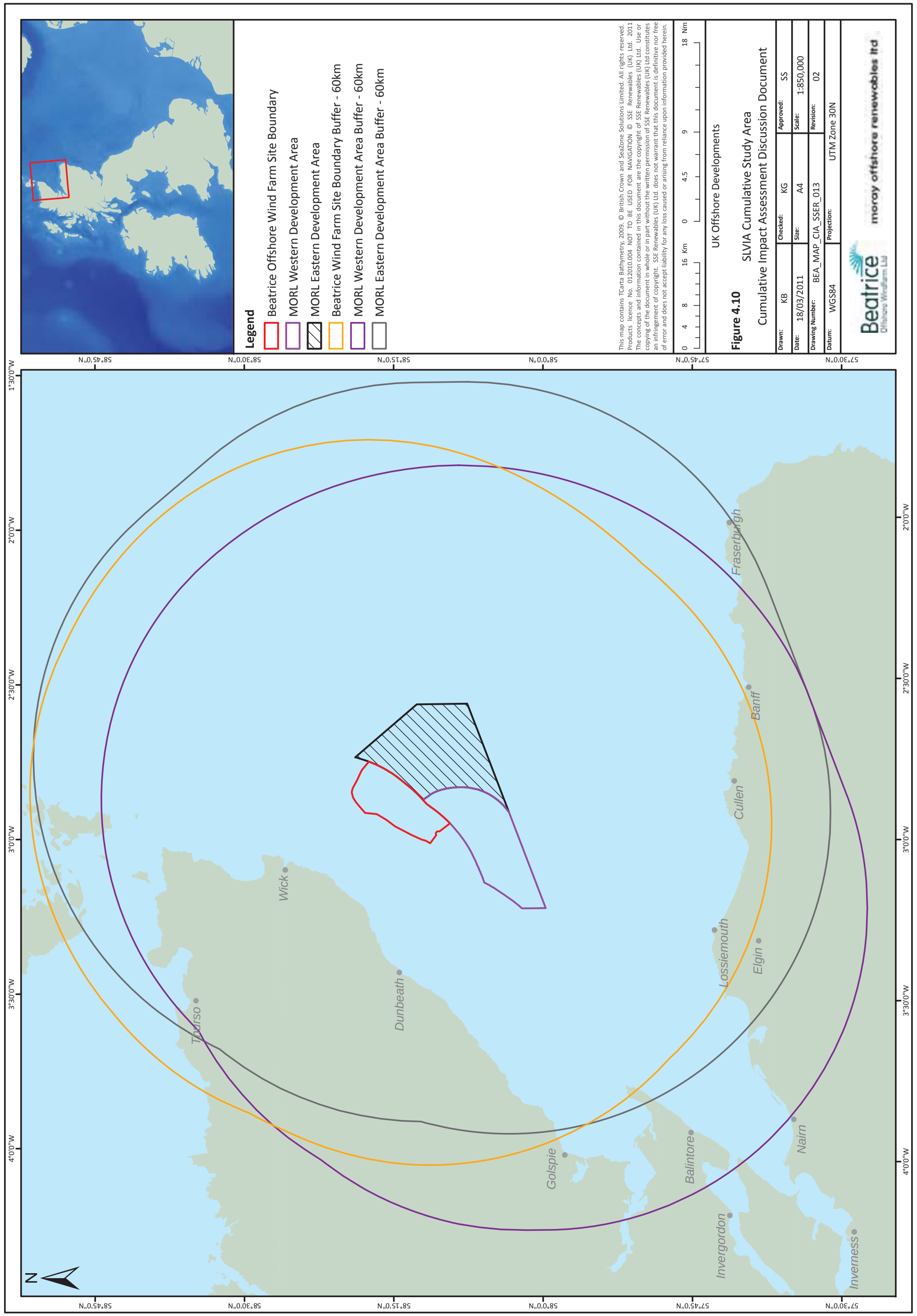
(1) Guidance: Cumulative Effect of Windfarms, SNH, 2005



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UK Offshore Developments

Figure 4.10

SLVIA Cumulative Study Area

Cumulative Impact Assessment Discussion Document

Drawn:	KB	**Checked:**	KG	**Approved:**	SS
Date:	18/03/2011	**Size:**	A4	**Scale:**	1:850,000
Drawing Number:	BEA_MAP_CIA_SSER_013			**Revision:**	02
Datum:	WGS84	**Projection:**	UTM Zone 30N		

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photomontages will also be prepared, the number and location of viewpoints will be agreed with the relevant consultees.

With the large number of wind farms in the Highlands, Moray and Aberdeenshire area, sequential effects are also acknowledged as an important part of the cumulative assessment.

Are you aware of any additional data sources that should be considered in the assessment?

4.7.8 Assessment Methodology

Given the proximity of the Beatrice Offshore Wind Farm and Moray Round 3 Zone the landscape consultants for both sites will seek to coordinate a cumulative approach that is consistent with current best practice for agreement with the relevant consultees.

Do you have any comments on the proposed approach to the assessment methodology?

4.7.9 Presentation of Results

The significance of cumulative effects of the proposed changes will be determined by the sensitivity of the receptor and the magnitude of the change. The criteria for this will be based on the 'Guidelines for Landscape and Visual Impact Assessment', 2nd Edition (LI/IEMA 2002).

Significant effects (in terms of EIA regulations) are those that are Major or Major-Moderate. As stated within the EIA regulations, if an effect is not significant, it should not be considered as material to the decision making process. It should also be noted that whilst an effect may be significant, and therefore material in coming to a decision, that does not necessarily mean that such an impact would be unacceptable.

The Table 4.7.1 below illustrates the potential significance criteria for landscape/seascape and visual effects.

Table 4.7.1 Potential Significance Criteria

Significance of Effect	Landscape/Seascape Resource	Visual Resource / Amenity
Major	Total or major alteration to key elements, features or characteristics of the seascape or landscape, such that post development the baseline situation will be fundamentally changed	Total or major alteration to a valued view or view of high scenic quality that post development the baseline situation will be fundamentally changed
Moderate	Partial alteration to key elements, features or characteristics of the seascape or landscape, such that post development the baseline situation will be noticeably changed	Partial alteration to key views such that post development the baseline situation will be noticeably changed
Minor	Minor alteration to key elements, features or characteristics of the landscape or seascape, such that post development the baseline situation will be largely unchanged despite discernable differences	Minor alteration to key views such that post development the baseline situation will be largely unchanged despite discernable differences
Negligible	Very minor alteration to key elements, features or characteristics of the landscape or seascape, such that post development the baseline situation will be fundamentally unchanged with barely perceptible differences	Very minor alteration to key views such that post development the baseline situation will be fundamentally unchanged with barely perceptible differences
None	No effects on the landscape/seascape resource as proposals are either not visible, or are in keeping with the character and/or mitigation proposals balance any significant effects.	No effects on the visual amenity as proposals are either not visible, or are in keeping with the character and/or mitigation proposals balance any significant effects.

4.8 Marine Archaeology and Cultural Heritage

4.8.1 Specialist Advisor

Both MORL and BOWL have commissioned the services of Headland Archaeology to complete the EIA exercise and advisory services.

4.8.2 Guidance Documents

There are currently a number of specific guidance documents available to inform the approach and these will be considered during the cumulative impact assessment on archaeology and cultural heritage assets. The guidance that will be considered will include the following:

- Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy, Oxford Archaeology with George Lambrick Archaeology and Heritage, January 2008 (commissioned by COWRIE Ltd);
- Assessment of Impact on the Setting of the Historic Environment Resource – Some general considerations, Historic Scotland, 2009; and
- Managing Change in the Historic Environment – Setting, Historic Scotland, 2011.

4.8.3 Baseline

Offshore

The baseline for marine cultural heritage assets comprises three confirmed known wreck locations classified as 'live' by the UKHO within the Moray Round 3 Zone and associated 1 km buffer; three further known wrecks or obstructions lie within the Moray Zone and associated 1 km buffer that are classified as 'dead' (i.e. the identity was established initially but subsequent survey has failed to locate the wreck remains). Whilst this is the case, the preliminary assessment of marine geophysical data has identified two anomalies that may well represent at least one of the 'dead' wrecks located within the Moray Round 3 Zone and an obstruction within the 1 km buffer. There are no known wrecks or obstructions located within the Beatrice Offshore Wind Farm, although two geophysical anomalies indicate the location of a well-head associated with the Jacky gas and oil field and a further potential feature of anthropogenic origin. There are no designated or protected wrecks within either development area. In addition, initial geoarchaeological assessment of the seabed substrates has indicated negligible potential for the survival of relict landscape surfaces, features or deposits within the Beatrice Offshore Wind Farm and Moray Round 3 Zone.

Onshore

There are 142 scheduled monuments, four of which are Properties in Care, 21 Category A-listed buildings, two conservation areas and two inventory gardens or designed landscapes within 30 km of Beatrice Offshore Wind Farm and Moray Round 3 Zone. This 30 km buffer will be further refined in consultation with Historic Scotland and local planning authorities.

The scheduled monuments comprise a wide range of monument types, but in the current context the most significant are the various prehistoric burial cairns located near the coast and several stone alignments. Such monuments have specific alignments and therefore views associated with their function and in some instances there is a clear relationship between these monuments' architecture and views out over the sea. Many of the inland monuments lie outside the 30 km buffer.

Most of the Category A-listed buildings lie some distance from the coast and are unlikely to be of concern. The exception to this is Dunbeath Castle, which stands on the coast. Associated with the castle is its garden, which appears in the Inventory of Gardens and Designed landscapes. The remaining designed landscape is Langwell Lodge.

4.8.4 Proposed Consultees

It is proposed that the following organisations will be consulted during the scope refinement and ongoing cumulative impact assessment:

- Historic Scotland;
- Royal Commission on the Ancient and Historical Monuments of Scotland; and
- Highland Council Archaeology Service.

Given the large number of onshore cultural heritage assets within 30 km of Beatrice Offshore Wind Farm and the MORL Round 3 Zone, the primary concern of the consultation process will be to agree the scope of the CIA by identifying specific assets that will be considered in relation to cumulative impacts.

4.8.5 Potential Effects

The proposed wind farms may have the following cumulative effects:

- *Physical effects:* Physical effects on marine cultural heritage assets may occur with the introduction of the Beatrice Offshore Wind Farm and Moray Round 3 Zone, both individually and in combination. These may include numerous individual effects such as those related to turbine foundations and associated infrastructure; and changes in the sediment regime and scour as a consequence of the installations. These effects have potential for beneficial and adverse effects on the survival of cultural heritage assets such as known or potential wreck remains and associated debris. While it is unlikely with the BOWL and MORL developments, there is the potential for cumulative effects on submerged landscapes and deposits, perhaps spread over a wide geographical area. This will be confirmed through consultation with Historic Scotland.

- *Setting effects*: Cumulative setting effects upon onshore cultural heritage assets may result from Beatrice Offshore Wind Farm and MORL Round 3 Zone being seen in combination in views that are relevant to the setting of cultural heritage assets. Similarly, a cumulative effect may occur where onshore wind farms are visible in succession with the Moray Zone offshore wind farms from a viewpoint that is relevant to the setting of an asset.

4.8.6 Study Area

The study area within which effects and impacts will be considered from an archaeology perspective will be defined by the MORL and BOWL site boundaries, including an initial buffer zone of 1 km to take into consideration any likely dispersion and settlement of sediments during the construction phases of the projects. It should be noted that this buffer zone may be revised once data regarding turbine layout and sediment flow measurements become available. Both beneficial and adverse potential impacts will be considered.

For the purposes of assessing the cumulative impact on terrestrial cultural heritage assets, assets within 30 km of MORL or BOWL turbines will be included initially. A Zone of Theoretical Visibility (prepared as part of the Seascape, Landscape and Visual assessment) will be utilised to determine specific assets that will be considered during the cumulative assessment, the list of assets will be agreed by Historic Scotland and Highland Council Archaeology Service.

Do you have any comments on the proposed study area?

4.8.7 Data Gathering

Data will from both the MORL and BOWL project teams will be derived and gathered in the same format where possible. Information requirements are as follows:

- Geophysical data;
- Location of turbine foundations;
- Modelling results of sediment dispersion during construction;
- Modelling results of scour impacts during operation/long term;
- Cumulative Zones of Theoretical Visibility for onshore and offshore wind farms; and
- Visualisations (wireframes in the first instance).

Site visits will be undertaken to inform the setting impact assessment.

Are you aware of any additional data sources that should be considered in the assessment?

4.8.8 Assessment Methodology

Physical Impacts

The assessment of cumulative physical impacts will be undertaken using the data sources highlighted above and will assess the cumulative effect of the BOWL and the MORL sites on marine cultural heritage assets, both individually and cumulatively. Such effects will relate to changes in the movement of sediments, which may result in the uncovering or covering of assets by sediments. Hence the assessment will identify assets where this may occur and establish how widespread such areas may be in order to assess the potential for unrecorded assets to be affected.

Other developments to be included in this study will include the following:

- BOWL generating station;
- MORL Eastern Development area;
- MORL Western Development area;
- BOWL OFTO cable;
- MORL OFTO cable;
- Proposed SHETL cable;
- Proposed SHETL offshore hub;
- Relevant oil and gas activities; and
- Dredging and sea disposal in the Moray Firth.

Setting Impacts

The cumulative setting impact assessment will consider the visual effects on setting of MORL, BOWL, the onshore Burn of Whilk Wind Farm, any other onshore wind farms and proposed oil and gas infrastructure as agreed with relevant consultees. Potential cumulative effects will in the first instance be identified using the cumulative ZTVs generated for the SLVIA to identify those assets where the various proposals will be visible in combination or succession. The assessment will then focus upon specific assets agreed with Historic Scotland and Highland Council Archaeology Service.

Other developments to be included in this study will include the following:

- BOWL generating station;
- MORL Eastern Development area;
- MORL Western Development area;
- Proposed SHETL offshore hub;
- Relevant oil and gas activities;
- Other on shore wind farms; and
- Other offshore wind farms.

Do you have any comments on the proposed assessment methodology?

4.8.9 Presentation of Results

Cumulative effects will be considered within each of the ESs produced for each development, using standardised impact assessment criteria which will be agreed with Historic Scotland and Highland Council Archaeology Service.

4.9 Aviation and MOD

4.9.1 Specialist Advisor

Scottish and Southern Energy Renewables (SSER) will be conducting an in-house assessment of potential impact of the proposed Beatrice Offshore Wind Farm on aviation interests; however, Osprey Consulting Ltd will be contracted to conduct discreet packages of work. Spaven Consulting has been commissioned by MORL to undertake the respective assessment. Both SSER internal staff, Osprey and Spaven Consulting have been liaising to ensure a consistent approach to the respective wind farm assessments and the cumulative impact assessment.

4.9.2 Guidance Documents

There is no specific guidance on the cumulative impact assessment of aviation impacts from wind farms. National Air Traffic Services (NATS) has stated that there would need to be a regional approach to a solution to mitigate cumulative effects. The MoD is likely to prefer a regional solution also.

4.9.3 Baseline

Aviation facilities with the potential to be affected by the cumulative effects of BOWL and MORL are as follows:

- NATS Allanshill primary surveillance radar;
- RAF Lossiemouth primary surveillance radar;

- Obstacle clearance for helicopter instrument approach procedures to the Beatrice platforms;
- Obstacle clearance issues for helicopters flying on Helicopter Main Route X-Ray; and
- Impacts on search and rescue helicopter operations.

4.9.4 Proposed Consultees

Consultees for cumulative aviation impacts of BOWL and MORL are as follows:

- NATS;
- Ministry of Defence;
- Ithaca/Wood Group;
- Bristow Helicopters;
- Bond Offshore Helicopters; and
- CHC Scotia.

4.9.5 Potential Effects

The potential cumulative effects of BOWL and MORL on aviation are set out below:

- Clutter on primary radar;
- Shadow effect on primary radar;
- Obscuration effect on primary radar;
- Obstruction of helicopter instrument approach procedures to Beatrice platform;
- Obstruction of low level helicopter routes on HMR X-Ray in icing conditions;
- Obstruction of search and rescue helicopter operations within the wind farms; and
- Requirement for suitable aviation lighting.

4.9.6 Study Area

The study area is a 150 km radius from the two developments, as this range is an appropriate distance to consider the operational range of long range en-route primary radar systems.

Do you have any comments on the proposed study area?

4.9.7 Data Gathering

Meteorological data are being gathered to inform the assessment of the impact of the MORL and BOWL projects on helicopter instrument approach procedures to the Beatrice platforms.

All other baseline data required to assess the military and civil aviation impact of the Beatrice Offshore Wind Farm and the MORL zone have been acquired.

4.9.8 Assessment Methodology

Other developments to be included in this study will include the following.

- BOWL generating station;
- MORL western development area generating stations;
- MORL eastern development area generating stations;
- Relevant oil and gas activities;
- Onshore wind farms; and
- Other offshore wind farms.

Cumulative impact on helicopter operations will be addressed by determining the sectors in which instrument approaches to the Beatrice platforms may be affected, followed by analysis of meteorological data to determine the frequency with which such approaches may be precluded.

In addition, potential impacts on use of Helicopter Main Route X-Ray are being addressed through consultations with helicopter operators.

Cumulative assessment of radar impacts will be based on assessing the physical extent of radar clutter and other impacts in relation to the air traffic service provider areas of operational responsibility.

Radar line of sight analysis based on initial possible turbine layouts suggest that some, but not all, of the BOWL and MORL turbines will be visible to the MoD PSR at RAF Lossiemouth and the NATS En-Route Ltd PSR at Allanshill. Taller turbine tip heights are likely to lead to higher numbers of turbines being ‘visible’ to the radar systems.

A feasibility and options document will be submitted to NATS to ascertain whether a Transponder Mandatory Zone (TMZ) over some or all of the turbines can mitigate the impacts on primary radar.

In conjunction, radar mitigation assessments will be undertaken to identify suitable mitigation measures should a TMZ not be feasible, or be refused on application.

Cumulative assessment of physical obstruction impacts will be based on assessing the overall extent of wind turbines presenting obstacles to specific instrument approach procedures and helicopter routes.

Meetings are to be held with the various offshore aviation stakeholders to clarify specific risks associated with the BOWL and MORL developments, and identify possible mitigation measures which are to be investigated and considered.

Do you have any comments on the proposed assessment methodology?

4.9.9 Presentation of Results

Results of the aviation cumulative assessment will be presented in graphical and text format as required.

4.10 Shipping and Navigation

4.10.1 Specialist Advisors

Both MORL and BOWL have commissioned Anatec Ltd to carry out the Shipping and Navigation Assessments. This will ensure a consistent approach to the CIA.

4.10.2 Guidance Documents

The two main guidance documents that relate to the cumulative assessment are as follows:

- Maritime and Coastguard Agency, August 2008. Marine Guidance Note 371 (M+F) Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response Issues; and
- DTI, November 2005. Guidance on the Assessment of the Impact of Offshore Wind Farms: Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms.

In addition to the aforementioned guidelines the following will also be considered within the cumulative assessment:

- MCA Marine Guidance Notice 372, 2008. Guidance to Mariners;
- Trinity House Lighthouse Service, 2008. Guidance based on IALA Recommendation O-139 On The Marking of Man-Made Offshore Structures, 1st Edition;
- BWEA, DTI, MCA & PLA, 2007. Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Wind farm;
- Howard, M. and Brown, C, 2004. Results of the Electro-Magnetic Investigations and assessments of marine radar, communications and positioning systems undertaken at the North Hoyle Wind farm by QinetiQ and the MCA;
- IMO, 2002. Guidelines for Formal Safety Assessment for use in the IMO Rule Making Process (MSC/Circ.1023/MEPC/Circ.392); and
- BERR, 2007. Guidance Notes on Applying for Safety Zones around Offshore Renewable Energy Installations – Guidance Notes.

4.10.3 Baseline

A baseline assessment will be carried out to ensure there is a sound understanding of current shipping and navigational characteristics. The following list provides a sample of the information that will be obtained within this process:

- Oil and gas operations;
- Fishing activities;
- Third party pipelines and cables;
- Water depths;
- Recreational vessel activities;
- RNLI responses and shipping accidents;
- Metocean;

- General shipping; and
- Navigational aids and features.

Overall the baseline will form the basis of consultation with the shipping and navigation stakeholders in the area.

4.10.4 Proposed Consultees

The following will be consulted during the shipping and navigation cumulative impact assessment to ensure all professional views are given consideration when assessing cumulative issues:

- Maritime and Coastguard Agency;
- Ministry of Defence;
- Northern Lighthouse Board;
- Ports & Harbour Authorities in the Moray Firth;
- The RYA;
- Chamber of Shipping;
- Scottish Fishermen's Federation;
- Ithaca; and
- Wood Group.

4.10.5 Potential Effects

Assessment of potential effects on navigation will take account of both vessels transiting through the wind farm sites and those vessels transiting outside but in close proximity (hereafter referred to as Non-Transiting Vessels).

In terms of potential effects and hazards, changes in the following hazard risks (probability of occurrence & hazard consequences) may be brought about by placement of offshore wind farms (either individually or collectively). These potential effects are separated into 'hazard risks' and 'operational costs', and may include those listed in Table 4.10.1.

Table 4.10.1 Potential Effects on Shipping and Navigation

Commercial Vessels		Fishing Vessels		Recreational Craft	
Hazard Risks	Operational Risks	Hazard Risks	Operational Risks	Hazard Risks	Operational Risks
Grounding	Fuel costs	Collision	Fuel costs	Collision	Fuel costs
Collision	Time costs	Foundering	Time costs	Foundering	Time costs
Foundering		Contact	Loss of fishing grounds	Contact	Loss of sailing areas
Contact		Snagging	Loss of fishing gear		

4.10.6 Study Area

The study area will encompass the following areas:

- MORL zone;
- BOWL site;
- Other wind farm sites;
- Proposed export cable routes; and
- Construction vessel routes.

In terms of temporal boundaries the main stages of the wind farm projects will be considered.

Do you have any comments on the proposed study area?

4.10.7 Data Gathering

Shipping and navigational data sources to be used include those described below.

Maritime Data

The Department of Energy and Climate Change (DECC) provides a web site from which it is possible to download various data. The database provides information on commercial shipping, fishing and recreational craft. Data sets include shipping density, fisheries surveillance records, and recreational cruising routes, racing areas and sailing areas.

Automatic Identification System Data

Automatic Identification System (AIS) data is transmitted from vessels to improve safety, specifically collision avoidance. All ships of 300 gross tonnage and upwards engaged on international voyages, cargo ships of 500 gross tonnage and upwards not engaged on international voyages and all passenger ships irrespective of size carry automatic identification systems (AISs) capable of providing information about the ship to other ships and to coastal authorities automatically. AIS provides information - including the ship's identity, type, position, course, speed, navigational status and other safety-related information - automatically to appropriately equipped shore stations, other ships and aircraft. In addition fishing vessels >45 m are required to carry AIS transponders.

Radar Data

A vessel can be tracked by radar to give its range, direction and speed, and from this the vessel's course can be derived. Radar has a distinct advantage over AIS as all recording equipment needed for data collection can be tested and calibrated, and is not reliant on "onboard" or third party equipment. Radar will also pick up vessels that do not carry AIS.

Vessel Monitoring Data

Satellite vessel monitoring systems (VMS) are used as part of the sea fisheries enforcement programme, to track the positions of fishing vessels 15 metres overall length and over in UK waters. It is also used to track all UK registered fishing vessels globally. VMS data for the study area can be obtained from Marine Scotland (Compliance). Data collected includes the following:

- Since 2000, two-hourly position reports from UK vessels ≥ 24 metres in length; and
- Since 2005, two-hourly position reports from UK vessels ≥ 15 metres in length.

Fishing Vessel Surveillance Data

Surveillance data of fishing vessels from fishery protection aircraft and vessels has also been collected historically, and is again available from Marine Scotland (Compliance).

UK Coastal Atlas of Recreational Boating

The Royal Yachting Association have compiled and presented a comprehensive set of charts which defined the cruising routes, general sailing and racing areas used by recreational craft around the UK coast.

Additional Desk Based Investigation

Desk based investigations into recreational craft usage can give a clear indication of recreational traffic within the proposed wind farm area. Investigation would be in line with the data used to create the RYA UK Coastal Atlas of Recreational Boating though it should be more up to date, Investigations should be based on reference material including the following:

- Standard publications
  - Almanacs
  - Charts
  - Pilots Books
- Web information
- Consultation

Surveys

The cumulative effects assessment undertaken for this area will be based on several periods of data gathered by site specific shipping and navigation surveys. These will predominantly be carried out to gather AIS data, radar data and manual logs. Shipping survey data has been collected for the following dates:

- Chartwell (2 April to 22 September 2010); and
- Gargano (2 November to 13 December 2010) and (31 December 2010 to 9 January 2011).

Project Information

For the purposes of assessing the cumulative impact on shipping and navigation there will be certain information required from both the MORL and BOWL project teams. This information may not necessarily be available at the same time from each project team. The following data will be used:

- Locations and orientation of all offshore devices;
- Types/sizes of turbines;
- Proposed mitigation measures; and
- Cable route and laying techniques.

Other projects that will also be included are as follows:

- BOWL generating station;
- MORL western development area generating stations;
- MORL eastern development area generating stations;
- The SHETL offshore hub;
- The SHETL cable;
- The BOWL OFTO cable;
- The MORL OFTO cable;
- Relevant oil and gas activities;
- Relevant military activities; and
- Dredging and sea disposal in the Moray Firth.

Are you aware of any additional data sources that should be considered in the assessment?

4.10.8 Assessment Methodology

Preliminary Hazard Assessment

Following navigational data analysis, a Preliminary Hazard Assessment (PHA) process will be undertaken in line with International Maritime Organisation guidance. The PHA is aimed at identifying all potential hazards to shipping and navigation associated with wind farm development and determining possible mitigation or risk control options. Consideration will also be given to potential effects on aids to navigation (e.g. RADAR, GPS etc).

Consultation

Consultation with a defined set of navigational stakeholders, representative of the area will be undertaken as part of the PHA process in the form of a stakeholder workshop. This will allow local users to analyse the outputs of the analysis, pass judgement and assess the hazards posed by the installations. The process will also enable the stakeholders to provide input on mitigation and risk control measures. A representative sample of stakeholders will be identified through the Navigation Risk Assessment.

Table 4.10.2 Summary of Shipping and Navigation Methods and Activities Agreed Between Developers

Method/Activity	Status
AIS and Radar Survey	Commissioned by BOWL and MORL
Regional Data Gathering	Commissioned by BOWL and MORL
Data Analysis – regional navigation assessment and consultation	Commissioned by BOWL and MORL

Do you have any comments on the proposed assessment methodology?

4.10.9 Presentation of Results

Assessment outcomes will be presented in a stand alone regional assessment report, which will provide details on optimised wind farm boundaries and risk control measures for construction, operation and decommissioning of the wind farms. It is anticipated that the report would contain the following sections:

- Introduction
- Data collection methodology
    - Commercial vessels
    - Fishing vessels
    - Recreational craft
    - Proposed developments by other companies (as above)
- Proposed site boundaries (supplied by developers)
- Proposed construction time line (supplied by developers)
- Analysis of proposed layouts
    - Track analysis(including plots and charts)
    - Gate analysis (including plots and charts)
    - Density analysis
- Preliminary hazard assessment (FSA style assessment of each possible scenario)
- Consultation
- Risk assessment (including mitigation / risk control options).

4.11 Commercial Fisheries

4.11.1 Specialist Advisor

Both MORL and BOWL have commissioned the services of Brown and May Marine Ltd. to undertake the commercial fisheries impact assessment.

4.11.2 Guidance Documents

There is currently no detailed commercial fisheries cumulative impact assessment (CIA) guidance available. In the absence of such published guidance, it is recommended that the final approach and methodology be agreed with Marine Scotland.

4.11.3 Baseline

Commercial fishing in the Moray Firth is broadly comprised of the following activities:

- Scallop fishing on and around the Smith Bank;
- *Nephrops* trawling in the southern Moray Firth;
- Seasonal squid fishery;
- Limited seine netting for whitefish, predominantly haddock, in the northern Moray Firth; and
- Inshore potting activities.

Figure 4.11 below shows the landings values (average ten years) of commercially exploited species in the Moray Firth, by ICES rectangle.

In the case of scallop dredging, the majority of vessels are considered to be 'nomadic', insofar as they will variously target grounds around the Scottish and, on occasion, UK coast. Figure 4.12 below shows the relative value of scallop grounds around the UK coast.

4.11.4 Proposed Consultees

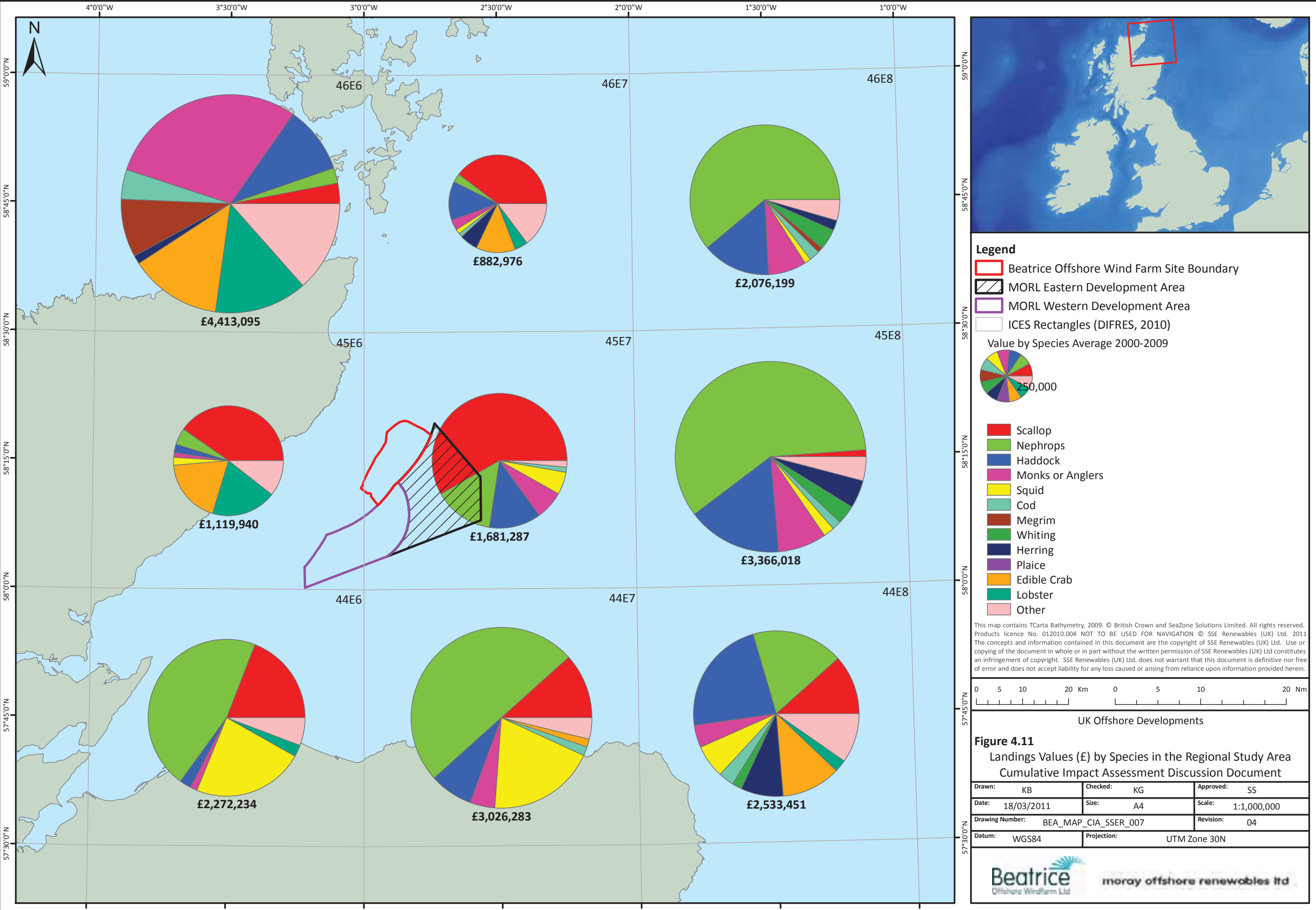
Consultation will be undertaken with the following organisations and individuals, as required:

- Marine Scotland;
- Marine Management Organisation;
- Scottish Fishermen's Federation;
- The Scallop Association;
- Inshore Fisheries Groups;
- Fishing Industry Representatives; ;and
- Any additional fisheries associations, fishermen and their representatives.

4.11.5 Potential Effects

The following potential effects of offshore wind farm development upon commercial fishing activities, as specified in the 'Offshore Wind Farms Guidance Note for Environmental Impact Assessment In Respect of FEPA and CPA Requirements (2004*)*, are as follows:

- Implications for fisheries during the construction phase;
- Implications for fisheries when the development is completed;
- Adverse impact on commercially exploited fish and shellfish populations;
- Complete loss or restricted access to traditional fishing grounds;
- Safety issues for fishing vessels;
- Interference with fisheries activities;
- Displacement of fishing vessels;
- Increased steaming times to fishing grounds;
- Removal of obstacles on the sea bed post-construction to ensure vessel safety;
- Any other concerns raised by local fishermen and fishing organisations; and
- Adverse impact on recreational fishing stocks.



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UK Offshore Developments

Figure 4.11
Landings Values (£) by Species in the Regional Study Area
Cumulative Impact Assessment Discussion Document

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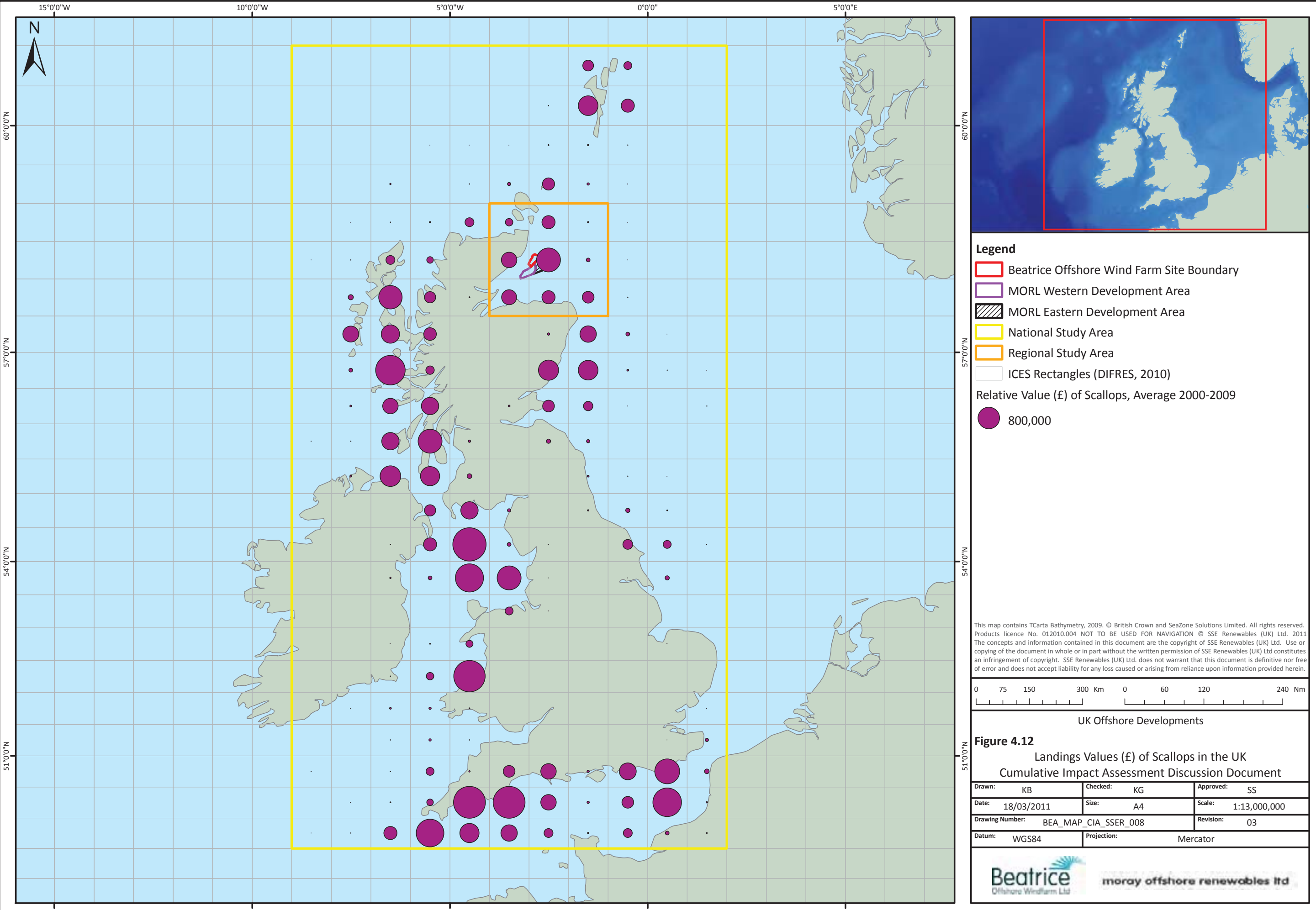
Date:	18/03/2011	Size:	A4	Scale:	1:1,000,000
Drawing Number:	BEA_MAP_CIA_SSER_007			Revision:	04
Datum:	WGS84	Projection:	UTM Zone 30N		

Beatrice Offshore Windfarm Ltd
moray offshore renewables ltd



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UK Offshore Developments

Figure 4.12
Landings Values (£) of Scallops in the UK
Cumulative Impact Assessment Discussion Document

Drawn:	KB	Checked:	KG	Approved:	SS
Date:	18/03/2011	Size:	A4	Scale:	1:13,000,000
Drawing Number:	BEA_MAP_CIA_SSER_008			Revision:	03
Datum:	WGS84	Projection:	Mercator		

Beatrice Offshore Windfarm Ltd
moray offshore renewables ltd

4.11.6 Study Area

Commercial fishing activities have varying geographical ranges, from the limited operational activities of the inshore potting fleet, to the UK wide activities of the scallop fleet. All fishing activities in the Moray Firth have the potential to be affected by the cumulative impact of the MORL and BOWL sites, as well as development of proposed oil and gas infrastructure, and other energy infrastructure within the Moray Firth region. In addition to this, certain vessels are also known to fish in other UK waters, such as scallop dredgers (although it is possible other towed gear fisheries may also be affected). Therefore, such fisheries sectors are likely to be affected by the wider cumulative impact from proposed offshore wind farm development, both regionally and nationally. As a result, it will be necessary to assess cumulative impacts upon these activities on a scale that includes all relevant fishing grounds around the UK.

Figure 4.13 shows the proposed regional and national study areas. The collation of data at a national level allows for the potential cumulative effects of proposed offshore wind farm developments around the UK to be assessed. Data analysis and interpretation will be more exhaustive at the regional level.

Do you have any comments on the proposed study area?

4.11.7 Data Gathering

Primary data sources are listed below:

- Literature review of all available, published material;
- Marine Scotland / MMO Datasets;
- Consultation; and
- Any additional research and publications.

The data and information that will be available from MORL and BOWL will be dependent on project timescales but are anticipated to be as follows:

- Locations and specifications of turbines;
- Locations and specifications of inter array cables and export cable routes;
- Cable lay/burial method;
- Fish ecology assessment;
- Navigation assessment; and
- Proposed / agreed / existing restrictions upon fishing activities within planned / consented / operational offshore wind farms.

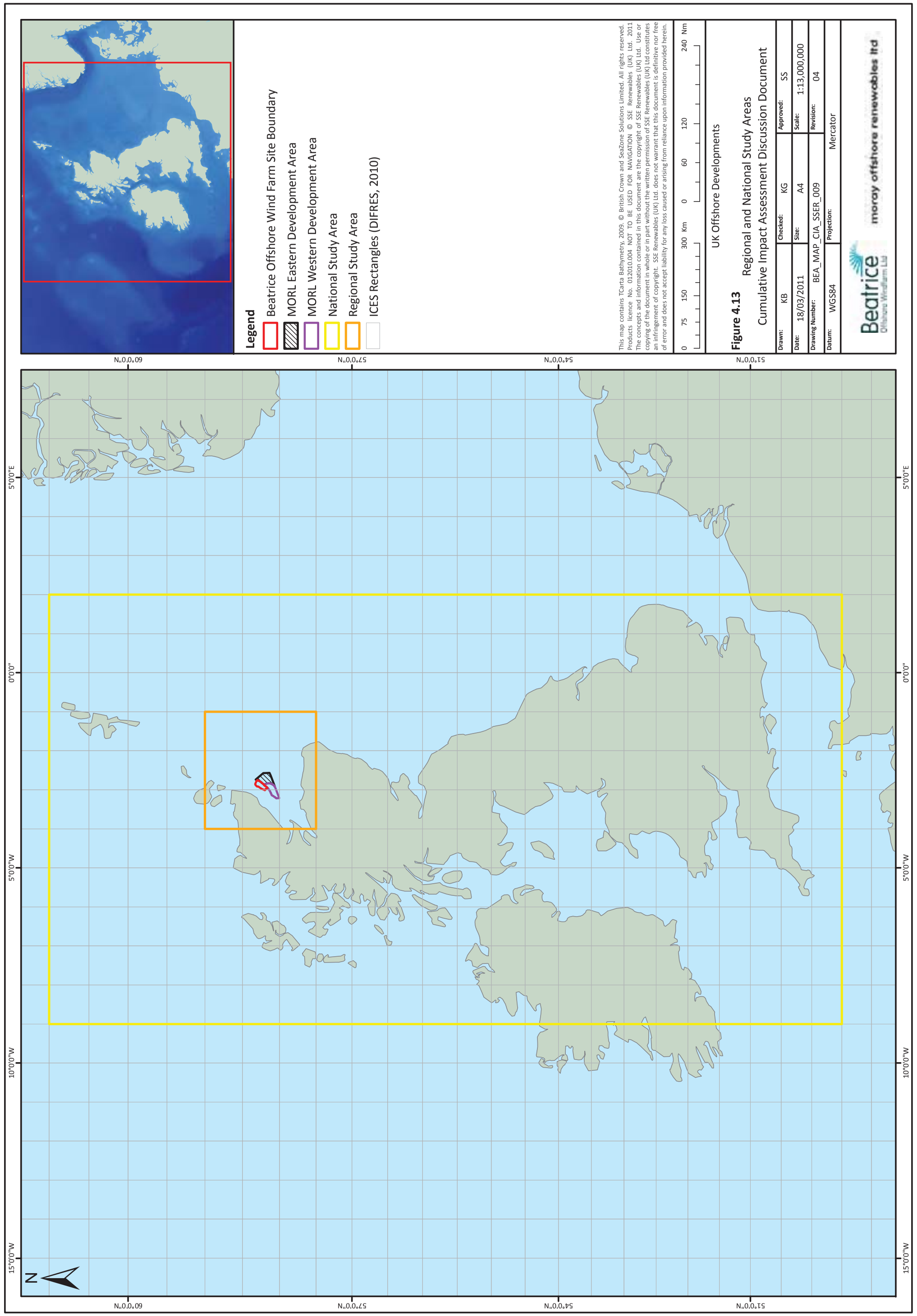

Figure 4.13
Regional and National Study Areas
Cumulative Impact Assessment Discussion Document

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The primary sources of data and information for the undertaking of the cumulative impact assessment on a regional and national scale will be as follows:

- Information provided by other wind farm developers (where available); and
- Other proposed developments in the Moray Firth region.

Are you aware of any additional data sources that should be considered in the assessment?

4.11.8 Data Analysis

Statistical Data Sets

The following statistical data sets provided by MS/MMO will be analysed:

Marine Scotland/MMO Landings Values and Effort Data

MS/MMO landings and effort data is collated by ICES rectangle. The data will be analysed and presented for the rectangles relevant to the study areas for the years 2001-2010. Where necessary for the assessment of longer term trends, additional annual data may be used. The following analysis will be undertaken:

- Information provided by other wind farm developers (where available);
- Landings values and effort data;
- Averaged landings values by rectangle by species, method and vessel length category;
- Annual landings values by species;
- Monthly (averaged) landings values by species;
- Averaged effort by method and vessel length category;
- Annual effort;
- Monthly (averaged) effort;
- Landings into ports by value; and
- Landings into ports by effort.

Marine Scotland/MMO Surveillance Sightings Data

The spatial distribution of fisheries surveillance sightings by fishing by method and nationality will be assessed. It should be noted that whilst such data provides an indication of fishing activities, it cannot describe quantitative levels due to the limited frequency of flights and patrols at sea over any given area.

Marine Scotland/MMO Satellite Tracking (VMS) Data

VMS data for over 15 m vessels (average 2005-2008) will be GIS plotted to show distribution and density. Limited data for 2009 and 2010 will be GIS plotted to show larger scale distribution and density by vessel category.

Marine Scotland Fishery Maps

This data set was produced by Marine Scotland – Science and shows the distribution of commercial fishing landings from vessels exceeding 15 m in length, by weight and by value, in the Moray Firth for the years 2007-2009.

Consultation

In addition to statistical analysis, it is expected that information gathered through consultation will describe fishing activities potentially affected by the wind farm developments and the location of fishing grounds by method. It will also assist in the identification of potential issues and specific areas/fleets with which intensive consultation may be required.

4.11.9 Assessment Methodology

Other developments to be included in this study will include the following:

- BOWL generating station;
- MORL western development area generating stations;
- MORL eastern development area generating stations;
- The SHETL cable;
- The BOWL OFTO cable;
- The MORL OFTO cable;
- The SHETL offshore hub;
- Relevant oil and gas activities;
- Other offshore wind farms;
- Shipping;
- Marine energy developments in the Pentland Firth and Orkney waters;
- Port and harbour developments in the Moray Firth;
- Relevant military activity; and
- Dredging and sea disposal in the Moray Firth.

In order to ensure consistency of approach, a review of the site specific and cumulative impact assessments undertaken for each development, where available, will be undertaken.

Each potential effect, as described above, will be considered cumulatively in the light of the established baseline. In each instance the scale of effect will be assessed relative to the sensitivity of the receptor (based upon importance and recoverability). The extent of the cumulative impact study areas for each potential effect will be defined on a receptor specific basis.

Where an impact is identified, potential mitigation measures will be evaluated with respect to their potential influence upon the residual effects.

Potential effects will be separately considered during the construction/decommissioning and operational phases of the developments. The potential effects of offshore development, planning and legislation in addition to developments in the Moray Firth will also be considered.

Construction / Decommissioning

The different construction schedules of the development projects in the Moray Firth will greatly affect an assessment of cumulative impacts. Spatial and temporal effects will influence the significance of cumulative impacts: a spatial effect will occur when developments are being constructed at the same time, which will cause a cumulative impact upon fishing in terms of the extent of the area disturbed; a temporal effect will occur with the construction of developments taking place in successive years and which will have the effect of causing a cumulative impact on fishing in terms of the extent of time fishing activities are potentially disrupted.

In addition to the construction of the developments in the Moray Firth, the construction of other Scottish or UK developments may need to be considered. This will depend on the receptor (i.e. nomadic scallop vessels).

Operation

It is considered that the potential effects arising from the operation of the BOWL and MORL developments will be spatial. As is the case in operation, in addition to the developments in the Moray Firth, the operation of other Scottish or UK developments may need to be considered. This will depend on the receptor (i.e. nomadic scallop vessels).

Standardised Assessment of Effects in EIA

Site specific impact assessments carried out for BOWL and MORL will, where possible, be integrated to facilitate the assessment of cumulative effects by each developer. In order to enable this, MORL and BOWL will be required to the following.

- Take a common, standardised approach to assessing the effects of the projects in the EIA.
- Share project information and programmes as such information becomes available.

Do you have any comments on the proposed assessment methodology?

4.11.10 Presentation of Results

The presentation of findings will be standardised for the MORL and BOWL projects in order to facilitate assessment of cumulative effects. Cumulative effects will be considered using standardised impact assessment criteria, which will be agreed by the MORL and BOWL project teams, and in consultation with Marine Scotland.

4.12 Underwater Noise

4.12.1 Specialist Advisor

Both MORL and BOWL have commissioned the services of Subacoustech Environmental Ltd to complete the EIA exercise and provide advisory services.

4.12.2 Guidance Documents

The understanding of the impacts of underwater noise on marine species is still developing and until recently guidance has been limited. However, in recent years a number of documents have been issued that will be used during the cumulative impact assessment. The documents that will be considered are set out below:

- Joint Nature Conservation Committee (JNCC), Natural England and Countryside Council for Wales. (2010). The protection of marine European Protected Species from injury and disturbance: Guidance for England and Wales and the UK offshore marine area. June 2010;
- Nedwell, J. R., Turnpenny, A. W. H., Lovell, J., Parvin, S. J., Workman, R., Spinks, J. A. L., Howell, D. (2007). A validation of the dB_{ht} as a measure of the behavioural and auditory effects of underwater noise. Subacoustech Report Reference: 534R1231, Published by Department for Business, Enterprise and Regulatory Reform (commissioned by COWRIE); and
- King, S., Maclean, I.M.D., Norman, T., and Prior, A. (2009) Developing Guidance on Ornithological Cumulative Impact Assessment for Offshore Wind Farm Developers. COWRIE.

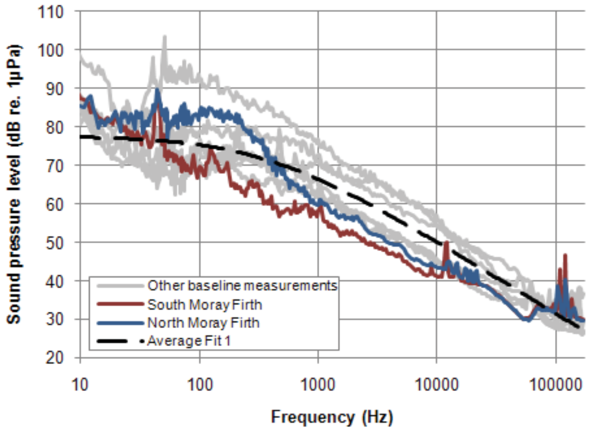
As has been noted in the fish and marine mammals sections, the King *et al*., (2009) study will be used to inform the assessment process.

4.12.3 Baseline

The underwater noise aspects of the EIA will consider the impact on marine mammals and relevant fish species and birds.

Subacoustech hold a database of baseline underwater noise measurements from many locations around the UK coast, including the Moray Firth. As part of the data review these data have been compared and this indicates that background noise in the Moray Firth are generally slightly below average at frequencies above 500Hz but may occasionally be slightly higher than average. The data does not indicate a baseline noise level for the Moray Firth region significantly out of the ordinary and this is illustrated in Box 4.12.1. As such, a baseline noise survey is not considered necessary however this will be confirmed with regulators.

Box 4.12.1 Background noise in the Moray Firth compared with other locations around the UK Coast



The levels of underwater noise that are sufficient to cause physical or behavioural effects to marine species are considerably higher than baseline noise levels and the cessation of behavioural impact will occur when the noise has fallen to an acceptable level rather than to background. Therefore baseline noise is not critical in assessing an impact for high levels sources such as impact piling. Baseline noise will therefore be considered on a more generalised basis using measured underwater noise data from other areas around the UK coast. Subacoustech Environmental holds a large database of baseline noise recordings that will be used for this purpose and further public domain literature will also be used, where available.

Potential noise from military sonar and other development activities within the Moray Firth region (e.g. offshore hub and proposed oil and gas infrastructure) will also be considered where details are available.

Both developers are currently considering the use of impact piling operations during the construction of the wind farm and it is likely that these will be the principal consideration in terms of cumulative impact due to the large areas that could potentially be affected by underwater noise. The impacts of other noisy activities such as vessel movements will also be considered.

Noise levels from turbine operation are considered to be negligible, both in terms of their absolute levels, and in terms of their potential to cause cumulative effects by superposition with other noise. It is proposed that noise from turbine operation is scoped out of the cumulative impact assessment.

4.12.4 Proposed Consultees

It is proposed that the following organisations will be consulted during the EIA process:

- Marine Scotland;
- SNH;
- JNCC; and
- Ministry of Defence.

4.12.5 Potential Effects

Potential effects resulting from the cumulative effects of underwater noise are considered under the relevant receptor headings; see Section 4.4, fish ecology, Section 4.5, marine mammals and Section 4.6 ornithology.

4.12.6 Study Area

The study area will be determined based on the area of impact for the most sensitive marine species to be assessed and the developments to be included in the cumulative impact assessment. See Section 4.4, fish ecology, Section 4.5, marine mammals and Section 4.6 Ornithology.

Do you have any comments on the proposed study area?

4.12.7 Data Gathering

As part of the wider EIA process, Subacoustech Environmental is carrying out a desk-based review of all publically available information and also data held on its own internal database. This work is ongoing, however, data on the baseline noise levels as described above, are available.

Source level, frequency range and transmission loss data are also available on a wide range of wind farm related underwater noise sources so it is proposed that all data required for the assessment can be gathered by desk based studies.

Of principal importance to the underwater noise study will be the source level of the impact piling operations as this will be the principal source of disturbance. This information will also be gathered from a desk-based exercise and will predominantly be based on the information contained on the Subacoustech Environmental internal database of recordings. This is probably the largest database of broadband underwater noise recordings in the world and it is therefore considered to be the best available resource for this project.

Are you aware of any additional data sources that should be considered in the assessment?

4.12.8 Assessment Methodology

The assessment methodology for the cumulative impact assessment will be based on the modelling and analysis procedures that will be used in the broader EIA process. The proposed underwater noise modelling methodology is presented in Annex D. This will be based on a number of key processes, as follows:

- A broad-brush Source Level-Transmission Loss model will be used in order to identify the key noise sources that are likely to have an adverse impact on marine species. This will allow noise sources to be rank-ordered and eliminated from further consideration;
- Subsea noise propagation modelling will then be carried out using the proprietary noise propagation model, INSPIRE, to estimate the ranges of impact for various simultaneous piling operations;
- The extent of cumulative impacts will be assessed based on the overlap of impact zones (auditory injury and behavioural impact);
- In order to conform to the assessment requirements for the EU Habitats Directive relating to the deliberate disturbance to marine mammals, the impact zones will be based on both the M-weighted Sound Exposure Level model (1) as per the JNCC guidance and also the dB_{ht} (species) as the two principal metrics currently available for assessing the impact of underwater noise; and
- In order to make the assessment quantitative in nature these data will need to be compared to marine mammal and fish ecology data. This will be carried out by the relevant specialists.

Do you have any comments on the proposed assessment methodology?

4.12.9 Presentation of Results

Underwater noise impact zones for various individual species (for the dB_{ht} (*species*) data) and for species groups (for the M-weighted SEL data) will be presented as contours of equal perceived loudness overlaid on suitable GIS base layers. Initially these will be charts of the region showing bathymetric data and key locations within the wind farm area. These data will be presented in technical reports to both MORL and BOWL.

4.13 Socio-economics, Recreation and Tourism

4.13.1 Specialist Advisor

It is anticipated that BOWL and MORL will appoint socio-economic specialists to further the cumulative impact assessment in the near future. Consideration is being given to the appointment of the same consultant for both projects as this would promote consistency of approach and streamline the cumulative impact assessment process.

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(1)Southall, Brandon L.; Bowles, Ann E.; Ellison, William T.; Finneran, James J.; Gentry, Roger L.; Greene, Charles R.; Kastak, David; Ketten, Darlene R.; Miller, James H.; Nachtigall, Paul E.; Richardson, W. John; Thomas, Jeanette A.; Tyack, Peter L, (2007) Marine Mammal Noise Exposure Criteria Aquatic Mammals, Vol 33 (4).

4.13.2 Potential Effects

Both the BOWL and MORL projects are of such a large scale that it is likely to have significant impacts at a national level. Significant impacts from the quantity of electricity to be provided, from helping to meet EU and national political targets for renewables and CO_2 emission reduction, and helping to achieve long term sustainable development of the Scottish economy, and job creation.

4.13.3 Assessment Methodology

Other developments to be included in this study will include the following:

- Other offshore wind farms;
- Shipping;
- Port and harbour developments in the Moray Firth;
- Relevant military activity; and
- Relevant oil and gas activities.

Once an appropriate appointment(s) has been made the approach to the cumulative assessment will be detailed and agreed with relevant consultees.

An assessment of effects will need to be undertaken first on a site-specific basis and thereafter the developers will share information to enable an informed assessment of cumulative effects within their respective EIAs.

Proposed methodologies for the assessment of Socio-economics, Recreation and Tourism impacts are outlined in detail in the BOWL and MORL Scoping documents. The methodologies by which cumulative effects will be assessed will be developed jointly by BOWL and MORL to ensure consistency where required.

4.14 Oil and Gas, Cables and Pipelines

4.14.1 Baseline

Much of the area of the Moray Firth has never been licensed for oil and gas exploration, or was previously licensed but has since been relinquished. The main oil and gas activity in the Moray Firth area at present is the Beatrice oil field (Block 11/30a). This field was discovered in 1976 and began production in 1981. The oil field has produced over 160 million barrels of oil to date. In the 23rd Licensing Round, Ithaca was also awarded, as one licence, several further blocks and part blocks which surround the Beatrice Field. Polly, 2.5 km east of Beatrice oil field is an emerging opportunity and straddles blocks 11/30a and 12/26c. The Polly oil field region has been illustrated with reference to Ithaca Energy website(1). Key structures include the following:

- The Jacky platform;
- Beatrice Alpha, Bravo and Charlie platforms;

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(1)http://www.ithacaenergy.com/greater-beatrice-area.asp

- Seabed cables and pipelines linking the platforms;
- Beatrice oil is exported via a 66 km long 16 inch pipeline from the Alpha complex to a shore terminal at Nigg in the Cromarty Firth, where it is stored until tanker shipment; and
- The Beatrice complex is linked to the mainland via a 132/33 kV seabed power cable from Dunbeath. The demonstrator wind turbines provide approximately 30 % of the Alpha platforms daily requirements.

Beatrice oil platforms A, B and C are owned by Talisman Energy and operated by Ithaca Energy. The Jacky platform is owned and operated by Ithaca Energy. Existing oil and gas infrastructure including well heads will be afforded certain wayleaves and buffer zones, restricting certain types of activities and development within their proximity. Caithness Petroleum holds three licences awarded in the 23rd Round and covering five offshore blocks in the northern coastal area of the Inner Moray Firth. PA Resources hold an exploration licence in the Moray Firth and has been awarded a new license in the UK's 26th Licensing Round.

Cumulative impacts on helicopters and vessels servicing oil and gas infrastructure are considered in Section 4.9 Aviation and Section 4.10 Shipping and Navigation.

The Kingfisher Cable Awareness Charts identify the main subsea cable routes around the coast of the UK. The SHEFA telecommunications cable runs north to south to the east of the development sites. There is also the proposed Viking power transmission cable to consider, the current route of which passes through the MORL eastern development area.

Figure 4.14 illustrates oil and gas infrastructure in the Moray Firth, the SHEFA cable and the proposed Viking Cable.

4.14.2 Proposed Approach

Consultations will take place with the existing platform operators and owners and licence holders to fully understand current and future exploration and production operations.

Consultations are ongoing with SHETL to investigate potential issues, constraints and mitigation measures to ensure all required cabling can be accommodated for each project. SHEFA Ltd will also be consulted.

Other developments to be included in this study will include the following:

- BOWL generating station;
- MORL western development area generating stations;
- MORL eastern development area generating stations;
- The SHETL cable;
- The BOWL OFTO cable;
- The MORL OFTO cable; and
- The SHETL hub.

Do you have any comments on the proposed study area?

Are you aware of any additional data sources that should be considered in the assessment?

Do you have any comments on the assessment methodology?

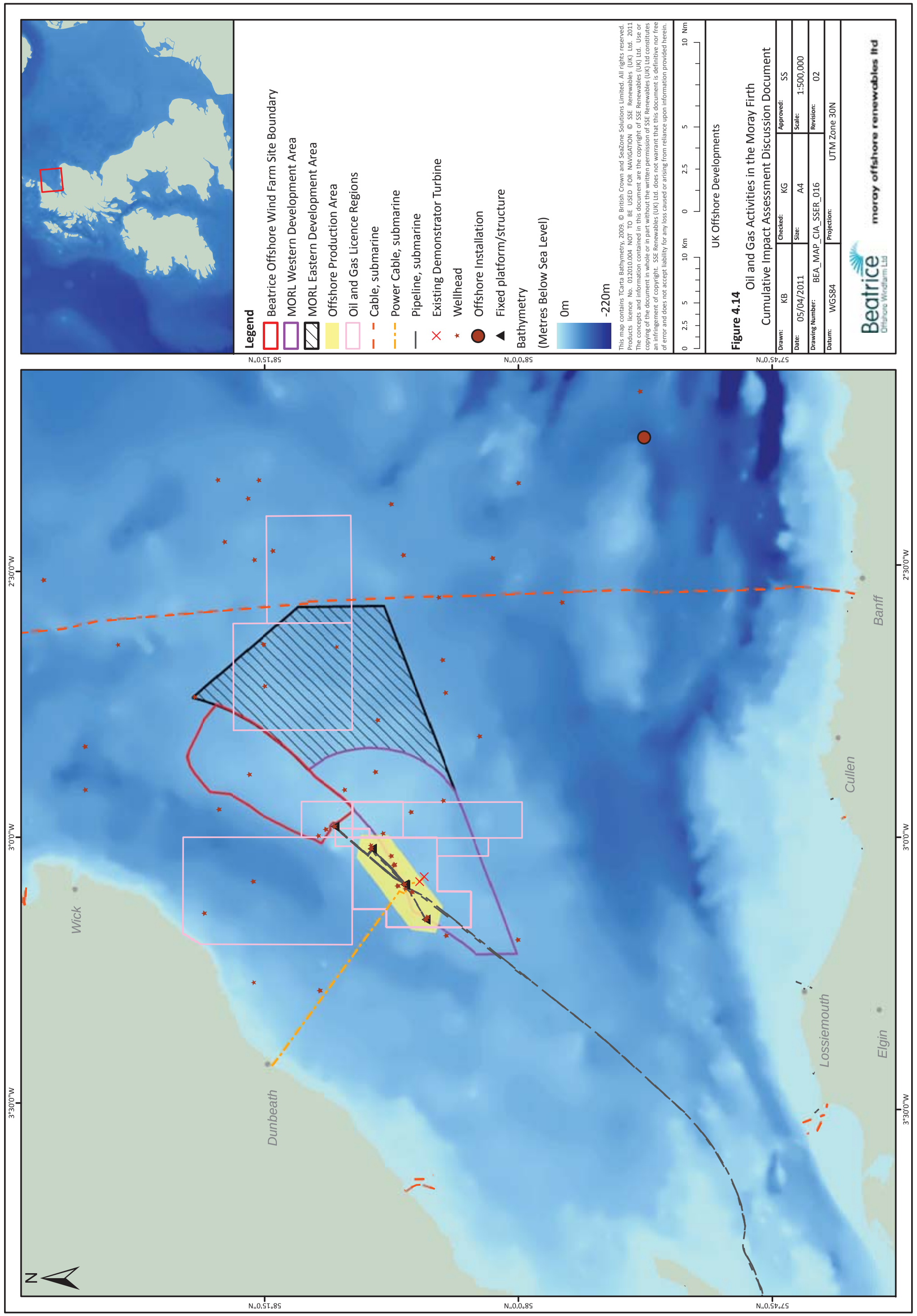

Figure 4.14 Oil and Gas Activities in the Moray Firth
Cumulative Impact Assessment Discussion Document

4.15 Onshore Traffic and Transport

4.15.1 Specialist Advisor

Specialist consultants will be appointed by both MORL and BOWL to undertake an assessment of traffic and transport impacts.

4.15.2 Potential Effects

The proposals relate solely to the marine elements of the wind farm projects (OFTO will be subject to separate licensing and permissions). However, at this stage it is anticipated that turbine components would be delivered to a suitable port facility by sea before being transferred to the wind farm sites to be erected. If both projects were to use the same port facility, there may be the potential for significant land based traffic and transport cumulative impacts. Furthermore, if other port users were loading or unloading abnormal loads or large volumes of material, further cumulative impacts could result.

4.15.3 Assessment Methodology

Where there are residential properties or other sensitive receptors near roads, guidance provided by the former Institute of Environmental Assessment (1) (now the Institute of Environmental Management and Assessment) suggests that significant traffic-related environmental impacts (i.e. noise) may occur if:

- traffic generated by the development increases baseline traffic flows by more than 30 percent; or
- site-related HGV traffic increases HGV flows by more than 10 percent.

Whether significant cumulative impacts result will depend on the port facilities selected. Once port facilities have been selected, local councils and Transport Scotland will be consulted in order to discuss any requirement for an assessment of cumulative traffic and transport impacts during construction and operation of the developments. This may involve the collection of a baseline e.g. classified average annual daily flows and the prediction of generated traffic associated with the project. The percentage traffic increase above the baseline traffic flows would be calculated and an assessment made.

Other developments to be included in this study will include the following:

- BOWL generating station;
- MORL western development area generating stations;
- MORL eastern development area generating stations;
- The SHETL cable;
- The BOWL OFTO cable;
- The MORL OFTO cable;
- Other offshore wind farms; and

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(1) Institute of Environmental Assessment (1993) Guidelines for Environmental Assessment of Road Traffic, Guidance Notes No 1, IEA.

- Relevant oil and gas activities.

Do you have any comments on the proposed study area?

Are you aware of any additional data sources that should be considered in the assessment?

Do you have any comments on the assessment methodology?

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5. CONSULTEE RESPONSE TEMPLATE

One of the objectives of this document is to invite comment from statutory and other key consultees and seek agreement of the approaches proposed by the MFOWDG. We are particularly interested in your responses to the specific questions below and would also welcome any other comments you may have.

Please submit your response by 2 May 2011 to Moray Firth Offshore Wind Developers Group care of:

Stuart Szylak
Environmental Resources Management
Norloch House
36 King's Stables Road
Edinburgh
EH1 2EU

By Email to:
stuart.szylak@erm.com

5.1 Definitions, Receptors and Developments

Do you agree with the definitions of cumulative impacts proposed?

Do you have any comments on Table 2.6.1?

Are the effects identified in Table 3.1.1 appropriate and are you aware of any other effects that should be considered?

Do you agree with the receptors that have been scoped out of the cumulative impact assessment?

Do you agree with the developments to be considered during the cumulative impact assessment? Are there additional developments that should be considered?

5.2 Nature Conservation Designated Areas

Are there other designated areas you would suggest are considered as part of the assessment, in addition to those provided in Table 4.1.4?

5.3 Physical Processes and Geomorphology

Do you have any comments on the proposed study area?

Are you aware of any additional data sources that should be considered in the assessment?

Do you have any comments on the proposed assessment methodology?

5.4 Marine Mammals

Do you agree that long term avoidance is not likely to be a potential cumulative impact?

Do you have any comments on the proposed study area?

Do you have any comments on the proposed assessment methodology?

5.5 Ornithology

Do you have any comments on the proposed study area?

Are you aware of any additional data sources that should be considered in the assessment?

Do you have any comments on the proposed assessment methodology?

5.6 Benthic Ecology

Do you agree that the potential release of contaminants and accidental spillages can be scoped out of the cumulative impact assessment?

Do you have any comments on the proposed study area?

Are you aware of any additional data sources that should be considered in the assessment?

Do you have any comments on the proposed assessment methodology?

5.7 Fish Ecology

Are you aware of any additional data sources that should be considered in the assessment?

Do you have any comments on the proposed assessment methodology?

5.8 Landscape, Seascape and Visual Impacts

Do you have any comments on the proposed study area?

Are you aware of any additional data sources that should be considered in the assessment?

Do you have any comments on the proposed approach to the assessment methodology?

5.9 Archaeology and Cultural Heritage

Do you consider that the initial 30 km study area is appropriate?

Do you consider that the initial 1 km buffer is sufficient?

Are you aware of any additional data sources that should be considered in the assessment?

Do you have any comments on the proposed assessment methodology?

5.10 Commercial Fisheries

Do you have any comments on the proposed study area?

Are you aware of any additional data sources that should be considered in the assessment?

Do you have any comments on the proposed assessment methodology?

5.11 Shipping and Navigation

Do you have any comments on the proposed study area?

Are you aware of any additional data sources that should be considered in the assessment?

Do you have any comments on the proposed assessment methodology?

5.12 Aviation/MOD

Do you have any comments on the proposed study area?

Do you have any comments on the proposed assessment methodology?

5.13 Underwater Noise

Do you have any comments on the proposed study area?

Are you aware of any additional data sources that should be considered in the assessment?

Do you have any comments on the proposed assessment methodology?

5.14 Traffic and Transport

Do you have any comments on the proposed study area?

Are you aware of any additional data sources that should be considered in the assessment?

Do you have any comments on the assessment methodology?

5.15 Oil and Gas, Including Cables and Pipelines

Do you have any comments on the proposed study area?

Are you aware of any additional data sources that should be considered in the assessment?

Do you have any comments on the assessment methodology?

5.16 Any Further Comments

Please provide any further comments on the proposed approach to cumulative impact assessment.

Annex A

Methodology for Coastal Processes EIA

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moray offshore renewables
limited

Beatrice Offshore Windfarm Ltd and
Moray Offshore Renewables Ltd

Proposed Methodology for Coastal Processes EIA for the Beatrice and Moray Firth Offshore Wind Farm Developments

Date:	November 2010
Project No:	R/3888/7
Report No:	R.1698

Proposed Methodology for Coastal Processes EIA for the Beatrice and Moray Firth Offshore Wind Farm Developments

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Abbreviations

2D	2-Dimensional
3D	3-Dimensional
ABPmer	ABP Marine Environmental Research Ltd
BOWL	Beatrice Offshore Windfarm Ltd
Cefas	Centre for Environment, Fisheries & Aquaculture Science
CPA	Coastal Protection Act
Defra	Department for Environment, Food and Rural Affairs
DHI	Danish Hydraulic Institute
DNV	Det Norske Veritas
EDPR	EDP Renováveis
EIA	Environmental Impact Assessment
ES	Environmental Statement
FEPA	Food and Environment Protection Act
GW	Giga Watts
HRA	Habitat Regulations Assessment
JNCC	Joint Nature Conservation Committee
MCA	Maritime and Coastguard Agency
MGN	Maritime Guidance Note
MORL	Moray Offshore Renewables Ltd
MS	Marine Scotland
MW	Mega Watts
OFTO	Offshore Transmission Operator
OREI	Offshore Renewable Energy Installation
PDS	Project Design Statement
RSPB	Royal Society for the Protection of Birds
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SERL	SeaEnergy Renewables Limited
SNH	Scottish Natural Heritage
SPA	Special Protection Areas
SSC	Suspended Sediment Concentration
UK	United Kingdom

1. Introduction

Beatrice Offshore Windfarm Ltd (BOWL) and Moray Offshore Renewables Ltd (MORL) propose to construct Offshore Wind Farms adjacent to each other in the Moray Firth, Scotland (Figure 1). An overview of these developments is provided in the following sections.

Environmental Impact Assessment (EIA) scoping documents were provided by BOWL and MORL to Marine Scotland (MS) in early to mid 2010. The reports contained sections for each of the anticipated EIA topics, including 'Coastal Processes', a topic that broadly encompasses the potential effects of the developments on the physical (marine) environment. In relation to coastal processes, the report provided information relevant to the proposed Beatrice and Moray Firth Offshore Wind Farms including the following.

- A baseline summary description of the naturally occurring:
  - wind and wave climate;
  - tidal regime (water levels and currents);
  - predicted effects of climate change;
  - geology and seabed sedimentary deposits;
  - seabed sediment mobility; and
  - suspended sediment concentrations.
- Consideration of the potential for in-combination and cumulative effects.
- A summary of potential impacts of the development identified for assessment.
- A summary of the proposed methods by which these potential impacts might be assessed.

This information was disseminated by MS to a further list of statutory and non-statutory consultees, some or all of whom have returned an opinion regarding their more specific requirements for a suitable depth and breadth of EIA.

This document summarises for both developments, the coastal process issues identified by the original scoping documents and, in the instance of the BOWL project, by the subsequently received scoping responses. More detail is then provided with regard to the proposed methodologies by which to make the required assessments, however, these may be necessarily subject to slight variation where possible (following the anticipated publication of best practice guidelines) as the project and the data/evidence base evolves.

This document also will form the basis for further consultation with MS in order to agree a definitive list of issues that will be addressed by the EIA process for both developers.

At the time of writing this version of this document, comments have not yet been received in response to the MORL scoping document, although it is not expected that any significantly different issues will be identified at this stage. Following receipt of comments, this document will be updated accordingly and resubmitted to MS, highlighting any additions or modifications to the list of identified issues or the methodologies proposed.

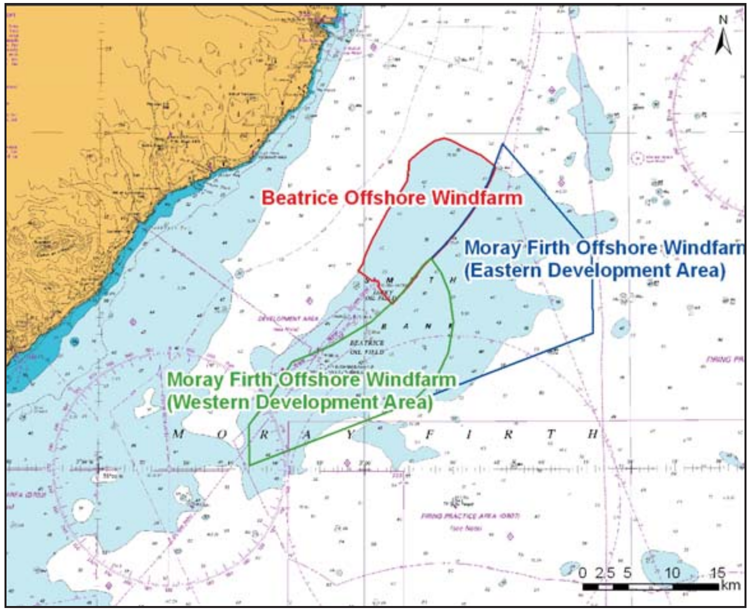

Figure 1. Location of the BOWL and MORL Wind Farm Developments

1.1 Overview of the BOWL Offshore Wind Farm Development

In February 2009, SSE Renewables and SeaEnergy Renewables were granted permission by The Crown Estate to investigate the feasibility and development of the proposed 'Beatrice' offshore wind farm site in Scottish Territorial Waters. SSE Renewables and SeaEnergy Renewables have together formed BOWL to undertake this investigation.

The Beatrice Offshore Wind Farm site is located on the Smith Bank, approximately 15km off the Caithness coastline in the Moray Firth, Scotland (see Figure 1). The south-eastern site boundary (corresponding also to the common boundary between the BOWL and MORL developments) is determined by the Scottish territorial waters limit. The site lies in water depths between 35-50m with a tidal range of 2.8-3.2m and with a maximum tidal current speed of approximately 0.5 knots.

The Beatrice site could accommodate up to 200 wind turbines each with a capacity of approximately 5MW and a maximum rotor tip height of approximately 150m above sea level. However, the final design and layout of the wind farm will ultimately be informed by a number of technical, physical and environmental considerations.

1.2 Overview of the MORL Offshore Wind Farm Development

In January 2010, The Crown Estate awarded EDP Renováveis (EDPR) and SeaEnergy Renewables Limited (SERL) the exclusive rights to develop wind farm sites within Zone 1 of the UK Round 3. EDPR and SERL have formed MORL to develop the zone in the Moray Firth, Scotland

The Moray Firth zone is located 22.2km from the coast on the Smith Bank in the Moray Firth and covers an area of 522.15km^2. The water depths vary between approximately 30-60m. Peak spring tidal speeds can be up to 1.2 knots.

MORL intends to develop 1.5GW of offshore wind by 2020 within the zone. The development will be split into two phases (see Figure 1): a 1.14GW phase (Eastern Development Area) and a 360MW phase (Western Development Area). The table below shows the intended deployment scenarios for the Eastern and Western Development areas from 2016 to 2020.

Table 1. Intended deployment scenarios for the MORL Eastern and Western Development areas from 2016 to 2020

Year	Annual No of Turbines Installed	Turbine Rating (MW)	Annual Installed Capacity (MW)	Cumulative Capacity (MW)	Phase
2016	24	5	120	120	Eastern
2017	60	5	300	420	Eastern
2018	60	6	360	780	Eastern
2019	60	6	360	1140	Eastern
2020	60	6	360	1500	Western

Although the above estimate is based on 5-6MW it is intended that the project will be consented using the envelope of a 5-8MW turbine. As such the turbine number may reduce if the larger rating (and height) turbines are used.

It is intended to progress the consenting of the Eastern Development Area and Western Development Area separately, with the consent applications for Eastern Development Area to be submitted in early Q2 2012 and consent application for Western Development Area to be submitted in 2015.

2. Summary of EIA Scoping and Responses

2.1 Summary of the EIA Scoping Reports: Updated Baseline Conditions

Both EIA scoping reports presented a baseline environmental description, informed by the available literature, from which the scoped EIA issues were proposed. Since that time, the conceptual understanding of the sites has become further supported by the outcomes of the metocean and geophysical surveys that have been undertaken (to date). These data will be reported during the course of the EIA exercise in the form of the baseline assessment in the ES and as separate survey type specific reports.

In particular, the metocean and geophysical surveys have provided further evidence in support of the previous assessment of sediment mobility and transport patterns on the Smith Bank.

It was previously understood (e.g. from Holmes *et al*. 2004) that the internal structure of the Smith Bank comprises erosion resistant glacial till deposits (poorly sorted gravels and sands) and other relatively stable geological sequences. This means that the bank as a morphological feature is relic and inherently stable. A relatively thin sand veneer is observed across parts of the bank (order tens of centimetres to a few meters thick). The geophysical data collected from the BOWL site to date (presently in draft form) supports this description; similar data will become available for the Eastern Development Area of the MORL site shortly.

It has become increasingly evident from the historical and measured tidal and wave climate data that the tidal regime is insufficient to induce frequent mobility of these sands but that intermittent storm wave action may cause energetic sediment resuspension (but not necessarily directional transport). Measurements of suspended sediment concentrations have been observed to significantly increase during storm events, but not in response to the spring-neap tidal cycle.

The draft findings of the BOWL geophysical survey (OSIRIS, pers. comm.) also did not indicate the presence of any tidal current related sedimentary bedforms. Instead, the indicators of long-term sediment transport direction (buried slope angles in the sub-surface geophysical data) suggest that, once resuspended by waves, sediment tends to move down slope under gravity and off the crest of the bank, rather than in the direction of the tidal axis or the dominant wave directions. It is likely that the same observations will result from the similar MORL surveys, to be reported in the near future.

2.2 Summary of the Original EIA Scoping Report: Previously Identified EIA Issues

In the original scoping reports, the following potential impacts were identified for consideration by MS and other consultees.

Potential impacts during the construction and decommissioning phases were identified as the following:

- Increase in suspended sediment concentration during installation/removal of foundations or cables, or the initial phases of seabed scouring around foundations, resulting in short-term locally elevated levels of suspended sediment concentrations and subsequent deposition of sediment on sensitive receptors.
- Seabed compaction or smothering in the footprint of foundations and of jack-up vessels used, leading to mortality of sensitive marine life in these areas.

Potential impacts during the operational phase were identified as the following:

- Changes to patterns of tidal currents and wave activity leading to changes in sediment transport pathways (suspended or bedload) and the form and function of the Smith Bank, impacting on sensitive receptors.
- Scour around foundations leading to local changes in seabed morphology, potentially impacting upon the stability of the turbine foundation itself as a sensitive receptor.
- Impacts on swell waves (period, height and direction) leading to impacts on recreational surfing wave resource in the lee of the development.
- Changes to erosional/depositional processes along the adjacent coastline impacting on morphology and consequently on sensitive receptors.

Potential cumulative and in-combination effects were identified as the following:

- The interaction between plumes of sediment created by the coincident installation of foundations or burial of cables as part of the Beatrice and Moray Firth Offshore Wind Farm site developments during the construction phase, leading to enhanced levels of suspended sediment concentration or rates or thicknesses of sediment deposition, impacting on sensitive receptors.
- The cumulative changes to patterns of tidal currents and wave activity as a result of the presence of both the Beatrice and Moray Firth Offshore Wind Farm site foundations in the operational phase, leading to changes in sediment transport pathways (suspended or bedload) and the form and function of the Smith Bank, impacting on sensitive receptors.
- The cumulative attenuation of waves as a result of the presence of both the Beatrice and Moray Firth Offshore Wind Farm site developments in the operational phase, leading to greater changes or likelihood of changes in erosional/depositional processes along the adjacent coastline impacting on morphology and consequently on sensitive receptors.

2.3 Summary of Scoping Responses

The comments considered relevant to the coastal processes topic of the EIA for the present study are summarised in Table 2, extracted from the various scoping response documents. Comments were provided by the following consultees but not all consultees provided comments relevant to coastal processes.

- Statutory Consultee:
  - Scottish Natural Heritage
- Non-Statutory Consultees:
  - JNCC;
  - RSPB;
  - Historic Scotland;
  - Civil Aviation Authority;
  - Maritime and Coastguard Agency;
  - BT Networks;
  - Northern Lighthouse Board;
  - RYA; and
  - Ports and Harbours.

2.3.1 Scoping Responses Received by BOWL

The comments received in response to the BOWL scoping document from stakeholders of relevance to the coastal processes study are summarised in the following separate documents.

- Marine Scotland (September 2010). Beatrice Offshore Wind Farm - Moray Firth: Scoping Opinion. pp28.
- Scottish Natural Heritage (May 2010). Beatrice - Proposed Offshore Wind Farm: SNH and JNCC Scoping Advice. pp34. Letter, ref CNS REN OSWF BEA.
- Historic Scotland (2010). Beatrice Offshore Wind Farm, Scottish Territorial Waters, Moray Firth Scoping Opinion. Letter, 15/4/2010, ref AMN/16/H.
- Moray Firth Inshore Fisheries Group (2010). Beatrice Offshore Wind Farm Ltd, Beatrice Offshore Wind Farm: Environmental Impact Assessment (EIA) - Scoping Exercise Consultation. Letter, 0/4/2010.
- Northern Lighthouse Board (2010). Beatrice Offshore Wind Farm - EIA Scoping Exercise Consultation. Letter, 9/4/2010, ref AJ/OPS/CPA/OREI/10/W.
- RYA (2009). The RYA's Position on Offshore Energy Developments. General guidance note, December 2009.

2.3.2 Scoping Responses Received by MORL

At the time of writing this version of this document, comments have not yet been received in response to the MORL scoping document, although it is not expected that any significantly different issues will be identified at this stage. Following receipt of comments, this document will be updated accordingly and resubmitted to MS, highlighting any additions or modifications to the list of identified issues or the methodologies proposed.

2.3.3 MCA Guidance MGN371

The MCA and the Ports and Harbours consultees have requested that the assessment should comply with MCA non-mandatory guidance note MGN371. Of relevance to the coastal

processes topic, Annex 2 (Part 1 - The Effect of Tides and Tidal Streams) of the guidance recommends that it should be determined whether:

- Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed installation is situated at various states of the tide i.e. whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa;
- The set and rate of the tidal stream, at any state of the tide, has a significant affect on vessels in the area of the site;
- The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect;
- The set is across the major axis of the site layout at any time, and, if so, at what rate;
- In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream;
- The structures themselves could cause changes in the set and rate of the tidal stream; and
- The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the wind farm area or adjacent to the area.

2.3.4 Recreational Surfing Interests

Groups representing surfing interests were also contacted for a further scoping response but none have yet been received. However, the potential for impact has been recognised in the scoping exercise and Surfers against Sewage, one of the most active and long-established of such groups in the UK, provides detailed guidance for the assessment of surfing wave resource in relation to offshore renewable energy developments (Surfers Against Sewage, 2009).

Table 2. Consultee responses of relevance to coastal process issues

Coastal Process Issue	Body			
	Marine Scotland	SNH/JNCC/RSPB	Historic Scotland	MCA/RYA/Ports and Harbours
Hydrodynamics (waves and currents)		Impacts upon the extent, distribution, function or structure of marine and coastal habitats (SACs and SPAs). RSPB - especially the East Caithness Cliffs SPA.		Changes in the set and rate of the tidal stream. Ref MCA guidance MGN371.
Sediment dynamics (changes to sediment transport pathways, suspended sediment concentrations and resulting sediment deposition)		Impacts upon the extent, distribution, function or structure of marine and coastal habitats (SACs and SPAs).	Impacts upon sites of potential archaeological interest	Potential for changes in sediment mobility that might affect navigable water depth. Ref MCA guidance MGN371.
Footprint of seabed lost (Footprint of foundations, of scour around foundations and of installation vessels)		Impacts upon the extent, distribution, function or structure of marine and coastal habitats (SACs and SPAs).		
Cable burial	Concern regarding impacts on local (inc. intertidal mudflat) habitats. However, temporary and localised nature of any effect is acknowledged.			MCA - Concerns regarding depth of cable burial.
Importance of considering cumulative/in-combination effects	Noted	Noted		Noted

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3. Proposed General Methodologies for EIA

3.1 Evidence Based Approach

The EIA process will incorporate an "*evidence based approach*" in so far as that remains possible, which is consistent with current best practice and in accord with the regulatory process. Here the relevant works to consider are the two recent COWRIE publications led by ABPmer (COWRIE 2009, 2010). ABPmer continues to add to the published evidence base and aims to maintain an awareness of all relevant studies to support further investigations such as that presently being undertaken.

The evidence based approach relies partially on the previous development of analogous schemes, from which an evidence base has been developed, providing an alternative means to confidently assess the likely impacts of certain aspects of the development without such detailed site specific study. Hence, this approach is appropriate for scheme proposals which have similarities with existing developments and for coastal settings of a similar type. If the development profile were markedly different to existing projects and their known effects (i.e. outside the present envelope of the established evidence base) then the requirement for additional investigations is likely to increase. It can be noted that, despite the scale of this development and the relatively deep water location, the distance from shore is not as great as some other Round 1 and Round 2 developments and hence an evidence based approach might remain relevant to certain aspects of the EIA.

3.2 Collaboration between the Adjacent Developers

It was highlighted in the scoping response to BOWL from MS and also independently by several of the consultees that a coordinated approach to the assessment of EIA issues between BOWL and MORL would be preferable to ensure a holistic approach and consistency of methodology, particularly in relation to cumulative and in-combination effects.

The advantages of such an approach were identified early in the pre-EIA-scoping stages of project development. In relation to Coastal Processes, BOWL and MORL have both retained the services of one specialist advisor, ABPmer, to undertake a joint study on behalf of both developers; an agreement is also in place to share information and data collected to inform the EIA process, wherever possible.

3.3 Scheme/Project Definition

'Realistic worst case' scenarios for the design of the Beatrice and Moray Firth (Eastern Development Area) Offshore Wind Farms will be assessed, both alone and in-combination with each other and other selected identified activities (including the proposed MORL Western Development Area). The resulting EIA will enable the regulator to simultaneously license a range of potential scheme designs, provided that the scheme design(s) eventually chosen is accepted to have a potential for impact equal to or lesser than the schemes tested in the EIA (a

Rochdale Envelope approach). This approach has been taken (by ABPmer) for the majority of offshore wind farm EIAs in UK.

From the Project Design Statement (PDS) two primary scheme definitions for each development will be identified for testing as part of EIA; this decision will be made initially between ABPmer and the client, and subsequently agreed with MS prior to proceeding further with the EIA studies. The chosen schemes will represent the 'realistic worst case' scenarios for development and typically include:

- The foundation option (type and size) presenting the greatest blockage to waves and tides, at the most dense corresponding layout spacing; and
- The largest foundation option (type and size) corresponding to the most dense foundation layout.

In addition to the size and layout of turbine foundations, the PDS will also inform the characterisation of:

- The nature of any ground preparation works (i.e. the rate of sediment resuspension);
- The likely schedule for ground preparation and/or foundation installation (i.e. the scheduling of sediment resuspension events);
- The nature of scour protection being considered;
- The type of installation vessel that may be used (i.e. the extent and frequency of bed disturbance);
- The overall construction timeline (i.e. the overall scheduling of construction events);
- The likely methods for inter-array cable burial (i.e. the potential for and the rate of sediment resuspension); and
- The expected method for decommissioning (i.e. methods for the removal of the foundation, the scour protection and cabling).

The details of the schemes tested in the EIA may not correspond exactly to the eventual scheme design chosen for development, but will be realistic in their nature and have an equal or greater potential for impact. The nominal lifetime of the development from construction to decommissioning will be assumed to be consistent with the typical lease period (50 years).

In addition to the wind farm infrastructure described in the MORL and BOWL Scoping Reports, additional infrastructure will be required to connect the wind farms to the onshore network. This infrastructure is likely to consist on transmission cables and offshore substation platforms.

Due to changes in the regulatory regime relating to transmission infrastructure both the MORL and BOWL transmission assets will likely be owned and operated by a third party, the Offshore Transmission Operator (OFTO). At the moment this regime is subject to consultation with the Regulator Ofgem and the Industry. As a result there is a certain amount of uncertainty regarding how EIA and Consenting Regulations can be applied to these assets.

As a result it should be noted that OFTO Infrastructure may or may not be included in the EIA from either developer. If the OFTO Infrastructure is *not* included within the respective MORL and BOWL Wind Farm EIA's it will be considered within the EIA as a cumulative impact. The full EIA for the OFTO Infrastructure will then be subject to a standalone EIA.

The approach for consideration of cumulative impact and the OFTO Infrastructure will be agreed in consultation with Marine Scotland and its consultees.

3.4 Gap Analysis of Historical Data

A gap analysis of historical (existing) metocean data (wind, wave, tidal water levels and tidal currents) was undertaken by ABPmer for BOWL and MORL in December 2010 and is being updated as the project progresses. A gap analysis and review of (existing) non-metocean data (e.g. bathymetry, suspended sediment concentrations, sedimentary and geological characterisation) was also undertaken.

A range of suitable data sources were found to support a robust description of the regional context for both developments (i.e. the Outer Moray Firth) but the conclusions of the analysis were generally that insufficient site specific data were available.

In response to this study, a metocean survey programme was designed and executed (see the following section for more details) to fill the site specific metocean data gaps.

Input was also provided from the coastal processes EIA topic leaders to the required outputs of the geophysical survey (collecting bathymetry, broad sedimentary classification maps and sub-surface geological information) and to the design of the benthic survey (collecting sediment grab samples for sediment characterisation), so that the results will be suitable to inform the coastal processes topic.

The requirements for data input to the coastal processes topic (and the design of the surveys) have been identified following the best practice guidance for the use of numerical modelling tools in coastal process EIA for offshore wind farms (COWRIE 2009) and based on the experience of ABPmer in undertaking coastal processes assessments for the majority of offshore wind farm developments in the UK to date.

3.5 New Surveys to Address the Identified Data Gaps

In support of coastal processes assessments (as well as other EIA and Engineering topics), a number of surveys with consistent and complimentary specifications have been commissioned by both developers to address the identified data gaps, namely:

- Metocean survey;
- Geophysical survey;
- Benthic survey; and
- Geotechnical survey.

A metocean survey was undertaken by BOWL to collect direct measurements within the Beatrice site of:

- Tidal water levels (4 months);
- Tidal current profiles (4 months);
- Wave climate (February 2010 to present, approx 8 months to date); and
- Nearbed suspended sediment concentration (February 2010 to present, approx 8 months to date).

A metocean survey was undertaken by MORL to collect direct measurements within the MORL Zone of:

- Tidal water levels (4 months to date);
- Tidal current profiles (4 months to date);
- Wave climate (June 2010 to present, approx 5 months to date); and
- Nearbed suspended sediment concentration (June 2010 to present, approx 4 months to date).

The locations of the equipment deployed, in addition to other public and privately available sources of metocean data are shown in relation to the BOWL development (red) and the MORL development (blue) in Figure 2.

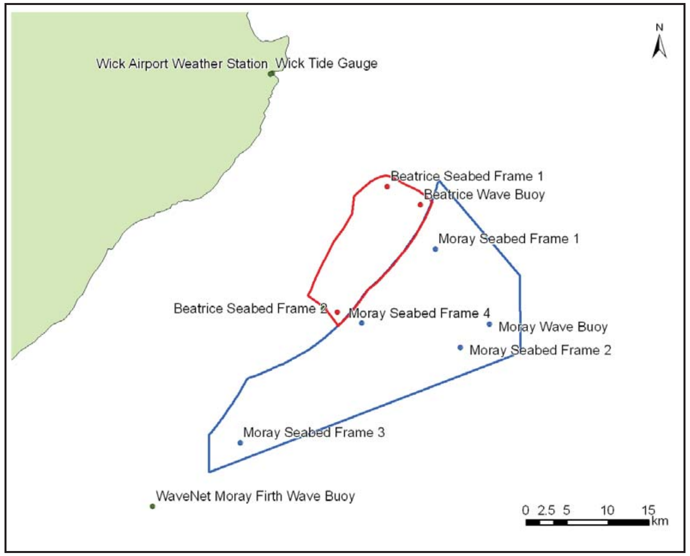

Figure 2. Locations of Newly Collected and Historical Sources of Metocean Data

The main period of data collection at the BOWL site was between February and June 2010; although some equipment presently remains in the water. The main period of data collection at the MORL site began in June-July 2010 and is presently ongoing. The surveys were designed in accordance with the recommendations of COWRIE (2009), draft guidance from MS for wave and tidal renewables EIA (EMEC & Xodus, 2010), interpreted for likely requirements for offshore wind EIA, and previous guidance regarding wind farm coastal process EIA (Cefas, 2004). Measurement locations and the survey duration have been specifically designed in order to collect appropriate data in support of numerical modelling and the EIA process.

Geophysical surveys were commissioned by both developers to confirm the detailed geological structure of the part of the Smith Bank within the extent of the site of the Beatrice and Moray Firth (Phase 1) Offshore Wind Farms, for the purposes of informing the engineering design of the development and the various EIA topics (including coastal processes, benthic ecology, archaeology, etc). The final results of the surveys will become available during the course of the EIA. In relation to coastal processes, the survey collected detailed measurements within the site of:

- Detailed bathymetry;
- Seabed roughness (inferring sediment type); and
- Subsurface geology.

Benthic (ecology) surveys were commissioned by both developers and undertaken in Autumn 2010. In relation to coastal processes, the benthic surveys collected sediment grab samples from the seabed and returned the detailed grain size distribution, providing more detailed information on the regional sediment properties.

Geotechnical surveys are currently underway on the MORL site with approximately 20 borehole samples to be collected in the Eastern Development Area. Geotech surveys will also be commissioned by BOWL (scheduled for autumn/winter 2010). Both campaigns will collect borehole samples at a selected number of locations across the site with the objective of ground-truthing the inferred character of sediments in the subsurface geophysical data already collected. The primary purpose of this survey is to inform the engineering design of the foundation structures. However, should the data become available during the EIA process, they will also be used to further inform the coastal processes topic in relation to the nature of any potential drill arisings.

The complementary metocean (wave, tide and suspended sediment) data sets being collected by the two developers will be incorporated into either the site specific or joint studies being proposed and together provide greater confidence in the potential accuracy of any modelling tools used and therefore any predictions of the potential impacts of the developments.

3.6 Interaction with other EIA Topics

It is anticipated that the coastal processes topic of the EIA (the work described here) will inform, in part, the impact assessments made by other topics, e.g. benthic ecology, archaeology.

To support this process, lines of communication have been established between the topic leaders to share relevant information regarding potential impacts of the development on the physical environment, with implications for other sensitive receptors.

3.7 General Approach to the Physical Processes Assessment

The physical processes assessment will take into account the guidance provided in this respect from the Scottish Regulators (EMEC & Xodus 2010 for wave and tide, to be updated for wind) and will also aim to be consistent with the guideline previously published for EIA of Round 1 and Round 2 of wind farm development to date (Cefas 2004, to be updated shortly for the Round 3 process).

Initially, a baseline understanding of the processes controlling the physical environment in the Moray Firth will be developed to form a conceptual model of the region. The baseline understanding will also include the foreseeable lifetime of the projects (nominally 50 year leases). The natural ranges and statistical behaviour of metocean parameters will be characterised using:

- A review of the available historical metocean data (Section 3.4);
- A review of the available newly collected metocean data (Section 3.5); and
- Where the available measured data are limited in spatial or temporal extent, these may be supplemented using hydrodynamic models, validated using the field data.

The historic natural seabed variability will also be evaluated through the comparison of historical charts and surveys thus allowing the assessment of the likelihood of naturally occurring seabed level change. This will be combined with a further conceptual understanding of baseline sediment transport processes and pathways (without the wind farm structures in place) which will be developed through:

- A review of the geophysical survey data for bedform features (scale, orientation and asymmetry);
- A review of the grab sample and geophysical survey data to characterise the distribution of surficial sediment type;
- A review of any relevant previous studies; and
- Numerical modelling of sediment transport pathways, incorporating use of a hydrodynamic model validated using existing and newly collected field data.

Once a robust baseline understanding of the site specific and regional physical processes has been established, the project specific EIA issues identified in Section 2.2 and 2.3 will be addressed using the methodologies shown.

3.8 General Approach to the Use of Numerical Modelling Tools

In 2009, ABPmer led the production of Best Practice Guidance on behalf of COWRIE regarding the appropriate use of numerical modelling tools for Offshore Wind Farm EIA (COWRIE 2009).

The lead author was David Lambkin (the Project Manager of the present study) and the report was steered and co-authored by Bill Cooper (the Project Director of the present study). Modelling tools and studies in the present study will be developed in accordance with this guidance. The choice of when to use or apply the results from modelling tools is related mainly to the ability of the study to identify and characterise sensitive receptors (examples of which are given in the following section), as summarised in the following extracts from the guidance.

"The sensitivity of some receptors can be clearly defined in measurable terms, while for others there is presently insufficient understanding of the receptor to make anything more than a qualitative statement. For example, loss of 2m depth in a navigation channel may mean that vessels of a certain draught can not access a harbour, or may require regular dredging to allow continued use. Similarly, cable trenching close to a known shellfishery may cause suspended sediment concentrations or sediment deposition rates to rise above a specified threshold value over a defined time period, causing significant mortality rates and loss of fishery income. In these cases numerical modelling may be very useful in defining the intensity and extent of the physical change for comparison with the quantified threshold value."

"In the cases where there is only an indeterminate possibility that changes to the physical situation may affect a receptor, but with no understanding of significant threshold levels or natural variation, then undertaking numerical modelling may well be of no more value than an expert opinion delivered for a fraction of the cost and time. For example, deposition of remobilised fine sediment on a nursery ground may be noted as a possible problem for survival rates, but with no information on the natural tolerance to deposition there is little point in defining the footprint of deposition rates to the nearest millimetre as would be possible with standard plume dispersion modelling - stating significance would be no more than conjecture."

At this point, the need for modelling tools has been identified and will be delivered primarily by the DHI MIKE 21 software suite. For most modules, a flexible mesh (a network of interlocking triangles of variable size) will be utilised. This will be beneficial to the study as higher resolution can be smoothly and selectively applied to sites of interest and enables more accurate definition of bathymetric features (such as deep water channels and complex coastlines).

MIKE modules proposed for use are:

- Tidal regime - MIKE 21 FM HD (Hydrodynamics);
- Wave climate - MIKE 21 SW (Spectral Waves);
- Sediment transport - MIKE 21 FM ST (Sediment Transport); and
- Plume dispersal - MIKE 21 PA (Particle Analysis, rectilinear mesh).

A 2D (vertically integrated) flexible mesh approach is considered to be most suitable in addressing this problem. A 3D modelling approach was considered but found to be unnecessary due to the absence of reported or measured vertical stratification in the water column strong enough to affect hydrodynamic processes.

4. Proposed Detailed Methodologies for EIA

The guidance contained in COWRIE (2009) states that the most appropriate and efficient method to assess each potential impact should be individually considered during the EIA process, in the following order.

i. What are the potential sensitive receptors by category or species? Are the sensitivity thresholds of the defined receptors understood and quantified?
ii. What information about the physical environment is required to categorise the potential impacts on the identified receptors?
iii. Can sufficient information be practicably and effectively provided by existing knowledge and available field data without the need for numerical modelling?
iv. If the answer to Point iii is 'no', can numerical models represent the processes involved sufficiently to provide the required information? If not, then a conceptual solution must be developed.
v. If the answer to Point iv is 'yes', sufficient field data must be obtained to adequately calibrate and validate the model to provide confidence in the results.
vi. Does the regulating authority agree with the proposed approach to the study?

Points i-v of the above list have already been considered at a high level and have been incorporated into the proposed study methodology below.

Also as described in COWRIE (2009), sensitive receptors may be environmental or socio-economic and may include, for example:

- Particular flora or fauna, including commercial species, that might be disturbed, displaced, weakened or even killed by changes to the physical environment (waves, currents, sea bed mobility, coastal erosion, suspended sediment load or increased levels of contaminated sediment or other pollutants);
- Navigation where safety or accessibility may be compromised by changes to water depths, wave conditions or currents;
- Coastal communities, property, infrastructure, habitats, protected geological exposure or valued geomorphological features that may be disturbed or lost due to changing risks of coastal erosion, accretion or flooding;
- Marine structures, infrastructure, wrecks, dumped ordnance, etc that may be compromised by changes to the physical environment; and,
- Coastal or marine recreation that may be influenced by changes to waves, currents, coastal processes, suspended sediment or landscape (due to structures intended to protect cables at the landfall).

In the following sections, EIA issues under the following headings are offered as the complete list which will be considered during the EIA scoping process.

- Sediment Resuspension;
- Footprint of Turbines and Installation Vessels;
- Effect on Tidal Currents and Waves;
- Scour Around Turbine Foundations; and,
- Cumulative and In-Combination Effects.

Where relevant, the further impact of climate change on the baseline metocean conditions or scheme impact will also be assessed. The effects of climate change will be characterised on the basis of UKCP'09 (http://ukclimateprojections.defra.gov.uk/) and a nominal 50 year project lifetime following construction.

More detailed methodologies are proposed with which to address each potential impact in relation to the baseline understanding.

4.1 Sediment Resuspension

Table 3. Sediment resuspension

Sediment Resuspension	
Phase	Construction, Repowering and Decommissioning
Issue	Increase in suspended sediment concentration during installation/modification/removal of foundations or cables, or the initial phases of seabed scouring around newly installed foundations resulting in short-term locally elevated levels of suspended sediment concentrations.
Potential Impact	Methodology
Elevated levels of suspended sediment concentration on sensitive receptors.	The location of receptors sensitive to elevated levels of suspended sediment will be determined. The modelling tools will be used to simulate the release of sediments into the baseline environment at prescribed locations, rates and intervals as described in the PDS for foundation installation, ground preparation and inter-array cable burial. The locations for release will be the likely sites of turbines or cable installation in the vicinity of the identified sensitive receptors; the rate of sediment release will be calculated as the [volume of sediment disturbed]/[time required] and the interval between consecutive releases will be based on the activity Selected time steps of the resulting time-series maps of cumulative suspended sediment concentration in relation to the location of the identified receptors will be presented. These will show the predicted spatial distribution of cumulative or persistently elevated levels of SSC which might be expected as a result of these activities.
Subsequent deposition of sediment on sensitive receptors	The location of receptors sensitive to smothering by sediment deposition will be determined. Using the same approach described above, the predicted spatial distribution of the cumulative thickness of sediment deposited out of suspension will be estimated presented as a map in relation to the identified receptors.

4.2 Footprint of Turbines and Installation Vessels

Table 4. Footprint of turbines and installation vessels

Footprint of Turbines and Installation Vessels	
Phase	Construction, Repowering and Decommissioning
Issue	Seabed compaction or smothering in the footprint of foundations and of any jack-up vessels used.
Potential Impact	Methodology
Mortality of sensitive marine life in directly affected areas.	The most likely sensitive receptors to be affected will be determined. The footprint of the foundations will be calculated from the PDS as [seabed footprint area] x [number of turbines]. The footprint of installation vessels will be determined as [seabed footprint area] x [number of turbines] x [likely number of visits per turbine]. Both values will be presented as a proportion of the total site area and as a proportion of the total habitat area of that type (within the site and within the Moray Firth if possible).

4.3 Effect on Tidal Currents and Waves

Table 5. Effect on tidal currents and waves

Effect on Tidal Currents and Waves	
Phase	Operational
Issue	Changes to patterns of tidal currents and wave activity as a result of the presence of the turbine foundations.
Potential Impact	Methodology
Change in sediment transport pathways (suspended or bedload) affecting the form and function of the Smith Bank or other named SACs or SPAs.	The sensitive receptors to test in this respect are the SACs and SPAs identified in the scoping response. Using the same long time series of baseline and with-scheme data created above, similar cumulative exceedance analyses will be undertaken for locations offshore of the identified sites.
Reduction in recreational surfing wave resource in the lee of the development.	Guidance with respect to assessment of impact on surfing resource is available from Surfers Against Sewage (2009). The sensitive receptors to test in this respect are the surfing beaches located across the south coast of the Moray Firth; the particular wave events of concern are when large waves enter the firth from offshore sectors between North and East. In addition to a set of cumulative exceedance plots (as described above, but without reference to sediments), a subset of key wave conditions will be identified for testing, to be identified using the available guidance. The wave distribution across the firth will be calculated for baseline and with-scheme cases. The effect on the wave climate will be presented as a difference map ([with-scheme] - [baseline]) in the context of natural variability and as a series of tables showing absolute and percentage effect on key surfing wave parameters.
Modification of tidal currents or wave climate affecting navigation in the area	The peak tidal current distribution on flood and ebb tides, for spring and neap periods, will be modelled for baseline and with-scheme cases. The effect on peak current speeds will be presented as a difference map ([with-scheme] - [baseline]) in the context of natural variability. A comment will be made as to any measurable effect on the orientation of the tidal axis.

4.4 Scour around Turbine Foundations

Table 6. Scour around turbine foundations

Scour Around Turbine Foundations	
Phase	Operational
Issue	Scour around foundations leading to local changes in seabed sediment type and morphology.
Potential Impact	Methodology
Impact upon the stability of the turbine foundation.	A high-level estimate of the maximum depth of local scour will be made using empirical relationships from the relevant peer-reviewed literature and following relevant guidance (e.g. DNV, 2007). Such an assessment is not an integral requirement for EIA and no detailed assessment will be made of any resulting effect on actual structural stability. This information will however provide additional confidence in the validity of the PDS and chosen Rochdale envelope.
Localised loss of seabed habitat through seabed modification.	Using the scour depth determined above and information regarding the surficial sediment properties, the likely diameter of the scour hole footprint will be determined. The area of seabed modified by scour will be calculated as ([area of scour footprint] - [area of foundation footprint]) x [number of turbines]. This value will be presented as a proportion of the total site area and as a proportion of the total habitat area. A comment will be made as to the likely difference between the naturally present and scoured sediment surfaces, if no scour-protection were used.

4.5 Cumulative and In-Combination Effects

Other types of activities to be considered, include:

- Other offshore wind developments;
- Marine aggregate extraction activities;
- Marine spoil disposal activities;
- Capital/maintenance dredging operations;
- Port development activities;
- Oil and gas development;
- Sub-sea cables and pipelines; and,
- Wave and tidal developments.

Except for the two proposed offshore wind farms, no other relevant new or planned development activities were identified. The effect of the small number of oil platforms and the two Beatrice Demonstrator turbines on the marine environment is considered to be minimal and is already included in the recently measured baseline data upon which the project will be based (including the recently collected metocean, geophysical and benthic ecology data).

All of the above assessments will be undertaken also for the case of the simultaneous presence of the Beatrice Offshore Wind Farm and the Moray Firth Offshore Wind Farm ([Eastern Development Area alone] and [Eastern + Western Development Areas together]), following the proposed methodologies. The description of the MORL Western Development Area in the cumulative and in-combination testing will be proposed on the same basis as the initial Eastern Development Area. However, this design description will not be informed by the same level of geophysical and geotechnical data and residual uncertainty will be addressed in a separate future EIA to assess the specific impact of the second phase of the MORL development.

Studies of construction related impacts will seek to investigate the operations with the greatest potential for cumulative effect, i.e. simultaneous sediment release along the border of the two development areas.

Studies will consider only one operational in-combination/cumulative scenario, i.e. one of the two site specific schemes being tested for each developer will be taken forward for assessment in the EIA - that which is found to have the greatest potential for or levels of effect.

Assessments of habitat loss due to the footprint of turbines, installation vessels and scour will simply be presented as a combined figure in the same format.

Table 7. Cumulative and in-combination effects

Cumulative And In-Combination Effects	
Phase	Construction, Operational, Repowering and Decommissioning
Issue	For all issues identified above, there is a concern that the combined development activities or presence of the Beatrice Offshore Wind Farm and Moray Firth Offshore Wind Farm may result in local or regional effects greater than would be predicted by considering each separately in isolation.
Potential Impact	Methodology
Impacts as above for each EIA issue.	The same methodologies will be used to assess each potential impact, considering the simultaneous presence of foundations in operational phases

5. Assessment of Significance

A set of criteria will be developed by the respective project lead EIA consultants, against which to assess the significance of any potential impacts of the development(s).

Wherever possible, impacts relating to modifications to scalar quantities (e.g. current speed, wave height, current and wave directions, suspended sediment concentration, rates of sediment deposition, etc) will be assessed in comparison to the natural range of variability at that location, determined either through direct measurements or from the additional data created using the modelling tools.

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Appendix A

List of Relevant SPAs and SACs

Appendix A. List of Relevant SPAs and SACs

In their scoping response, SNH and JNCC provided advice in relation to Habitats Regulation Appraisal. It was recommended that the potential impacts of the Beatrice Offshore Wind Farm on Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) should be considered alone and in-combination with other plans and projects. It is also recommended that the following SPAs are considered in this regard:

- Cromarty Firth SPA.
- Dornoch Firth SPA.
- East Caithness Cliffs SPA.
- Inner Moray Firth SPA.
- Loch of Strathbeg SPA.
- Moray and Nairn Coast SPA.
- Troup, Pennan and Lion's Heads SPA.

It is also recommended that the following SACs designated for marine mammals and for marine and coastal habitats are considered in this regard.

- Culbin Bar SAC - designated for its coastal habitats including sand dunes, vegetated shingle and salt meadows.
- Dornoch Firth & Morrich More SAC - designated for its population of common (harbour) seals
- (*Phoca vitulina*) and for coastal and marine habitats including sand dune habitats, intertidal mudflats and sandflats; subtidal sandbanks and reefs.
- Moray Firth SAC - designated for bottlenose dolphin (*Tursiops truncatus*) and for subtidal sandbank habitat.

It is also recommended that the following SACs designated for fish of conservation concern are considered in this regard:

- Berriedale & Langwell Waters SAC - designated for Atlantic salmon (*Salmo salar*).
- River Borgie SAC - designated for Atlantic salmon, freshwater pearl mussel (*Margaritifera margaritifera*) and otter (*Lutra lutra*).
- River Dee SAC - designated for Atlantic salmon, freshwater pearl mussel and otter.
- River Evelix SAC - designated for freshwater pearl mussel.
- River Moriston SAC - designated for Atlantic salmon and for freshwater pearl mussel.
- River Naver SAC - designated for Atlantic salmon and for freshwater pearl mussel.
- River Oykel SAC - designated for Atlantic salmon and for freshwater pearl mussel.
- River Spey SAC - designated for Atlantic salmon, sea lamprey (*Petromyzon marinus*), freshwater pearl mussel and otter.
- River Thurso SAC - designated for Atlantic salmon.

The identified SPA's and SAC's are shown in relation to the BOWL development (red) and the MORL development (blue) in Figure A1.

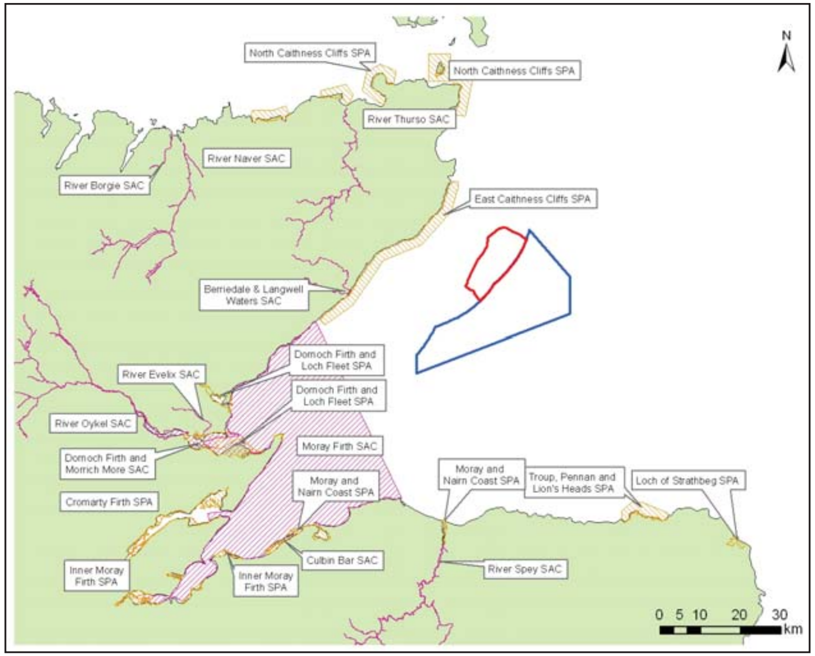

Figure A1. Locations of the SPA's and SAC's identified in the EIA scoping responses

Annex B

Marine Mammal Data Gathering

Pre-consent marine mammal data gathering at the MORL & BOWL wind farm sites

Paul Thompson (University of Aberdeen) & Kate Grellier (SMRU Ltd)

Progress Report - 21st January 2010

The work programme currently being undertaken by the University of Aberdeen and SMRU Ltd for BOWL and MORL has the following three key objectives:

- To use passive acoustic monitoring to characterise the site the cetacean species present, and detail seasonality and year-to-year variability in occurrence
- To use data form aerial surveys conducted in 2010 to assess the density of cetaceans at the proposed sites, and use habitat association models to predict cetacean densities across the Moray Firth
- To assess the likelihood of exchange between the proposed wind farm site and both the Moray Firth bottlenose dolphin SAC and the Dornoch Firth harbour seals SACs.

This progress report provides proposals for the structure and scope of the final project report(s) and a summary of ongoing data collection as required under the programme deliverables.

Report Format

The original scope of work identifies four deliverables:

1. A report will provide an overview of the Passive Acoustic Monitoring (PAM) techniques used, and the data available from the BOWL & MORL sites. The key data presented will show year-to-year and seasonal variability in the occurrence of porpoises and dolphins in and around the BOWL & MORL sites for the period 2005 – 2011. These data will be discussed in relation to other PAM data from NE Scotland. (Objective 1)

2. A report will provide details of the aerial survey techniques used in the DECC funded study, and the habitat modelling used to predict densities in other parts of the Moray Firth. These data will be discussed in relation to previous estimates of cetacean density in waters around the UK, primarily those based upon SCANS and SCANS II surveys. In addition, direct estimates of densities in August/September 2010 will be discussed in relation to PAM data on seasonal and inter-annual variation in occurrence. (Objective 2)

3. A report will outline the acoustic methods used to determine the likelihood that dolphins using the BOWL and MORL sites are likely to be bottlenose dolphins that use the Moray Firth SAC. This will include details of field data collection, and the development and application of the newly developed software used to identify the dolphin species from recordings of their broadband vocalisations. These data will be discussed in relation to other sources of data on the distribution and movements of bottlenose dolphins using the Moray Firth SAC. (Objective 3a)

4. A second report will outline the availability of harbour seal telemetry data, and the strengths and weaknesses of the different datasets in relation to the precision of the techniques used and their temporal coverage. The SSM approach used to account for the different error structures will be described, and the standardised tracking data provided in GIS format. We will outline how mixed GAMMs models are used to provide maps of predicted densities, and provide data in a format that can be incorporated into noise modelling studies. These data will also be used to assess the extent to which harbour seals from the Dornoch Firth SAC are likely to spend time in the BOWL & MORL sites. Data will also be discussed in relation to current knowledge of harbour seal foraging distribution. (Objective 3b)

We now propose to integrate the first two of these reports, and provide a single technical report that describes the University of Aberdeen's work on the distribution and abundance of cetaceans in the outer Moray Firth. This report will also include the results of additional habitat association modelling that uses boat survey data collected in the outer Moray Firth between 2005 and 2010. The proposed structure of this report is given in Annex 1.

Two additional reports will follow the original plan outlined above. These will each report on two separate work packages carried out by SMRU Ltd. The first of these will report on the acoustic analyses undertaken to assess the likelihood that bottlenose dolphins from the Moray Firth SAC use the proposed windfarm sites. These second will describe the habitat association modelling of harbour seal telemetry data to describe the foraging distribution of seals from the Dornoch Firth SAC. The proposed structure of these reports is given in Annex 2 and Annex 3 respectively.

Ongoing data collection.

C-PODS were installed on moorings at 6 locations within the BOWL site and 15 locations within the MORL site during July 2010 (Table 1). These deployments over the summer were carried out as part of the University of Aberdeen's DECC funded project. Following completion of this work in early October, efforts were then made to recover these devices and redeploy replacements at the same locations over the winter. Poor weather delayed this work at most sites, with 3 of the MORL sites serviced on 21st October, the BOWL sites and a further 6 MORL sites serviced on 21st/22nd November, and all but one of the remaining MORL sites finally completed on 19th January 2011. Only 3 devices (15%) were lost during this deployment, a reduced rate of loss compared with 2009, with one remaining mooring to to be checked. Analyses of data from all but the most recent recoveries indicate that all but one of these devices had operated successfully throughout the deployment.

Deployments of EARS for work under Objective 3 were all successfully deployed and recovered between August and November (Table 2). Useful recordings were made during all but one deployment which suffered battery failure. Longer deployments of other EAR units (sampling 60 seconds every 500 seconds) were made during the DECC study to monitor variations in anthropogenic noise. This information is included in case these recordings may be of value for future assessments of variation in ambient noise.

Table 1. Details of the deployment and changeover of C-PODS at locations in the BOWL and MORL sites 2010/11.

Site	Latitude	Longitude	Depth (m)	Deployment date	Changeover Date	Complete record
A15	58.06678	-3.1154	MORL	24/07/2010	31/10/2010	✓
A16	58.07402	-3.01645	MORL	24/07/2010	19/1/2011	Not Found
A17	58.10447	-2.96075	MORL	24/07/2010	31/10/2010	✓
A18	58.16208	-2.93442	MORL	24/07/2010	22/11/2010	✓
A19	58.18403	-2.85993	MORL	25/07/2010	19/1/2011	TBC
A20	58.19663	-2.76345	MORL	25/07/2010	21/11/2010	✓
A21	58.22607	-2.69858	MORL	24/07/2010	19/1/2011	TBC
A22	58.27112	-2.66363	MORL	24/07/2010	21/11/2010	✓
D04	58.08863	-3.09572	MORL	25/07/2010	31/10/2010	×
E14	58.12763	-2.97883	MORL	24/07/2010	19/1/2011	TBC
E15	58.20247	-2.99767	BOWL	24/07/2010	22/11/2010	✓
E16	58.12095	-2.85883	MORL	22/09/2010	21/11/2010	✓
E17	58.22713	-2.93545	BOWL	24/07/2010	22/11/2010	✓
E19	58.23388	-2.86832	BOWL	24/07/2010	22/11/2010	✓
E20	58.26672	-2.88652	BOWL	25/07/2010	22/11/2010	Not found
E21	58.30537	-2.88625	BOWL	24/07/2010	22/11/2010	✓
E23	58.2879	-2.83697	BOWL	24/07/2010	22/11/2010	✓
E24	58.23885	-2.78987	MORL	24/07/2010	21/11/2010	✓
E25	58.12765	-2.75602	MORL	25/07/2010	19/1/2011	Not found
E26	58.15025	-2.61987	MORL	25/07/2010	TBC	TBC
E27	58.17995	-2.67548	MORL	25/07/2010	21/11/2010	✓

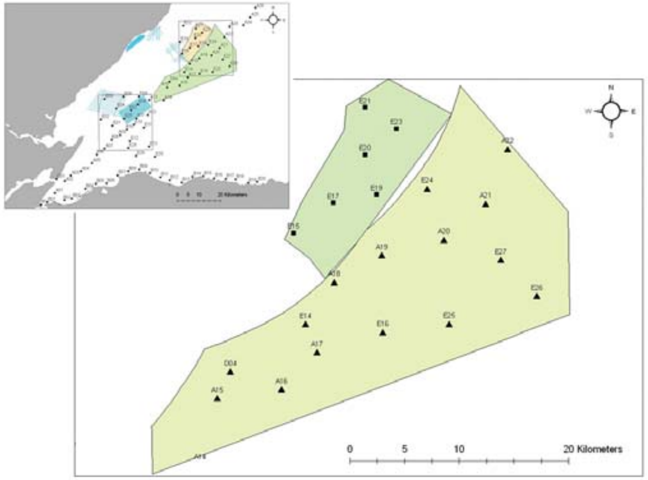

Figure 1. Map showing the sites at which C-PODS have been installed in the BOWL and DECC sites. All sites except E26 now have devices in place that will be collecting data until at least March 2011. Inset map shows site location and the locations of other sites used during the DECC study in the summer of 2010

Table 2. Details of deployment and recovery of EARS for monitoring broad band noise and dolphin vocalisations.

Site	Sampling rate (KHz)	Duty cycle (secs)	Deployment date	Data end / recovery date
A10	50000	60/600	12/07/2010	29/09/2010
A20	64000	1800/3600	25/07/2010	15/08/2010
E17	64000	1800/3600	24/07/2010	11/08/2010
E19	50000	60/600	24/07/2010	22/11/2010
E21	64000	1800/3600	16/08/2010	09/09/2010
E16	64000	1800/3600	22/09/2010	16/10/2010
A22	64000	1800/3600	22/09/2010	23/09/2010
D01	64000	1800/3600	07/10/2010	01/11/2010

Annex 1. Proposed format for report on work carried out under Objectives 1 & 2.

Working title: Distribution and density of cetaceans in the Outer Moray Firth

Lead Authors: University of Aberdeen

Contents:

1. **Background**
2. **Methodology**
    - 2.1 Visual surveys - (April-October data)
        - 2.1.1 Data sources
            - 2.1.1.1 AU Boat surveys within SAC (2004, 2005)
            - 2.1.1.2 AU Boat surveys in Outer Moray Firth (2009)
            - 2.1.1.3 AU Aerial surveys in Outer Moray Firth (2010)
            - 2.1.1.4 RPS Boat surveys of BOWL site (2010)
            - 2.1.1.5 Natural Power surveys of MORL site (2010)
        - 2.1.2 Habitat association modelling
        - 2.1.3. Estimation of density form line-transect aerial surveys
    - 2.2 Passive acoustic monitoring – (year-round data)
        - 2.2.1 Data sources
            - 2.2.1.1 Beatrice Demonstrator study (2005-2007)
            - 2.2.1.2 DECC Study (2009-2010)
            - 2.2.1.3 MORL/BOWL funded studies (2010-2011)
        - 2.2.2 T-PODS – data collection and analysis techniques
        - 2.2.3 C-PODS – data collection and analysis techniques
3. **Results**
    - 3.1 Distribution patterns
        - 3.1.1 Figures and tables providing information on visual survey effort in different years and using different platforms.

3.1.2 Figures and tables providing summaries of all visual sightings of different cetacean species

3.1.3 Modelled distributions from visual surveys – presented as a standard set of figures (4x4km grid scale) for key species. The number of species included will depend upon sample sizes, but anticipated to include harbour porpoise, bottlenose dolphins, combined “other dolphin species” and minke whales.

3.1.4 Spatial variation in occurrence based upon PAM data

3.1.4.1 Figures showing probability of detection of a) porpoises and b) dolphins at different sampling across the wider Moray Firth (using data from summer 2009 and 2010).

3.1.4.2 Analysis comparing consistency of spatial patterns in 2009 and 2010

3.1.4.3 Analysis comparing PAM data with predicted distributions from visual survey to evaluate performance of PAM data and likely identify of dolphins using different parts of the Moray Firth.

3.2 Density estimates

3.2.1 Tables presenting results of DISTANCE analysis of line-transect data from aerial surveys, including estimates of the number of individuals using MORL/BOWL sites. Species to be considered will depend upon sample sizes and may be restricted to harbour porpoises.

3.2.2 Analysis comparing PAM data with density estimates to inform understanding of extent to which PAM data can provide insights into variation in density.

3.3 Seasonal & inter-annual patterns of occurrence

3.3.1 Comparison of T-POD and C-POD data to evaluate potential for comparing recent data (2009 & 2010) with earlier data from the Beatrice Demonstrator (2005-2007)

3.3.2 If appropriate, analyses and Figures assessing inter-annual variation in the occurrence of a) porpoises and b) dolphins data at the demonstrator site (2005-2011).

3.3.3 Figures showing seasonal (monthly) patterns of occurrence within the MORL and BOWL sites for a) porpoises and b) dolphins. Limited data for 2005-2007 from the demonstrator site. More comprehensive data from July 2009-March 2011 (BOWL) and July 2011 (MORL).

4. Discussion

5. References

6. Data Appendices

Annex 2. Proposed format for report on work carried out under Objectives 3a.

Deliverable 3a. (Objective 3a).

SMRU Ltd will be responsible for writing a report that outlines the acoustic methods used to determine the likelihood that dolphins using the BOWL and MORL sites are likely to be bottlenose dolphins that use the Moray Firth SAC. This will include details of field data collection (written with support from AU), and the development and application of the newly developed software used to identify the dolphin species from recordings of their broadband vocalisations. These data will be discussed in relation to other sources of data on the distribution and movements of bottlenose dolphins using the Moray Firth SAC.

Annex 3. Proposed format for report on work carried out under Objectives 3b.

Deliverable 3b. (Objective 3b).

SMRU Ltd will be responsible for writing a report that outlines the availability of telemetry data, and the strengths and weaknesses of the different datasets in relation to the precision of the techniques used and their temporal coverage. The SSM approach used to account for the different error structures will be described, and the standardised tracking data provided in GIS format. We will outline how mixed GAMMs models are used to provide maps of predicted densities, and provide data in a format that can be incorporated into noise modelling studies. These data will also be used to assess the extent to which harbour seals from the Dornoch Firth SAC are likely to spend time in the BOWL & MORL sites. Data will also be discussed in relation to current knowledge of harbour seal foraging distribution. Some additional work would be required to update discussion of these data in relation to the latest data on seal abundance trends and ecology in the Dornoch Firth and Morich More SAC and nearby Loch Fleet NNR.

Annex C

Ornithology - Autumn 2010
Migration Survey Report

BOAT-BASED MIGRATION SURVEYS

A dedicated migration observer was present on both the R3Z1 and Beatrice survey vessels whilst undertaking the boat-based ESAS surveys during the autumn migration period. These surveys were carried out for R3Z1 on 22nd and 29th September, and 13th, 16th and 31st October, and for Beatrice OWF on 12th and 13th October. These surveys will be repeated in Spring 2011. The protocol used was:

- systematic 360° scanning (including overhead) for birds in flight;
- target species were geese, swans and any raptors;
- secondary target species were seaduck, waders and passerines; and
- data collected were:
  - time of observation (which was used to identify vessel location with the use of the GPS log);
  - species;
  - flock size;
  - flight height (0-5 m, 5-10 m, 10-20 m, 20-200 m, 200-300 m, or 300+ m);
  - flight direction; and
  - distance from vessel (to the nearest 500 m).

COASTAL MIGRATION SURVEYS

Migration observations from four coastal vantage points were undertaken to collect additional flight route data. Observations were carried out over an 8-week period between mid-September and mid-November, on a total of 16 days per vantage point (i.e. an average of 2 days per week). These surveys will be repeated in Spring 2011. The locations for the coastal vantage points were:

- Sarclet Head, 7 km south of Wick (ND350433), to record flights heading from Caithness across the Moray Firth; and
- Duncansby Head (ND406733), to record flights around the coast into the Moray Firth;
- Rosehearty, 7 km west of Fraserburgh (NJ931678) to record flights arriving into north-east Aberdeenshire; and
- Whitehills, 4 km west of Banff (NJ658655) to record flights arriving into the eastern part of the Moray coast.

Locations further west on the Moray coast, or further south-west on the Caithness coast, were not felt necessary as flights were unlikely to occur over these parts of the coast which are either heading towards or have headed from the proposed wind farm developments of MORL and BOWL. The protocol used was:

- systematic 180° scanning (including overhead) for birds in flight, for 6 hours per day (an hour break was taken between each 3-hour stint);
- target species were geese, swans and any raptors;
- secondary target species were seaduck, waders and passerines;
- these surveys were not undertaken in weather conditions which were likely to preclude migration; and
- data collected were:
  - vantage point location;
  - time of observation;
  - species;
  - flock size;
  - flight height (0-20 m, 20-200 m, 200-300 m, or 300+ m);
  - flight direction;
  - distance from observer (to the nearest 500 m); and
  - the recording of flight-lines at the site onto maps which could later be digitised.

The observations on the Caithness coast were organised by Natural Power, and the observations on the Moray coast were organised by RPS Group Ltd. Surveys were coordinated between the four locations to ensure that some observations were carried out concurrently, and where this was the case there was communication between observers so that repeat sightings of the same flock could be identified. Days when a survey vessel was carrying out at-sea bird surveys for either site were prioritised for carrying out the coastal observations, as long as weather conditions were not likely to preclude migration.

Annex D

Underwater Noise Modelling Method Statement

Project Title	Proposed methodology for the modelling of subsea noise impact on marine species for the Beatrice Offshore Wind Farm and Moray Firth Round 3 Zone development
Project Number	E287
Authors	J R Nedwell, A G Brooker and R J Barham
Company	Subacoustech Environmental Ltd
Report Number	E287IR0401
Date of Issue	4th March 2011

This summary report briefly reviews the information available regarding the effect of underwater noise on marine species, discusses the criteria that are available for assessing the likelihood of an adverse impact caused by the noise, and hence presents the intended approach for assessing the impact of subsea noise on marine species (fish, marine mammals and birds) for the Beatrice Offshore Wind Farm and the Moray Firth Offshore Wind Farm projects (BOWL and MORL).

Due to the close proximity of the BOWL and MORL development areas, the two developers have appointed Subacoustech Environmental as the sole specialist advisor for underwater noise modelling and advisory services. The approach will therefore be consistent between the two developments, which will be of particular value to the cumulative impact assessment stage.

The report is split into two sections, comprising a summary of the background considerations relating to the method adopted, and a more detailed discussion of some of the principal technical matters.

Background considerations.

While a detailed discussion of the effects of noise is beyond the scope of this document, a brief description is essential in order to understand the background to the methodology.

In order to understand the importance of any noise generated during an offshore construction programme, it is essential to understand the consequences of the noise. In order to understand the consequences, the effects must be divided into various classes, and a means found to understand the likelihood of that effect occurring as a consequence of the noise. In other words, it is essential to not only be able to predict the likely level of noise during an activity, but also to have a criterion by which the significance of the noise level can be judged. Without a criterion, an estimate of noise is completely useless. The criterion will be different for different effects, and may be expressed in a particular scale of measurement of noise, such as peak pressure, RMS level, impulse, or a more sophisticated measure.

The effects of noise on marine animals may be considered to fall into three categories. These comprise in order of descending severity:

1. **Lethality and physical injury.** At the highest levels of noise, such as may be caused by the use of underwater explosives, sound has the capacity to kill or maim. Injuries tend to be associated with the rapid compression of air containing structures, such as the swim

bladders in fish and the airways of marine mammals. The likelihood of injury or death tends to be associated with the peak pressure and impulse of the noise.

2. **Auditory injury.** At levels of noise below those capable of causing physical injury, damage to hearing may occur as a result of two processes. First, permanent and irreversible auditory trauma may result from a single exposure to noise at a high level. The likelihood of auditory trauma in humans is associated with the peak pressure of the sound, and is known to occur during close exposure to gunfire. Second, accumulative auditory damage may occur as a result of prolonged exposure to noise at lower levels. In humans, accumulative damage has been shown to be related to the energy of the noise. The SEL approach proposed by Southall et al (2007)[1] will be used to estimate the likelihood of auditory damage to classes of marine mammals, and the dB_{ht} approach proposed by Nedwell et al (2007)[2] to estimate the likelihood of auditory damage to individual species of marine mammals and fish.

3. **Behavioural effects.** This range of effects is probably the most misunderstood, yet since they may occur at relatively low levels of noise, they are of critical importance since they always effect very much greater areas than the preceding categories of effects. For the purposes of this document, the authors offer a definition of the behavioural effects of noise as "a change in the behaviour of an animal, caused by exposure to noise". The change in behaviour may be cognitive, that is, involving a conscious decision by the animal, or instinctive, where an animal reacts to a pleasant or unpleasant stimulus. Behavioural effects may also encompass attraction or avoidance. For instance, an animal moving towards and investigating a noise may be considered to be an example of cognitive attraction. An animal fleeing a noise having the characteristics of a predator may be considered to be an example of cognitive avoidance. An animal fleeing an acceptably loud noise may be considered to be an example of instinctive avoidance. The importance of this classification is that cognitive effects may occur at any level of sound that the animal may hear, whereas instinctive effects are believed to be associated with a sensation of "unbearable loudness". All of these effects are however associated with the hearing, and therefore for a criterion to be realistic it must incorporate a measure of hearing acuity. The dB_{ht} of Nedwell has been developed to estimate the likelihood of behavioural effects on individual species of marine mammals and fish; Southall tentatively recommends the SEL as a criterion for single impulsive noises whereas for multiple pulse and non-pulses a qualitative model based on received RMS Sound Pressure Levels is proposed.

It may be commented that even in the case of relatively high noise level sources such as piling, there are practical mitigation strategies which may be used to reduce or eliminate the risk of both physical effects and auditory injury. Consequently, the methodology of this document focuses on

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[1] Southall, Brandon L.; Bowles, Ann E.; Ellison, William T.; Finneran, James J.; Gentry, Roger L.; Greene, Charles R.; Kastak, David; Ketten, Darlene R.; Miller, James H.; Nachtigall, Paul E.; Richardson, W. John; Thomas, Jeanette A.; Tyack, Peter L, (2007) *Marine Mammal Noise Exposure Criteria Aquatic Mammals*, Vol 33 (4).

[2] Nedwell J R, Turnpenny A W H, Lovell J, Parvin S J, Workman R, Spinks J A L, Howell D (2007b). *A validation of the dB_{ht} as a measure of the behavioural and auditory effects of underwater noise.* Subacoustech Report Reference: 534R1231, Published by Department for Business, Enterprise and Regulatory Reform.

behavioural effects, as being by far the most difficult to mitigate, covering the largest area of sea and therefore having the greatest capacity to cause an adverse effect.

Proposed general methodology

It is proposed that the general approach to estimating the levels of subsea noise from offshore wind farm developments is in two phases. Initially, a broad-brush modelling approach will be used to rank order a wide range of offshore wind farm related sources of underwater noise. In the main, the information used to generate this model will come from the very substantial database of recordings of various noise sources made by Subacoustech Environmental over the last 20 years. The model will use an estimate from this database of the typical frequency content, source levels and transmission losses associated with each noise source type. These data will be used to determine the impact of each noise source on the marine environment, by using the estimate of noise level and a suitable criterion for a level above which it will have an effect to estimate the area which is effected by the noise source for each class or species of marine animal.

The rank ordering will allow most of the activities to be eliminated from further consideration, where they are shown to cause negligible adverse effect, and hence allow further consideration to focus on sources of noise that have the capacity to cause a significant adverse effect. The activities that generate the highest noise levels (e.g. impact piling) will require detailed modelling to provide a detailed assessment of the area affected. The results of this detailed modelling will be combined with population and behavioural data to allow biological assessment of the significance of any effects on fish, marine mammals and birds to be determined.

Information required for modelling

All detailed modelling will be tested at all stages against previously measured data and the outputs of all modelling will be validated against existing measured data. By this means, it will be possible to ensure that the modelling is realistic and representative.

At the time of writing, it is anticipated on the basis of experience that the predominant noise source requiring evaluation in the case of the Beatrice Offshore Wind Farm and the Moray Firth Offshore Wind Farm projects. will be that of impact piling for the wind farm foundations. Subacoustech Environmental has developed the powerful INSPIRE model, which enables the noise from impact piling to be accurately predicted. It is intended that this model will be used predicatively to estimate the noise impact of individual piles and guide the construction programme, thus enabling the construction programme to be optimised from noise impact standpoint and hence ensuring adherence to best practice.

In order to determine the level of noise, reliable estimates of the critical parameters that effect the levels of underwater noise produced will be required. Typically for piling these include:

- Pile diameter
- Expected blow forces
- Expected installation time
- Water depths at the piling location and in surrounding waters

It is expected that these will be supplied by the engineering design team. Water depths to a suitable resolution are available as electronic bathymetry data from Seazone or the UKHO.

In order to assess the importance of other noise sources, a list of the types of activity creating the noise and the type of equipment used (trenching, rock placement, dynamically positioned vessels, work boats, seismic survey, etc) will be required, along with the likely duration of each activity.

Where details of the activity are not yet known, a range of scenarios will need to be considered, typically using a "worst case" estimation for each (the Rochdale Envelope approach). In estimating the impact of each source, both the area of sea affected and the duration of the exclusion (i.e., the loss of habitat in square kilometre-days) will be included, in order that the importance of low-level persistent noise sources can be assessed against high-level intermittent sources.

Interaction with other EIA topics

The output of the modelling will be objective physical quantities, including the predicted levels of underwater noise from wind farm activities and the area of sea effected around each noise source. These quantities represent relatively simple physical outputs that can be interpreted from a biological standpoint to assess their significance for fish, marine mammals and diving birds, thus ensuring that biological and acoustic expertise can be combined to provide the most accurate possible estimate of the biological significance of noise.

Details of the noise modelling methodology

The noise modelling will be undertaken in two phases.

Phase 1: rank ordering of noise sources.

The initial stages of the underwater noise modelling will be carried out using a simple yet realistic broad-brush Source Level-Transmission Loss (SL-TL) model. This model will be based on Subacoustech Environmental's substantial database of noise sources to provide an indication of the typical levels of underwater noise generated by wind farm related activities. This model is being developed as part of this project and will allow the significance of a wide range of sources of underwater noise to be rank-ordered for a wide range of marine animals. This information, along with details from the engineering specialists regarding duration of the activities, will then be used by the other EIA specialists in the marine mammal, fish and ornithology sections to determine the overall potential impact for each.

In detail, as sound propagates through water it reduces in level as a result of losses relating to energy dissipation (absorption) and also due to the sound energy simply spreading over a wider area (geometric spreading). Typically, a source of underwater noise is quantified in terms of a Source Level (SL), which is the level of sound energy released by the source, usually described as the level of underwater noise at a range of 1 m from the source. In order to characterise the rate at which energy is lost a value for the Transmission Loss (TL) is often given. The level at a particular point in the water space to which an animal is subjected, the Received Level (RL), is in logarithmic terms the Source Level minus the Transmission Loss.

$$RL = SL - TL \qquad \text{eqn. 1}$$

Over short distances, absorption effects have little influence on the Transmission Loss and can often be ignored, and in this case and over a defined spread of range it is reasonably accurate to use a linear fit of the form

$$RL = SL - N \log r \qquad \text{eqn. 2}$$

where N is generally characterised as being a term associated with the spreading of sound. The Source Level itself may be quoted in any physical quantity, for instance, a piling source may be expressed as having a "peak to peak Source Level of 200 dB re 1 µPa @ 1m". It may be also specified in terms of a frequency weighted level for a particular animal species or class, allowing the "loudness" or effect of the sound to be evaluated. This approach is inherent in both the Nedwell dB_{ht} formulation and the Southall SEL approach.

It will therefore be appreciated that this simple model has been chosen in the main because it is pan-specific, that is, able to evaluate the significance of the noise for a wide range of marine animals having greatly varying acuity of hearing, and frequency range over which they can hear. This is critical to any realistic investigation, because noise sources with a significant content of high frequency noise will tend to selectively effect high frequency hearers such as the harbour porpoise, while sources with a significant content of low-frequency will tend to affect low-frequency hearers such as fish. The effect of any given noise source may therefore be greatly different for different species, and it is therefore essential to use a modelling process that considers the hearing acuity of the effected species.

Although the formulation is simple, obtaining accurate values to insert into it from actual data from a wide range of experimental measurements processed into a large range of animal types is both complex and onerous. For instance, it is often not realised that, since the value of Source Level quoted for a particular source is obtained by extrapolation; the value will depend on the model that is used to perform the extrapolation. Figure 1 illustrates this point. The diagram illustrates a set of measurements made of the noise from piling. In the simplest case, in order to draw conclusions about the data, it may be fitted to a straight-line model; this is shown in the figure by the green line. Such a model effectively assumes that the noise level attenuates only as a result of geometric spreading. This however will generally over-estimate the level for low and high ranges, since it ignores the effects of absorption of the noise. An improved model, including absorption, is represented by the red line and gives a better fit to the data, and indeed this simple form is usually adequate for modelling sound propagation from a source in deep water of roughly constant depth. However, in the case of relatively shallow coastal waters, where the proposed project is situated, the depth may rapidly fluctuate between shallow water of a few metres and deep water of tens of metres or more. In these circumstances, the Transmission Loss becomes a more complex function of depth that depends heavily on the local bathymetry and hence should ideally be calculated using a more sophisticated model, such as INSPIRE. Where these effects are included, as illustrated by the blue line, yet another value of Source Level may result; typically lower levels of noise may be predicted near to the noise source.

The variation in estimates of Source Level for the same dataset, when analysed in different ways, indicates how Source Level will in general be a function of the model that is used to express the noise levels. For the purposes of the methodology of this assessment, the initial rank ordering of noise sources undertaken in phase 1 will use a simple straight-line formulation. However, for the detailed analysis of phase 2, the INSPIRE model will be used to offer sophisticated and more accurate estimates of the noise.

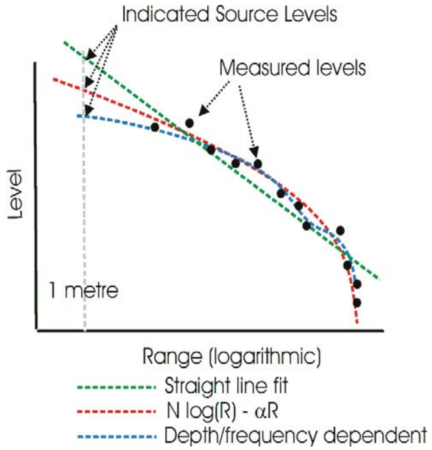

Figure 1 – Differences in Source Level estimation based on various models

The simple model will also take into account variations in the parameters affecting the noise level. For instance, currently available information suggests that the level of underwater noise from impact piling operations is closely related to the pile size, with sound levels increasing with pile size. The blow force applied to the pile also influences the noise levels produced; however, typically, blow forces also increase with pile size so these two factors are actually interdependent. The INSPIRE model also takes this into account via an inbuilt source function, but in the simple model it is intended to add this explicitly.

As an example, Figure 2 shows a summary of Source Levels extrapolated from measured data on a number of impact piling operations using various pile sizes. It can be seen that as the diameter of the pile increases, the source level also increases, although it may be commented that two results that underlie the general curve for small pile diameters are now believed to be anomalous. These Source Level data will be used as an input to the simple model to provide a reasonably accurate estimation of the sound energy generated by striking of different sized piles. This is adequate for the purposes of ranking the significance of the various noise sources required in phase 1. However, the subsequent estimates of phase 2 will use the highly accurate INSPIRE model to provide detailed analysis.

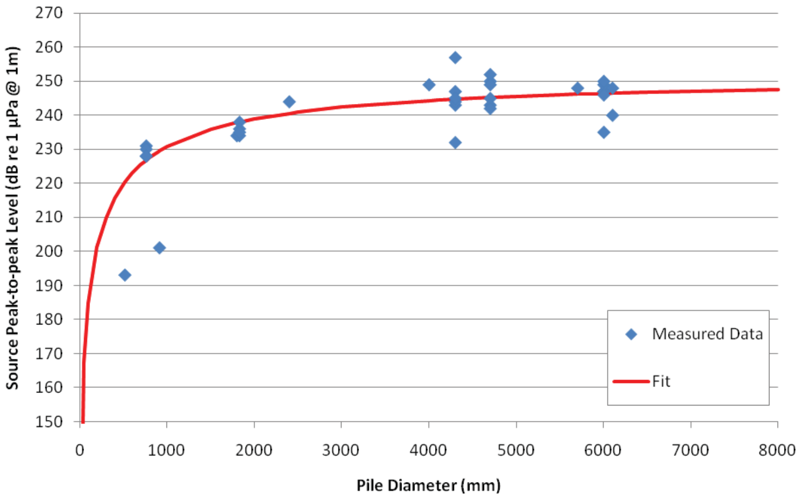

Figure 2 - Plot showing the asymptotic best fit to source level calculated from measured piling noise data for various pile sizes

In summary the initial ranking process will be based on a simple yet representative model which will enable the impact of a wide range of noise sources on a range of marine species to be evaluated in terms of the noise level, area affected and duration of activity. This process will be undertaken in consultation with the other EIA specialist areas.

It is envisaged that the information provided by this model will be capable of eliminating many of the construction activities from further consideration as they will be indicated to have a negligible risk of causing environmental impact. Phase 2 of the modelling programme will then use a more sophisticated model (INSPIRE) to provide detailed information on the noise levels from the highest level noise sources (e.g. impact piling)

Phase 2: Detailed noise modelling and guidance to engineering process.

Both developers are currently considering the use of impact piling to install foundations for the turbines and ancillary structures. Impact piling is known to generate high levels of underwater noise that can be potentially harmful to marine species (see for example Nedwell et al (2007)[3], Parvin et al (2007)[4]). It is therefore anticipated at this stage that the detailed modelling carried out in phase 2

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[3] Nedwell J R, Parvin S J, Edwards B, Workman R, Brooker A G and Kynoch J E (2007) *Measurement and interpretation of underwater noise during construction and operation of offshore windfarms in UK waters.* Subacoustech Report No. 544R0738 to COWRIE Lts. ISBN: 978-09554279-5-4.

[4] Parvin S J, Nedwell J R and Harland E (2007). *Lethal and physical injury of marine mammals, and requirements for Passive Acoustic Monitoring.* Subacoustech Report 565R0212, report prepared for the UK Government Department for Business, Enterprise and Regulatory Reform.

will need to concentrate on the potential impact of underwater noise from impact piling operations. On the basis of initial considerations, it is not thought that any of the other potential noise sources are likely to be of great significance, although this remains to be demonstrated by phase 1.

Where the level of noise is high, it is important to form an accurate estimate of its likely level such that its impact can be accurately assessed. There are a variety of acoustic models for underwater noise propagation in coastal and offshore regions as a result of military interests. However, the authors are not aware of any underwater broadband noise propagation models suitable for the much shallower environments typical of wind farm construction, or for the highly impulsive time histories encountered from impact piling. In these environments and with these source types there is a greater capacity for underwater sound to interact with absorptive processes in the seabed, resulting in propagation losses which typically increase with frequency but decrease with depth.

The Impulse Noise Sound Propagation and Impact Range Estimator (INSPIRE) model has been developed specifically to model the propagation of impulsive broadband underwater noise in shallow waters. It uses a combined geometric and energy flow/hysteresis loss model to conservatively predict propagation in relatively shallow coastal water environments, and has been tested against actual results from a large number of other offshore wind farm piling operations. A statistical package currently in development and due for release later in the year will also allow error bars to be assigned to the estimates. In addition, a "fleeing animal" model is being developed, which will enable the noise dose of an animal as it is moving away from a piling operation to be calculated. The model is able to provide a wide range of physical outputs, including the peak pressure, impulse, SEL, dB_{ht} etc. of the noise. Transmission Losses are calculated by the model on a fully range and depth dependent basis. The INSPIRE model imports electronic bathymetry data as a primary to determine the transmission losses along transects extending from the pile location input in addition to other simple physical data.

In the current version of the model, sound fields are generated on a high-resolution basis which is suitable as an output for detailed biological analysis. However, as a result of discussions during the early stages of the project, a stripped-down version of the INSPIRE model has also been generated, which can provide an output in a matter of a few minutes, and will be used during face-to-face meetings with engineering staff to guide the initial formulation of the construction plan. The authors are not aware of any other project in which environmental considerations relating to underwater noise have been built in to the engineering process at this relatively early stage.

In phase 2 the INSPIRE model will be used to assess in detail the range which fatality and physical injury, auditory injury and behavioural avoidance is likely to occur, for a range of animal species and classes. Each of these effects will be assessed in the EIA using the best available guidance, which for convenience is outlined below.

Physical injury and fatality

The data currently available relating to the levels of underwater noise likely to cause physical injury or fatality are primarily based on studies of blast injury at close range to explosives, with an additional small amount of information on fish kill as a result of impact piling. All the data concentrates on impulsive underwater noise sources as other sources of noise are rarely of a sufficient level to cause these effects.

Parvin *et al* (2007) presents a comprehensive review of information on lethal and physical impacts of underwater noise and proposes the following criteria to assess the likelihood of these effects occurring;

- Lethal effect may occur where peak to peak levels exceed 240dB re 1µPa; and
- Physical injury may occur where peak to peak levels exceed 220dB re 1µPa.

Although some evidence indicates that very small fish (<0.01g) may suffer injury at lower levels than these, the above criteria will be used to assess these effects on fish and marine mammals.

Auditory Damage

Parvin *et al*., (2007) also suggests that for continuous sound, direct injury to gas-containing structures or auditory mechanisms may occur at lower incident sound levels depending on duration and frequency content of the noise. Several studies have been carried out relating to the onset of auditory damage in terms of Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS) (see, for example Nedwell *et al*., (2007)[5] and Southall *et al*., (2007)[6] for a review of these studies). Nedwell *et al*., (2007) suggests the use of species specific weighting metrics (the dB_{ht}) similar to the approach used to assess human response to noise. The study suggests a criterion for instantaneous hearing damage that is similar to that used for humans, where levels of exposure exceeding 130 dB_{ht}(*species*) are likely to cause traumatic injury in a very short exposure time. This approach takes into the account the varying sensitivity and hearing abilities of marine species.

Southall *et al*., (2007) present another set of criteria for the levels of "pulsed" and "non-pulsed" underwater noise that may cause auditory injury to marine mammals based on the M-weighted Sound Exposure Level (SEL) and peak Sound Pressure Level. These criteria are presented in Table 1. In order to obtain the weighted sound exposure levels the data are first filtered using the proposed filter responses presented in Southall *et al*., (2007) for either high, low or mid-frequency cetaceans or pinnipeds in water, then the sound exposure level is calculated. Table 2 presents a summary of the various marine mammal groups, the suggested frequency range of hearing of each and example species.

It should be noted with regard to the below criteria that the Sound Pressure Level values are based on the peak pressure assumed to elicit TTS plus 6 dB and the Sound Exposure Level values are based on the SEL level assumed to elicit TTS plus 15 dB.

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[5] Nedwell J R, Turnpenny A W H, Lovell J, Parvin S J, Workman R, Spinks J A L, Howell D (2007). *A validation of the dB_{ht} as a measure of the behavioural and auditory effects of underwater noise.* Subacoustech Report Reference: 534R1231, Published by Department for Business, Enterprise and Regulatory Reform.

[6] Southall, Brandon L.; Bowles, Ann E.; Ellison, William T.; Finneran, James J.; Gentry, Roger L.; Greene, Charles R.; Kastak, David; Ketten, Darlene R.; Miller, James H.; Nachtigall, Paul E.; Richardson, W. John; Thomas, Jeanette A.; Tyack, Peter L, (2007) *Marine Mammal Noise Exposure Criteria Aquatic Mammals*, Vol 33 (4).

	Sound Type		
Marine mammal group	**Single pulses**	**Multiple pulses**	**Nonpulses**
Low frequency cetaceans			
Sound Pressure Level	230 dB re. 1 µPa (peak)	230 dB re. 1 µPa (peak)	230 dB re. 1 µPa (peak)
Sound Exposure Level	198 dB re. 1 µPa^2-s (M_{lf})	198 dB re. 1 µPa^2-s (M_{lf})	215 dB re. 1 µPa^2-s (M_{lf})
Mid frequency cetaceans			
Sound Pressure Level	230 dB re. 1 µPa (peak)	230 dB re. 1 µPa (peak)	230 dB re. 1 µPa (peak)
Sound Exposure Level	198 dB re. 1 µPa^2-s (M_{mf})	198 dB re. 1 µPa^2-s (M_{mf})	215 dB re. 1 µPa^2-s (M_{mf})
High-frequency cetaceans			
Sound Pressure Level	230 dB re. 1 µPa (peak)	230 dB re. 1 µPa (peak)	230 dB re. 1 µPa (peak)
Sound Exposure Level	198 dB re. 1 µPa^2-s (M_{hf})	198 dB re. 1 µPa^2-s (M_{hf})	215 dB re. 1 µPa^2-s (M_{hf})
Pinnipeds (in water)			
Sound Pressure Level	218 dB re. 1 µPa (peak)	218 dB re. 1 µPa (peak)	218 dB re. 1 µPa (peak)
Sound Exposure Level	186 dB re. 1 µPa^2-s (M_{pa})	186 dB re. 1 µPa^2-s (M_{pa})	203 dB re. 1 µPa^2-s (M_{pa})

Table 1 Proposed injury criteria for various marine mammals groups (after Southall et al., 2007)

Functional hearing group	Estimated auditory bandwidth	Genera represented	Example species
Low frequency cetaceans	7 Hz to 22 kHz	Balaena, Caperea, Eschrichtius, Megaptera, Balaenoptera (13 species/subspecies)	Gray whale, Right whale, Humpback whale, Minke whale
Mid frequency cetaceans	150 Hz to 160 kHz	*Steno, Sousa, Sotalia, Tursiops, Stenella, Delphinus, Lagenodelphis, Lagenorhynchus, Lissodelphis, Grampus, Peponocephala, Feresa, Pseudorca, Orcinus, Globicephala, Orcaella, Physeter, Delphinapterus, Monodon, Ziphius, Berardius, Tasmacetus, Hyperoodon, Mesoplodon* (57 species/subspecies)	Bottlenose dolphin, striped dolphin, killer whale, sperm whale
High frequency cetaceans	200 Hz to 180 kHz	*Phocoena, Neophocaena, Phocoenoides, Platanista, Inia, Kogia, Lipotes, Pontoporia, Cephalorhynchus* (20 species/subspecies)	Harbour porpoise, river dolphins, Hector's dolphin
Pinnipeds in water	75 Hz to 75 kHz	*Arctocephalus, Callorhinus, Zalophus, Eumetopias, Neophoca, Phocarctos, Otaria, Erignathus, Phoca, Pusa, Halichoerus, Histriophoca, Pagophilus, Cystophora, Monachus, Mirounga, Leptonychotes, Ommatophoca, Lobodon, Hydrurga,* and *Odobenus* (41 species/subspecies)	Fur seal, harbour (common seal), grey seal

Table 2 Functional marine mammal groups, their assumed auditory bandwidth of hearing and genera presented in each group (reproduced from Southall et al (2007))

Behavioural response

At levels lower than those that cause auditory injury, noise may nevertheless have important behavioural effects on a species, of which the most significant is avoidance of an area around the source. The significance of the effect requires an understanding of its consequences; for instance, avoidance may be significant if it causes a migratory species to be blocked, delayed or diverted. However, in other cases, if the noise merely causes the movement of species from one area to another, it may be of no consequence. Similarly, where the avoidance causes a significant proportion of the foraging area of an animal to be excluded to it, the noise may have a significant impact.

The physical and auditory injury effects of noise occur at relatively short distances from a noise source and effect relatively small areas of sea. While the possibility of an unlucky individual straying into this area around the piling operation cannot be excluded, the physical effects are relatively easily mitigated by approaches such as soft start, acoustic mitigation devices, and the use of MMOs. By contrast, since behavioural effects can occur at ranges of tens of kilometres, effective mitigation is difficult and accurate assessment of the likelihood of an effect is essential.

Various metrics have been proposed to assess the possibility of auditory damage and behavioural avoidance response occurring to marine species.

Estimates of behavioural effect based on the dB_{ht} criteria.

On the basis of a large body of measurements of fish avoidance of noise (Maes *et al,* 2004), and from re-analysis of marine mammal behavioural response to underwater sound, the dB_{ht} was developed to assess the potential impact of the underwater noise on marine species, and published by the Department of Business, Enterprise and Regulatory Reform (BERR) (Nedwell *et al,* 2007b). The concept of the dB_{ht} is very simple, although it should be commented that the calculation of the values is computationally onerous. In essence, the approach may be considered to be a generalisation of the dB(A) used to estimate the effect of noise on humans. The only significant difference lies in the use of various weighting curves that are related to the hearing abilities of individual species; this is the reason that the specific name must be appended to a value, since a given noise will have a different value for different species with different hearing abilities. A significant advantage of the approach is that where the audiogram of the species is known, or can be estimated, and accurate assessment of the "loudness" of a given noise may be made for any species. The approach is therefore particularly valuable in assessing the likelihood of a behavioural response,

Level in dB_{ht}(species)	**Effect**
0 – 50	Low likelihood of disturbance
75 and above	Mild avoidance reaction by the majority of individuals but habituation or context may limit effect
90 and above	Strong avoidance reaction by virtually all individuals
Above 130	Possibility of traumatic hearing damage from single event

Table 3 Assessment criteria used in this study to assess the potential impact of underwater noise on marine species

Conceptually, the approach is illustrated in Figure 3, in which the same noise spectrum is perceived at a different loudness level depending upon the particular fish or marine mammal receptor. The figure illustrates the spectrum of a source; overlaid over this are representations of the audiograms (threshold of hearing) of three typical marine animals. The portion of the noise that can be heard is therefore represented by the 'hatched' region in each case. It may be noted that the receptors also hear different parts (components) of the noise spectrum. In the case shown, Fish 1 has the poorest hearing (highest threshold) and only hears the noise over a limited low frequency range. Fish 2 has very much better hearing and hears the main dominant components of the noise. Although having the lowest threshold to the sound, the marine mammal only hears the very high components of the noise, and so in this case it may be perceived by that animal as relatively quiet.

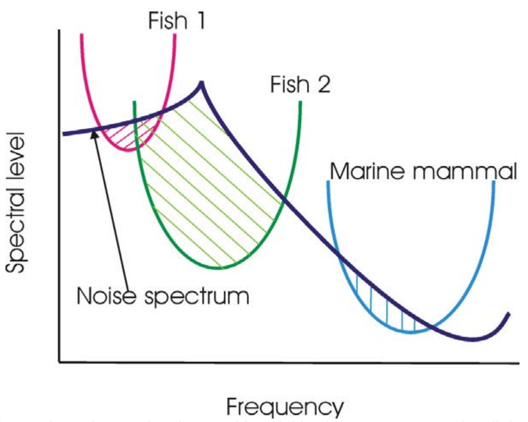

Figure 3. Illustration of perceived sound level (dB_{ht}) for representative fish and marine mammal species.

It will be realise that any given sound will inevitably be perceived differently by different species, since they have differing hearing abilities. Consequently, in dB_{ht} analysis, the species name must generally be appended when specifying a level. For instance, the same sound might have a level of 70 dB_{ht} (*Gaddus morhua*) for a cod and 40 dB_{ht} (*Salmo salar*) for a salmon.

It will be noted that the perceived noise levels of sources measured in dB_{ht} (species) are usually much lower than the unweighted (linear) levels, both because the sound will contain frequency components that the species cannot detect, and also because most aquatic and marine species have high thresholds of perception (are relatively insensitive) to sound.

Subacoustech has recently carried out a review of a substantial body of public domain literature relating to the impacts of underwater noise on marine species. This review will be available soon, however, the data indicate a high level of agreement between the dB_{ht} behavioural avoidance criteria and the observed reactions of marine species to underwater noise presented in the studies.

Fish and marine mammal hearing

The hearing sensitivity of an animal is specified by their audiogram, upon which the dB_{ht}(*species*) analysis is based. Table 5 presents a generalised summary of the hearing abilities of fish and marine mammals. As mentioned, there is a considerable variation even within these groups, however, this does provide an indication of the typical frequencies and levels that species are able to perceive.

Species group	Typical frequency range	Lowest threshold level	Frequency of peak sensitivity	Example species
Fish – hearing specialists	30 Hz – 4 kHz	75 dB re. 1 μPa	30 Hz – 1 kHz	herring (*Clupea harengus*), sprat (*Sprattus sprattus*)
Fish – hearing generalists	30 Hz – 400 Hz	95 – 118 dB re. 1μPa	100 – 200 Hz	Dab (*Limanda limanda*), cod (*Gadus morhua*)
Cetaceans	100 Hz – 170 kHz	40 dB re. 1 μPa	20 – 150 kHz	Harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncates*)
Pinnipeds	100 Hz – 128 kHz	60 dB re. 1 μPa	10 – 40 kHz	Common (harbour) seal (*Phoca vitulina*), grey seal (*Halichoerus grypus*)

Table 5 Summary of typical hearing sensitivity data for species of fish and marine mammals

Where good quality audiogram data for a species does not exist or is not available, it is possible that the audiogram data for another surrogate species having a similar hearing morphology may be used to provide an indicative assessment of potential impact. The surrogate audiogram data is usually selected on the basis of having similar auditory morphology, and therefore hearing abilities, as the species of interest. A surrogate may also be used to provide a conservative estimate of potential impact ranges by selecting a suitable representative audiogram for a species having sensitive hearing, that is, the lowest auditory threshold.

Table 6 presents a summary of the species which will be considered in the MORL and BOWL EIAs along with the availability of good quality audiogram data and use of surrogates.

Species common to area	Audiogram available?	Surrogate used	Comments	Reference
Grey seal	Partial – only upper frequencies	Harbour seal	No single audiogram dataset covering full audiometric range available. Data from two studies used	Kastak and Schusterman (1998) Mohl (1968)
Common (harbour) seal	Yes	-	No single audiogram dataset covering full audiometric range available. Data from two studies used	
Harbour porpoise	Yes	-	-	Kastelein (2002)
Minke whale	No	None	No surrogate data available for large mysticetes	-
Killer whale	Yes	-	-	Szymanski *et al*., (1999)
Risso's dolphin	Yes	Striped dolphin	Existing audiogram data indicates higher threshold than other dolphin species but high background noise levels during audiogram tests	Risso's dolphin – Nachtigall *et al*., (1995) Striped dolphin – Kastelein (2003)
White-sided dolphin	No	Bottlenose dolphin	Audiogram data suggest bottlenose dolphin are most sensitive dolphin species to sound so may provide conservative indication of impacts	Johnson (1967)
White beaked dolphin	Partial – only upper frequencies	Striped dolphin	Partial audiogram data for white-beaked dolphin indicates close match to striped dolphin data	White beaked dolphin – Nachtigall *et al*., 2007 Striped dolphin - Kastelein (2003)
Bottlenose dolphin	Yes	-	-	Johnson (1967)
Herring	Yes	-	-	Enger, 1967
Plaice	No	Dab		Chapman and Sand (1974)
Whiting	No	Cod	Of the same taxonomical family as cod so the audiogram data for cod is the best available information on which to base the impact assessment for this species.	
Cod	Yes	-	-	Chapman and Hawkins (1973)
Salmon	Yes	-		Hawkins and Johnstone (1978)
Trout	No	Salmon		Hawkins and Johnstone (1978)
Guillemot			See below section on assessment of underwater noise impact on diving birds	
Razorbill			See below section on assessment of underwater noise impact on diving birds	
Puffic			See below section on assessment of underwater noise impact on diving birds	
Gannet			See below section on assessment of underwater noise impact on diving birds	
Arctic turn			See below section on assessment of underwater noise impact on diving birds	

Table 6 Summary of species considered in this study and availability of audiogram data or suitable surrogates

Ornithology

While in principle there is no reason that the dB_{ht} approach should not be applied to the exposure of diving birds to noise underwater, the approach is particularly challenging as there is currently no audiogram available for submerged birds, and hence no direct indication of their sensitivity to underwater sound.

We would therefore propose to take the following approach to assess the impact of underwater noise on diving birds:

- Figure 4 indicates the average bird audiogram in air (after Dooling, 2002)[7]. This indicates that the bird hearing process is typical of terrestrial animals, with a maximum sensitivity in the low kHz region. It may be seen that the peak sensitivity is slightly higher than human sensitivity; however the basic hearing process is by tympanic conduction and hence similar to human hearing.
- Other average audiograms are available for other groups of birds (Passeriformes and Strigiformes); this particular audiogram is for species of birds that Dooling, (2002) refers to as "not of the order Passeriformes or Strigiformes". This group includes one species of the order Charadriiformes, which includes Guillemots, Razorbills and Puffins. We would welcome further discussion on the suitability of this choice, however, for the purposes of this advisory note the grouped average audiogram is presented.

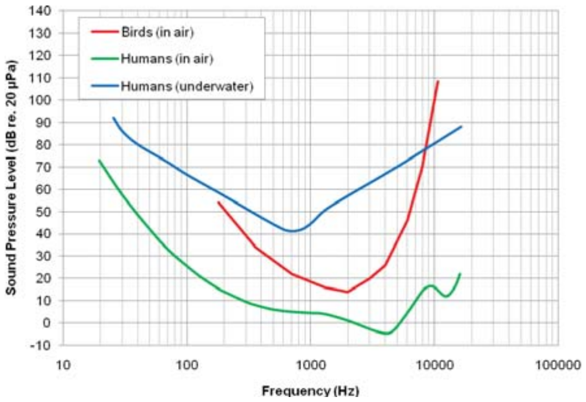

Figure 4 – A comparison between audiograms for humans in air and underwater and for an average bird in air

- The audiogram for human hearing in both air and water is also shown on Figure 4 (Parvin and Nedwell, 1995)[8]. These data indicate that there is a reduction in sensitivity to sound in a submerged human when compared to human hearing in air. This is because the water mass loads the tympanum, reducing the sensitivity of the tympanic hearing route. At high frequencies, hearing occurs by direct bone conduction.
- The underwater human hearing weighting curve (termed the dB(UW)) has been shown to be closely associated with the degree of impact of underwater sound on human divers, and it is interesting that the criterion that is used for unacceptable noise level is the same as that used by the authors of this report for more general application to the impact of underwater noise on marine animals. At the levels of 90 dB above the human submerged hearing threshold (i.e. dB_{ht}), sound is judged to be "unacceptable" by a majority of human divers.
- To apply these results to the case of diving birds, it is hypothesised that the same degree of sensitivity reduction to the average bird audiogram as is seen in human hearing is also likely to occur in diving birds under water. It is therefore proposed to use this as a "correction factor" to convert the average terrestrial audiogram of birds to an equivalent underwater hearing audiogram. In order to undertake this process, it is intended to non-dimensionalise the frequency based on the peak hearing sensitivity in air.
- This would generate an effective underwater generic bird audiogram, which would then be used in dB_{ht} analysis, subject to a 90 dB_{ht} criterion for unacceptable noise level, as has been done for fish and marine mammals, to provide indicative impact ranges for diving birds for wind farm related activities.

It should be noted that the study undertaken by Parvin and Nedwell is the only comparison of its type. In-air and underwater audiograms are available for various species of seal, however, as seals spend large amounts of time underwater, it is unlikely that this will give a meaningful comparison to species of birds; which, like humans, are primarily only exposed to terrestrial sound. Therefore, it is thought that the human hearing data will provide better guidance on submerged bird hearing.

Estimates of behavioural effect based on the Southall SEL criterion

Southall *et al*., (2007) also discuss the levels of underwater noise that may cause a behavioural avoidance response in marine species. Numeric criteria are provided for behavioural disturbance assessment for single pulse sound sources which are based on the level of underwater noise that the evidence presented in Southall et al (2007) indicate will be likely to cause TTS. The assumption upon which this is based being that a significant behavioural disturbance will occur at levels high enough to cause TTS as communication and/or detection capabilities will be interfered with. It may be commented that whereas the use of an SEL criterion for indicating the possibility of auditory injury in classes of marine mammals may well have utility, it is difficult to understand how it might provide an adequate criterion for behavioural effects. For instance, a human exposed at a sound pressure level of 75 dB(a) for eight hours, or 110 dB(A) for 10 seconds, both receive the same SEL value. It is clear that while the former is comparable with the levels of noise in a noisy office, and unlikely to cause a behavioural effects, the latter would be judged deafeningly loud by most people.

However, the study also concludes that the currently available evidence does not support the development of specific numeric criteria for the levels of underwater noise likely to cause a behavioural avoidance response for multiple pulse (i.e. impact piling) and non-pulsed noise sources. Instead, a severity scale is developed to rank the effects of a source of underwater noise in terms of the observable behavioural response. The findings of this study are used as the basis for the Joint Nature Conservation Committee (JNCC) guidance document on the deliberate

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[7] Dooling R. (2002). *Avian Hearing and the Avoidance of Wind Turbines.* National Renewable Energy Laboratory, NREL/TP-500-30844. p4. Available at: http://www.nrel.gov/wind/pdfs/30844.pdf

[8] Parvin S J and Nedwell J R. (1995). *Underwater Sound Perception and the Development of an Underwater Noise Weighting Scale.* Journal of the Society for Underwater Technology 21(1), 1995.

disturbance of marine mammals (JNCC, 2010)[9]. In the document the various severity ratings are summarised as "relatively minor and/or brief, score 0-3; with higher potential to affect feeding, reproduction, or survival, score 4-6; and considered likely to affect these life functions, score 7-9". It is also noted that the timescales over which a noisy activity may occur may be of significance. If an avoidance reaction lasts for less than 24 hours and does not occur again in subsequent days, it may not be considered to have caused a significant avoidance response, whereas an activity causing an avoidance response over a longer period would. Generally the guidance indicates that there is a greater risk of a disturbance offence being committed if the observable effect ranks as 5 or above on the Southall *et al*., (2007) severity scale.

Whereas this is useful in the context of observing behavioural response in marine species during an activity, it is difficult to quantify the potential for a behavioural avoidance response to occur in a predictive exercise such as this study. Table 4 below extracts a summary of the information presented in Southall *et al* (2007) for various levels of underwater noise from continuous noise sources and the behavioural avoidance responses that may result based on the studies reviewed by Southall *et al* (2007). These descriptions have been used to estimate the potential for behavioural avoidance to occur in marine mammals.

Group	RMS Received Level (dB re. 1 µPa)	Quoted description of associated behavioural response
Low frequency cetaceans	120 – 160	Increasing probability of disturbance
Mid frequency cetaceans	90 – 120	Individuals in the field showed behavioural response with high severity scores.
	120 – 150	Individuals in the field failed to show behavioural response
	170	Exposures in captive setting fail to induce a behavioural response
High frequency cetaceans	140	Profound and sustained avoidance responses
Pinnipeds	90 – 140	Generally do not appear to induce a strong behavioural avoidance response in pinnipeds

Table 4 Summary of behavioural avoidance responses and associated levels from Southall et al (2007)

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[9] Joint Nature Conservation Committee (JNCC), Natural England and Countryside Council for Wales. (2009). *The protection of marine European Protected Species from injury and disturbance: Guidance for the marine area in English and Wales and the UK offshore marine area.* March 2010.

Modelling output

The output of the modelling will be in terms of contour plots indicating areas of equal loudness, similar to weather surface pressure charts or mapping. An example of the output is shown below. In this example the data are presented in terms of unweighted peak to peak levels but data will also be presented in terms of the other metrics discussed above.

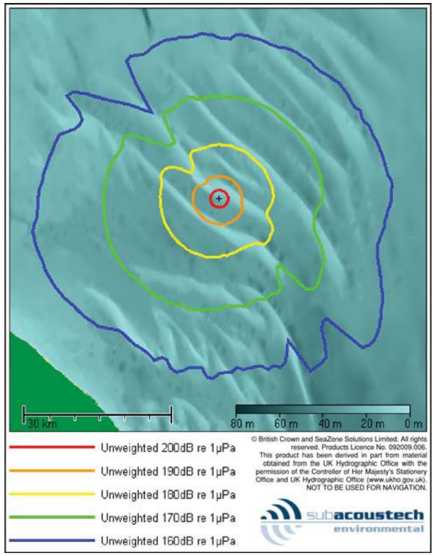

Figure 5 Typical example of the data output from the INSPIRE subsea propagation model

Cumulative impact assessment

The assessment methodology for the cumulative impact assessment will be based on the same modelling and analysis procedures that will be used in the broader EIA process.

- The broad-brush Source Level-Transmission Loss model will be used to provide information on the noise levels associated with a variety of wind farm related sources, and the range at which a behavioural effect may occur estimated. It is expected that the majority of sources will be of sufficiently low level that there will be no intersection of these zones with each other. In this case, the noise sources may be considered to be independent.
- It is envisaged that this process will however identify simultaneous impact piling operations as the key source of cumulative impact to marine species, with a significant probability of the zones of impact of two separate piling operations converging.
- Subsea noise propagation modelling will then be carried out using the proprietary noise propagation model, INSPIRE, to estimate the ranges of impact for typical simultaneous piling operations.

- The extent of cumulative impacts will be assessed based on the overlap of impact zones and the cumulative noise energy within the intersection.
- In order to conform to the assessment requirements for the EU Habitats Directive relating to the deliberate disturbance to marine mammals, the impact zones will be based on both the M-weighted Sound Exposure Level model10 as per the JNCC guidance and also the dB_{ht}(*species*) as the two principal metrics currently available for assessing the impact of underwater noise.
- This assessment will yield as an output objective, quantitative results which may be compared to marine mammal, fish and diving bird population, spawning and migration route data, allowing the overall cumulative impact to be assessed based on the overall effect of the noise on these key areas. It is anticipated that this will be carried out by the relevant biological specialists in each area.

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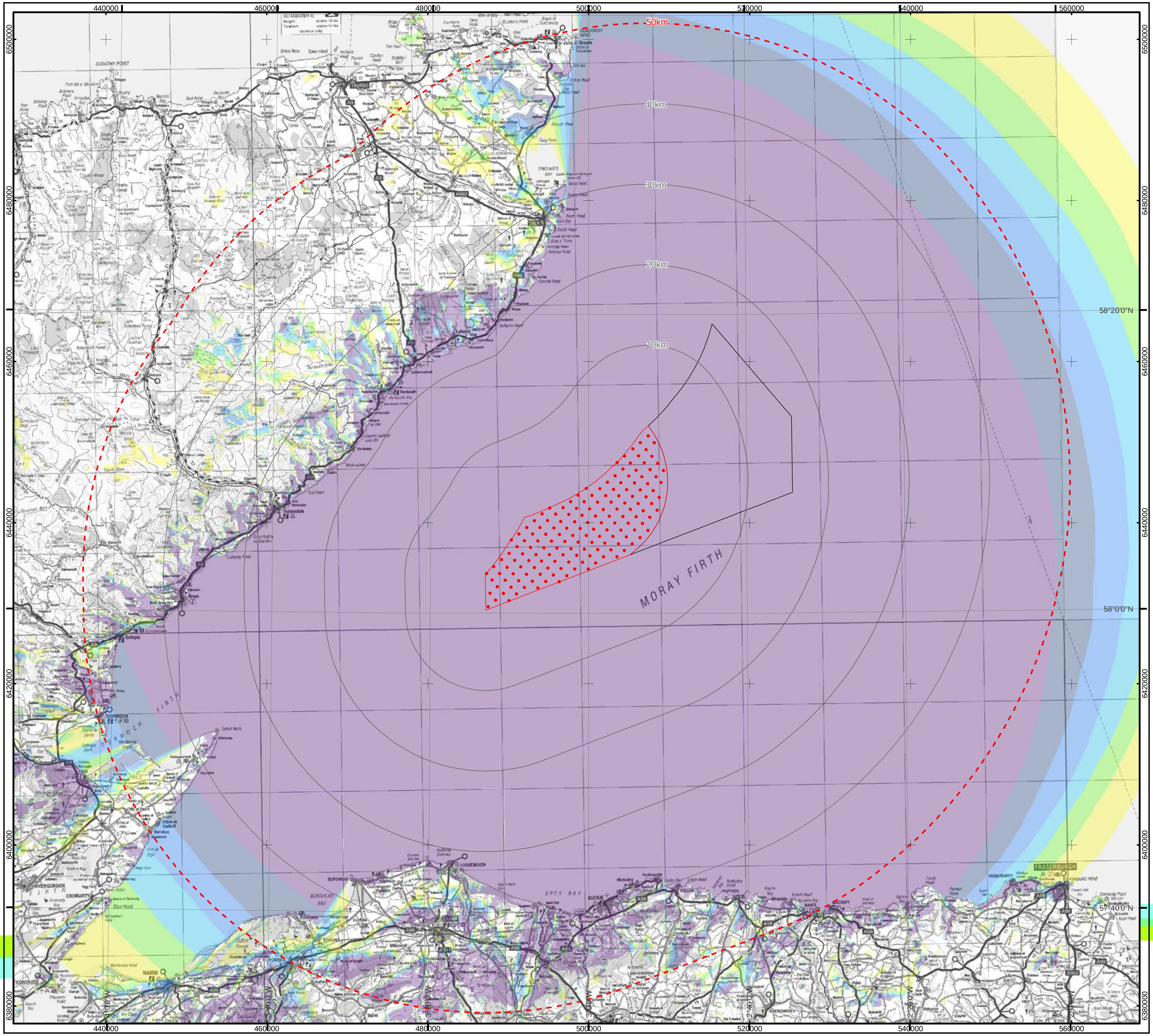
[10] Southall, Brandon L.; Bowles, Ann E.; Ellison, William T.; Finneran, James J.; Gentry, Roger L.; Greene, Charles R.; Kastak, David; Ketten, Darlene R.; Miller, James H.; Nachtigall, Paul E.; Richardson, W. John; Thomas, Jeanette A.; Tyack, Peter L, (2007) *Marine Mammal Noise Exposure Criteria Aquatic Mammals*, Vol 33 (4).



edp renewables

Moray Offshore Renewables Ltd

KEY

- ● Scoping Turbine Layout
- 🟥 Western Development Area
- ☐ 10km Radii
- ▨ 50km Study Area
- ☐ Eastern Development Area

Blade Tip ZTV

No. of Blade Tips Visible

- ☐ 0
- 🟨 1 - 30
- 🟩 31 - 60
- 🟦 61 - 90
- 🟦 91 - 120
- ▨ 121 - 150
- 🟪 151 - 159

Note:
Although there are 159 turbines shown here, there will only be a maximum of 90 turbines within the WDA. For the purposes of this ZTV and in order to provide an indication of the maximum extent of visibility regardless of the turbines' geographic location within the WDA, this ZTV has been created assuming the site is filled with turbines at the minimum spacing (1,050 x 1,200 m). It should also be noted that reduced spacing between the perimeter turbines is being considered for the WDA but these are not included within this indicative ZTV.

Blade Tip:	272m	Observer height:	2m
DTM:	OS T50	Surface features:	Excluded
DTM resolution:	50m	Earth curvature:	Included

Horizontal Scale: 1:450,000 A3 Chart

0 9,000 18,000 Meters

N

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: TH
Reviewed: SM
Approved: SM

Date: 10/05/2016 Revision: A

REF: 8460001-PQW0010-OPE-MAP-001

Figure 4.5-1
Blade Tip ZTV

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