MORAY EAST
OFFSHORE WINDFARM

Decommissioning of the Meteorological Mast Environmental Report

Moray East Offshore Wind Farm

July 2020

Moray Offshore Windfarm (East) Limited

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List of Abbreviations

ACFM	Alternate Current Field Measurement
AEZ	Archaeological Exclusion Zones
AIS	Automatic Identification System
BAP	Biodiversity Action Plan
BEIS	Department for Business, Energy & Industrial Strategy
CD	Chart Datum
CI	Confidence Interval
CIEEM	Chartered Institute of Ecology and Environmental Management
CRRU	Cetacean Research and Rescue Unit
CTV	Crew Transfer Vessel
CV	Coefficient of Variation
CVI	Close visual inspection
dB	Decibel
DECC	Department of Energy & Climate Change
DP	Dynamic Positioning
DPS	Dynamic positioning systems
DWCM	Diamond Wire Cutting Machine
EIA	Environmental Impact Assessment
ES	Environmental Statement
FEED	Front End Engineering Design
GBS	Gravity Base Structure
GIS	Geographical Information Systems
GVI	General Visual Inspection
HES	Historic Environment Scotland
HPDI	Highest posterior density intervals
HRA	Habitats Regulations Assessment
ICES	International Council of the Exploration of the Sea
JCP	Joint Cetacean Protocol
JNCC	Joint Nature and Conservation Committee
JUV	Jack-Up Vessel
kHz	Kilohertz
km	Kilometre
km^2	Kilometre squared
m	Metre
MPI	Magnetic Particle Inspection

MARP	Moray East Archaeological Reporting Protocol
MMOs	Marine Mammal Observers
MRT	Mattress Recovery Tool
MS-LOT	Marine Scotland – Licensing Operations Team
MU	Management Unit
NDE	Non-destructive testing
NLB	Northern Lighthouse Board
NNR	National Nature Reserve
NRA	Navigational Risk Assessment
OfTI	Offshore Transmission Infrastructure
ORPAD	Offshore Renewables Protocol for Archaeological Discoveries
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PMF	Priority Marine Features
PTS	Permanent Threshold Shift
RAT	Rope Access Technician
rms	Root mean square
RoC	Review of Consents
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SCANS	Small Cetaceans in the European Atlantic and North Sea
SCOS	Special Committee on Seals
SEL	Sound exposure level
SMRU	Sea Mammal Research Unit
SNH	Scottish National Heritage
SNS	Southern North Sea
SPA	Special Protection Area
SPL	Sound pressure level
SSC	Suspended Sediment Concentrations
TI	Transmission Infrastructure
TTS	Temporary Threshold Shift
TP	Transition Piece
UTROV	Utility Remotely Operated Vehicle
UXO	Unexploded Ordnance
WROV	Work-Class Remotely Operated Vehicle

Definitions

The following definitions have been used throughout this document with respect to the company, the consented wind farms and how these definitions have changed since submission of the Moray East Environmental Statement (ES) in 2012 and the Moray East Modified Transmission Infrastructure (TI) ES in 2014.

- **Moray Offshore Windfarm (East) Limited (formerly known as Moray Offshore Renewables Limited)** – the legal entity submitting this Environmental Report;
- **Moray East Offshore Wind Farm** - the wind farm to be developed in the Moray East site (also referred as the Wind Farm);
- **The Moray East site** - the area in which the Moray East Offshore Wind Farm will be located. Section 36 Consents and associated Marine Licences to develop and operate up to three generating stations on the Moray East site were granted in March 2014. At that time the Moray East site was made up of three sites known as the Telford, Stevenson and MacColl offshore wind farm sites. The Section 36 Consents and Marine Licences were subsequently varied in March 2018;
- **Telford, Stevenson and MacColl wind farms** – these names refer to the three consented offshore wind farm sites located within the Moray East site;
- **Transmission Infrastructure (TI)** - includes both offshore and onshore electricity transmission infrastructure for the consented Telford, Stevenson and MacColl wind farms. Includes connection to the national electricity transmission system near New Deer in Aberdeenshire encompassing AC offshore substation platforms (OSPs), AC OSP interconnector cables, AC export cables offshore to landfall point at Inverboyndie continuing onshore to the AC collector station (onshore substation) and the additional regional Transmission Operator substation near New Deer. A Marine Licence for the offshore TI was granted in September 2014 and a further Marine Licence for two additional distributed OSPs was granted in September 2017. The onshore TI was awarded Planning Permission in Principle in September 2014 by Aberdeenshire Council and a Planning Permission in Principle under Section 42 in June 2015;
- **Offshore Transmission Infrastructure (OfTI)** – the offshore elements of the transmission infrastructure, comprising AC OSPs, OSP inter-connector cables and AC export cables offshore to landfall (for the avoidance of doubts some elements of the OfTI will be installed in the Moray East site);
- **Moray East ES 2012** – The ES for the Telford, Stevenson and MacColl wind farms and Associated Transmission Infrastructure, submitted August 2012;
- **The Development** – the Moray East Offshore Wind Farm and Offshore Transmission Infrastructure (OfTI);
- **OfTI Corridor** – the export cable route corridor, i.e. the OfTI area as assessed in the Moray East Modified TI ES 2014 excluding the Moray East site;
- **Design Envelope** – the range of design parameters used to inform the assessment of impacts; and
- **Development area** - the Moray East site and OfTI Corridor together.

Moray East Offshore Wind Farm Consents – are comprised of the following:

Section 36 Consents:

- Section 36 consent for the Telford Offshore Wind Farm (as varied) – consent under Section 36 of the Electricity Act 1989 for the construction and operation of the Telford Offshore Wind Farm assigned to Moray East on 19 June 2018.
- Section 36 consent for the Stevenson Offshore Wind Farm (as varied) – consent under Section 36 of the Electricity Act 1989 for the construction and operation of the Stevenson Offshore Wind Farm assigned to Moray East on 19 June 2018.
- Section 36 consent for the MacColl Offshore Wind Farm (as varied) – consent under Section 36 of the Electricity Act 1989 for the construction and operation of the MacColl Offshore Wind Farm assigned to Moray East on 19 June 2018.

Marine Licences

- Marine Licence for the Telford Offshore Wind Farm (as varied) – Licence Number: 04629/20/0 – consent under the Marine (Scotland) Act 2010 & Marine and Coastal Access Act 2009, Part 4 marine licensing for marine renewables construction works and deposits of substances or objects in the Scottish Marine Area and the United Kingdom Marine Licensing Area transferred to Moray East on 19 July 2018.
- Marine Licence for the Stevenson Offshore Wind Farm (as varied) – Licence Number: 04627/20/0 – consent under the Marine (Scotland) Act 2010 & Marine and Coastal Access Act 2009, Part 4 marine licensing for marine renewables construction works and deposits of substances or objects in the Scottish Marine Area and the United Kingdom Marine Licensing Area transferred to Moray East on 19 July 2018.
- Marine Licence for the MacColl Offshore Wind Farm (as varied) – Licence Number: 04628/20/0 – consent under the Marine (Scotland) Act 2010 & Marine and Coastal Access Act 2009, Part 4 marine licensing for marine renewables construction works and deposits of substances or objects in the Scottish Marine Area and the United Kingdom Marine Licensing Area transferred to Moray East on 19 July 2018.
- Marine Licence for Moray Offshore Windfarm (East) Limited – Licence Number: 07086/19/0 – consent under the Marine (Scotland) Act 2010 & Marine and Coastal Access Act 2009 (as amended), Part 4 Marine Licensing to deposit, backfill of seabed depressions within the Scottish marine area and the UK marine licensing area.

OfTI Licences – are comprised of the following:

- Marine Licence for the Offshore Transmission infrastructure (as varied) – Licence Number 05340/19/0 – consent under the Marine (Scotland) Act 2010 & Marine and Coastal Access Act 2009, Part 4 marine licensing for marine renewables construction works and deposits of substances or objects in the Scottish Marine Area and the United Kingdom Marine Licensing Area (referred to as the "OfTI Marine Licence").
- Marine Licence for two additional distributed OSPs (as varied) – Licence Number 06347/19/0 – consent under the Marine (Scotland) Act 2010 & Marine and Coastal Access Act 2009, Part 4 marine licensing for marine renewables construction, operation and maintenance works and the deposit of substances or objects in the Scottish Marine Area and the United Kingdom Marine Licensing Area (referred to as the "OSP Marine Licence").

1 Introduction

1.1 Project Background

In March 2014, Moray Offshore Windfarm (East) Limited (Moray East) received consents from the Scottish Ministers under Section 36 of the Electricity Act 1989, and the associated Marine Licences under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009 for the construction and operation of the Moray East Offshore Wind Farm. At that time, the Moray East site was made up of three sites known as "Telford", "Stevenson" and "MacColl" offshore wind farm sites. Moray East plans to develop the three consented wind farms (Telford, Stevenson and MacColl) as a single wind farm (Moray East Offshore Wind Farm) (Figure 1-1 below).

A Marine Licence for the Offshore Transmission Infrastructure (OfTI) was granted in September 2014 and a further Marine Licence for two additional distributed offshore substation platforms (OSPs) was granted in September 2017 (together these are referred to as the OfTI Licences).

Moray East is a joint venture partnership between EDP Renewables, Engie, Diamond Generating and China Three Gorges which has been established to develop, finance, construct, operate, maintain and decommission the Moray East Offshore Wind Farm.

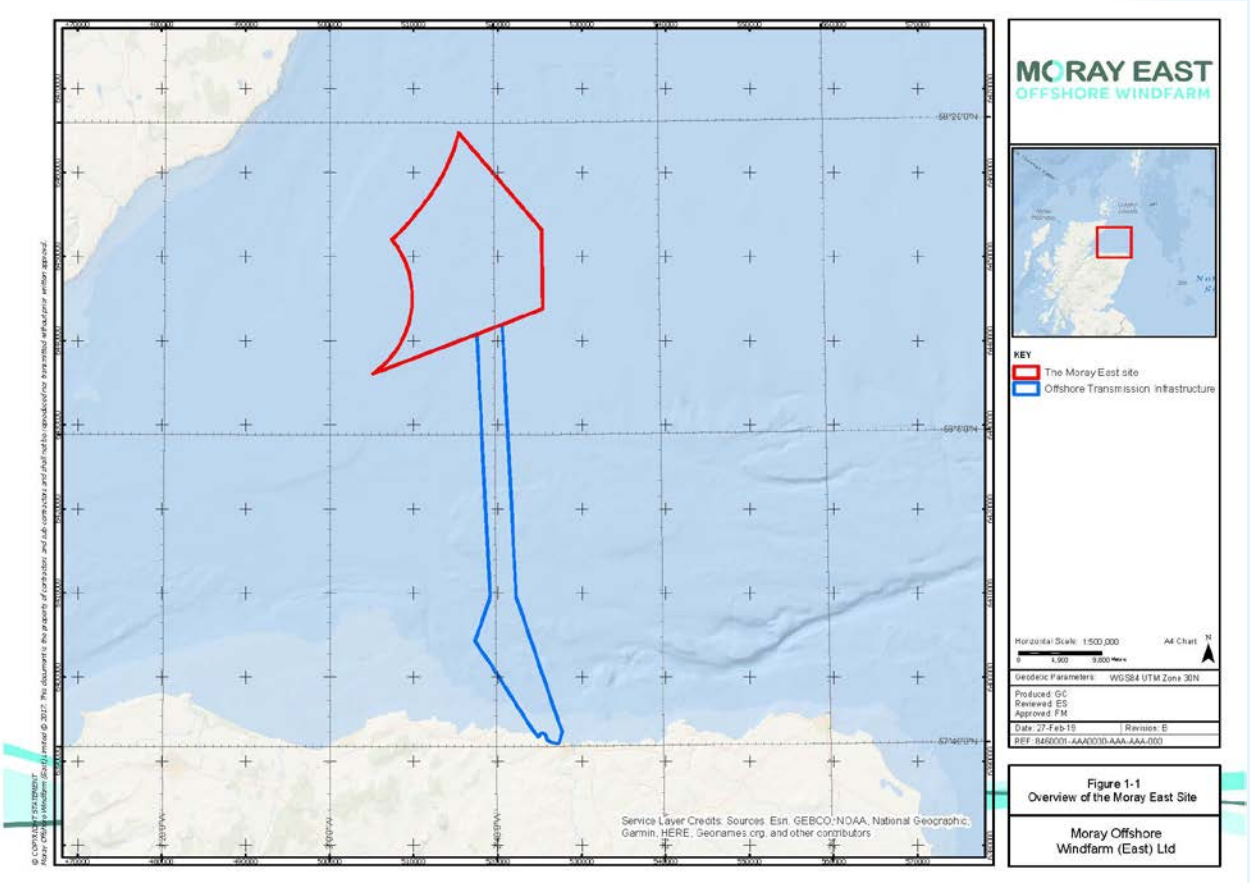


Figure 1-1. Moray East Site and OfTI Corridor

The Moray East meteorological mast was installed in 2014 to collect accurate meteorological data from the offshore windfarm (Figure 1-2). Due to unintended contact between a vessel and the lattice structure during installation, the structural integrity of the asset is compromised. As a result, the asset needs to be decommissioned on the earliest feasible opportunity.

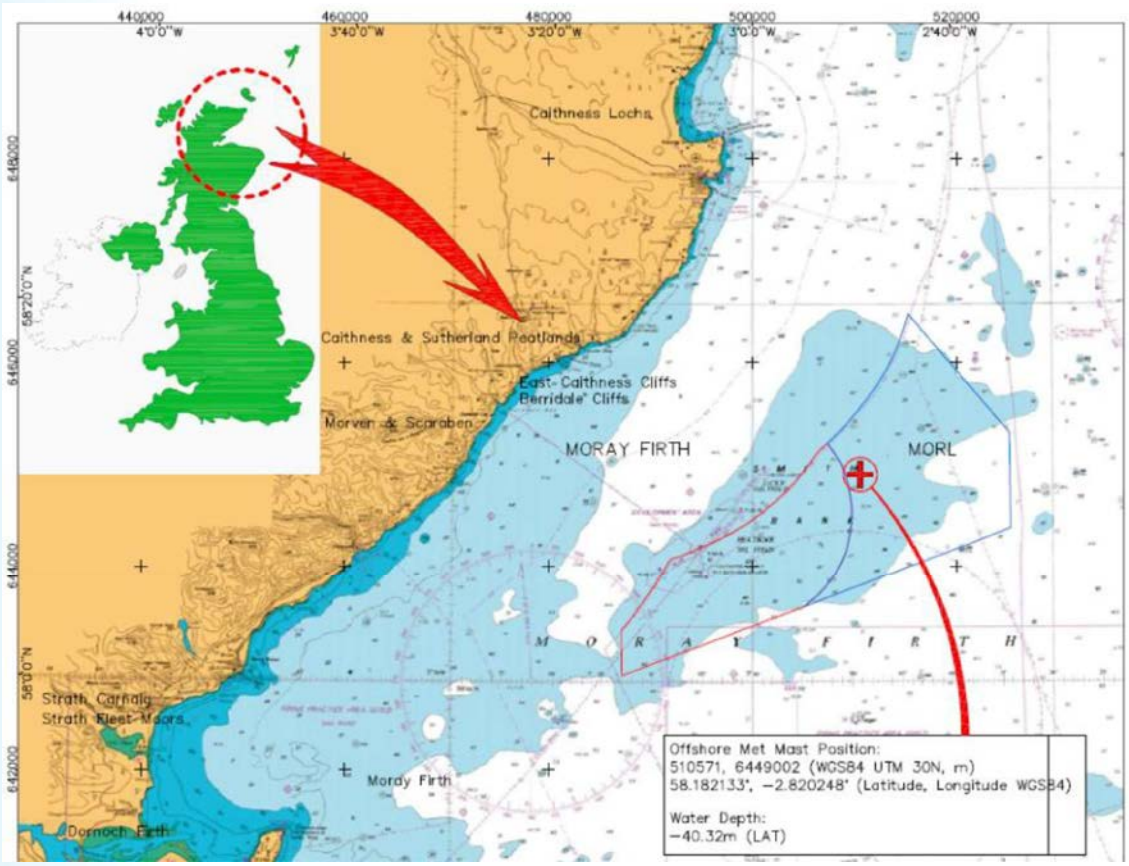


Figure 1-2. Location of Moray East meteorological mast

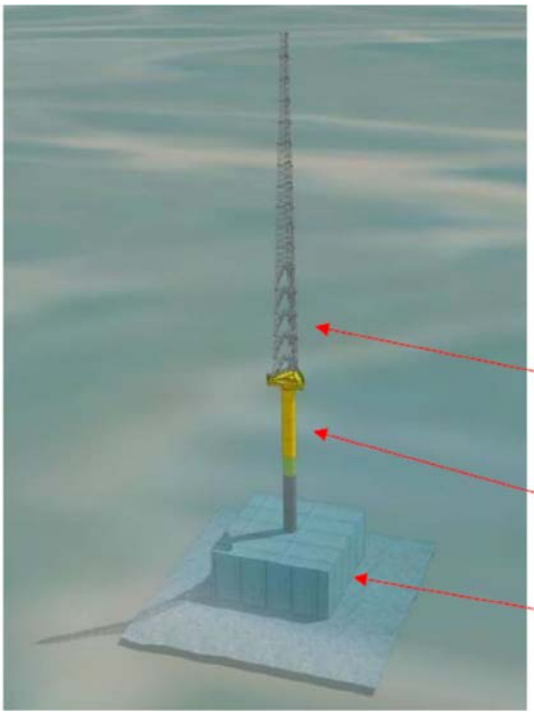
1.2 Objectives of this Document

In order to undertake the decommissioning of the meteorological mast, a Marine Licence is required from Marine Scotland Licensing Operations Team (MS-LOT). A Marine Licence is required for decommissioning activities under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009.

This Environmental Report is submitted in support of the Marine Licence application submitted by Moray East to MS-LOT. A description of the decommissioning methods is provided in Section 2, a description of the baseline environment is provided in Section 3 and an assessment of potential environmental effects is presented in Section 4.

2 Decommissioning Methods

The meteorological mast consists of four components: lattice tower, main deck, monopile, and concrete caisson gravity base structure (Figure 2-1).



Lattice + TP + Pile		
	Weight [Ton]	Height [m]
Lattice	40	65
TP	36	3
Shaft	163	40
TOTAL	239	108

Figure 2-1. Meteorological mast general arrangement and structure

The decommissioning of the met mast will take place in two phases. Phase 1 will consist of the removal of the lattice tower, main deck and monopile section (topsides). Phase 2 will consist of the removal of the gravity base structure and associated scour protection.

During pre-application discussions with MS-LOT it was agreed that only a high level indicative methodology for Phase 2 will be provided at this time (because no contractor has yet been appointed for the work and therefore a detailed methodology is not available) and that a more detailed methodology will be submitted for review at a later date, in advance of work on Phase 2 commencing. It is intended for Phase 1 to be undertaken as soon as reasonably practicable once the required Marine Licence has been granted, subject to contractor availability and suitable met ocean conditions. Phase 2 will be undertaken at a later date, expected to be after 2 – 3 years of commercial operations of the Moray East Offshore Windfarm (with removal expected no later than 2024).

2.1 Phase 1 – Topsides Decommissioning

2.1.1 Vessels and Equipment

The following types of vessels are expected to be used during Phase 1 of the meteorological mast decommissioning:

- Jack-Up Vessel (JUV): this is required for the lattice tower removal operations. An alternative option would be the use of a Dynamic Positioning (DP) Construction Barge, Heavy Lift Vessel (HLV), or similar floating vessel with crane. As the JUV is the base case option, it is this option that has been assessed within this report. The magnitude of the potential environmental effects associated with using a floating vessel are considered to be less than those associated with a JUV and, therefore, the assessment of the use of a JUV has considered a reasonable worst case

scenario. Figure 2-2 below provides an example of the location of the JUV's footprint during decommissioning activities

- Flat-top transport barge: the transport barge will be used to transport the lattice mast back to shore. It will also be the primary vessel for recovery of the platform & monopile structure using chain pullers and specially designed "monopile catcher".
- Diamond Wire Cutting Machine (DWCM) Cutting Vessel: currently under consideration is the deployment of the DWCM cutter from a separate vessel (such as the other vessels described in this section). As the likelihood of using a dedicated DWCM vessel is quite high, the potential impacts from using this vessel have been assessed within this report.
- Remotely Operated Vehicle (ROV) Support and Crew Transfer Vessel (CTV): this vessel will support the various lifting and cutting operations as well as a crew transfer vessel to the mast for the personnel during the Rope Access Technician (RAT) survey works.

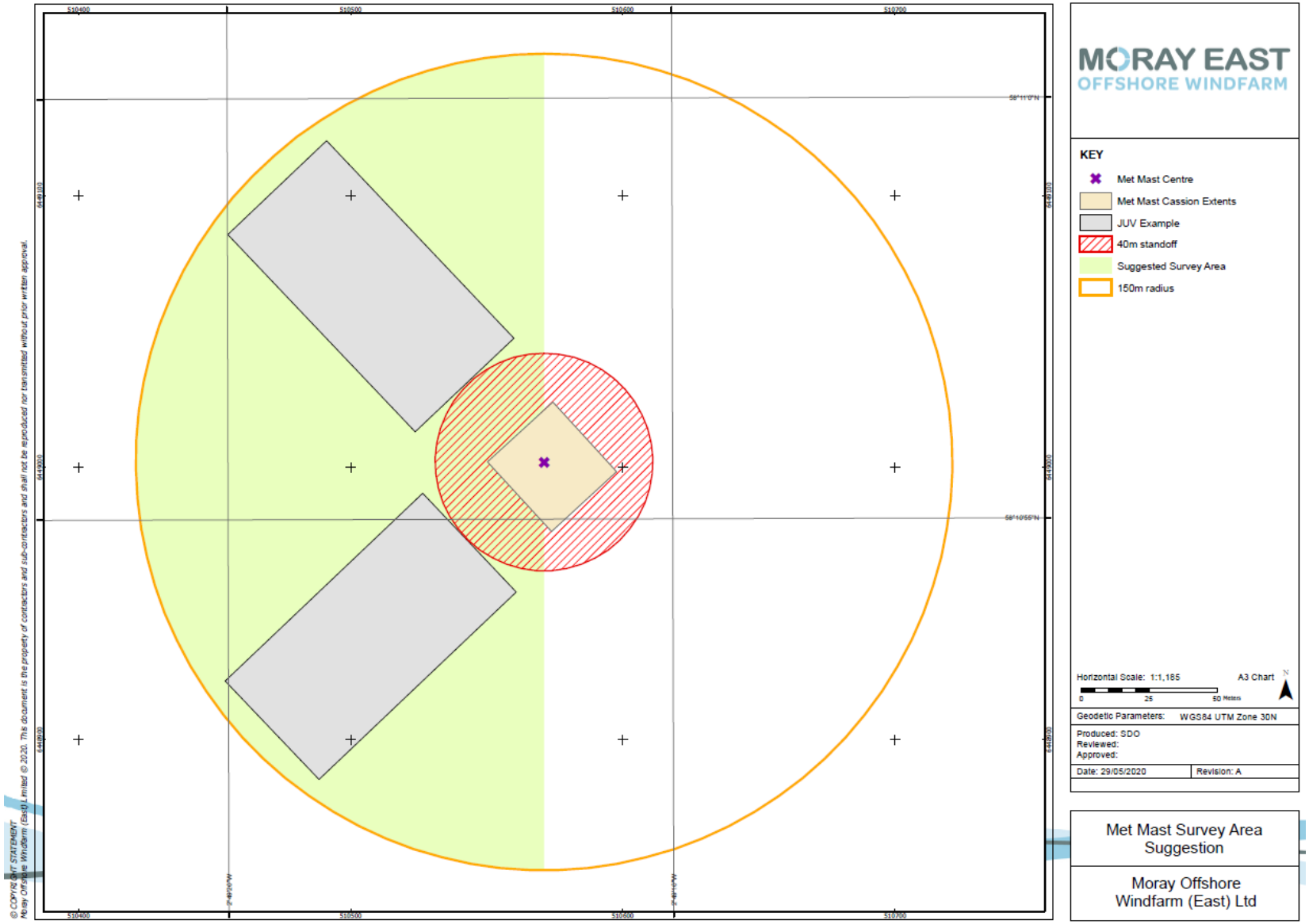


Figure 2-2: Indicative location of JUV footprint during decommissioning activities

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2.1.2 Pre-Survey of Mast

A small RAT and survey team will perform a thorough examination of the structure to validate the proposed technical solution, or modify it accordingly. This includes topside survey, interior survey and subsea survey. If this survey identifies the need for a material modification of the Phase 1 methodology described in this document, Moray East will notify MS-LOT and submit an updated methodology for review.

Topside survey:

1. Thorough visual examination of the entire meteorological structure and all proposed lifting points.
2. Locate and survey the lift points on the lattice structure
3. Ensure the structural integrity of all items to be removed and consider any 'springing[1]' of the structure during preparation works.
4. Non-destructive (NDE) test lift points on the transition piece (TP; item made to connect two different shaped objects, in this case the jacket and monopile). Techniques used for the NDE test may include:
   a. Close Visual Inspection (CVI);
   b. Alternate Current Field Measurement (ACFM); and
   c. Magnetic Particle Inspection (MPI).
5. RAT team to remove any extraneous electronic and monitoring equipment as required.

Interior Survey:

1. Access interior of structure using RATs with confined space access competence.
2. Option to use an eyeball/suitcase ROV to inspect the interior of the monopile below the waterline (if it is flooded, which is expected given the cracked flange).
3. Confirm presence of any obstructions which may prevent the use of an internal cutting tool.

Subsea survey:

1. Using an ROV launched from CTV, inspect intended cutting locations.
2. General visual inspection (GVI) of the monopile, with assessment of marine growth for subsequent weight calculations.
3. GVI of caisson, cracked interface flange, flooding ports and strainers, manhole covers, and caisson base.

Inspect intended location of JUV foot positions (200 x 200 m GVI and echo scan) and any previous spud-can locations.

The subsea survey would be carried out by employing a light work-class ROV (WROV), and would consist of a full visual inspection of the monopile from splash zone to caisson top. Marine growth thickness measurements will be collected every 5 m of water depth at the cardinal positions.

2.1.3 Removal of the Lattice Structure

During the pre-survey works, the platform furniture and remaining temporary works will be cleared out from the meteorological mast, ready for the decommissioning phase.

Following the pre-survey of the meteorological mast, RATs will access the mast, via a support vessel, to clear any "loose" temporary works that will present a hazard during the lattice lift. At the same time, the RATs will rig the existing lift points, or create new lift points for the arriving decommissioning vessel(s).

[1] Springing refers to global (vertical) resonant hull girder vibrations induced by continuous wave loading.

Prior to the removal of the lattice, the following works will also be carried out:

1. As-found structural survey.
2. Prior to the actual removal of the component parts of the Met Mast, any remaining instrumentation that needs to be recovered (e.g. anemometers, solar panels, etc.) will be removed by the RATs.
3. Detailed inspection of the entire mast to secure or remove any loose items.
4. Preparation for unbolting the upper lattice tower.
5. Preparation for gangway access from the decommissioning vessel(s), if required.

The lift points will be used for the lift of the whole lattice tower, in a single lift, if RAT inspection of the condition of the lattice tower gives confidence this is possible.

2.1.3.1 Recovery to the Flat Top Barge

Once rigged, the barge will be positioned on a 5-point mooring/anchor system (4 points, with an additional safety line) alongside the meteorological mast (Figure 2-3).

The location of the 5-point mooring system and the position of the barge will depend on the following criteria:

- direction of prevailing wind/weather;
- position of decommissioning vessel(s) to ensure easiest lift within crane limitations; and
- fall direction of the “tilted” meteorological mast.

The lattice tower will then be lifted and laid onto sea-fastenings on the deck of the barge; these being certificated lashing eyes on deck and certificated ship’s lashing chains.

There is the possibility that the lattice structure and monopile can be lifted together in a single operation. Once this single lift is complete and lattice is safely secured, the decommissioning vessel will demobilise back to its port of origin.

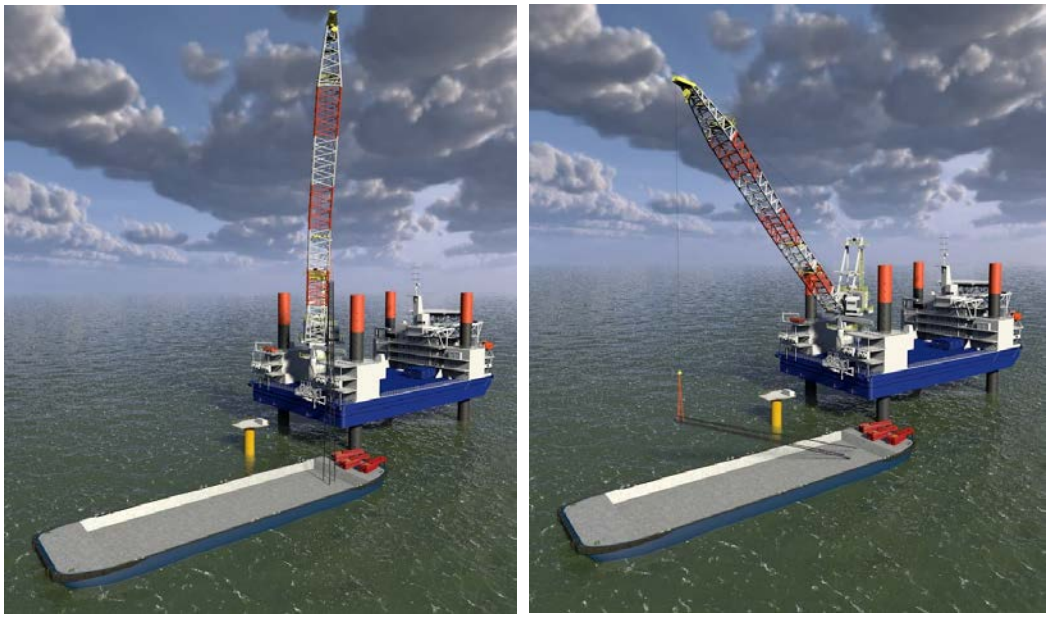

Figure 2-3. Lift of the lattice tower to the barge (image of JUV is indicative only)

2.1.4 Removal of Monopile & Platform

The barge, a specialist vessel designed for monopile decommissioning works, will be the primary vessel for recovery of the platform and monopile structure using chain pullers and specially designed "monopile catcher" (Figure 2-4).

Prior to engaging with the monopile, there may be requirement to unbolt/gas-axe the access ladder to the platform, or design around this, if it impedes on the monopile "catcher" design. The barge will engage the monopile with its specially designed "horns" either side of the monopile structure.

Chain pullers run over and down in a vertical orientation to lifting padeyes on a clamp, which is secured to the monopile by bolted flange or pins (ideally designed to accommodate WROV installation and minimise diving operations). Chain pullers are connected to the lifting padeyes with hydraulic shackles.

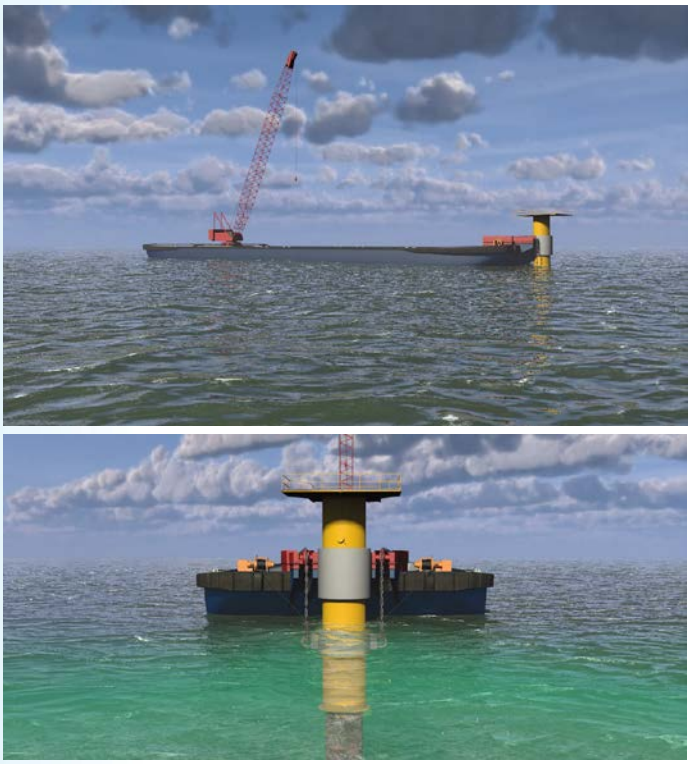

Figure 2-4. Top image shows the monopile and platform engaged by the barge; it is likely that the lattice mast will remain on the barge (omitted from the image). Bottom image shows front-on-view of gimbled pile catcher (top donut) and subsea clamp (below surface) showing the chain puller arrangement

Use of DWCMs are currently under consideration (Figure 2-5). This will also allow cutting operations of the monopile to begin immediately, once the main decommissioning vessel has engaged its horns onto the pile. The monopile will be cut approximately 3 m above the caisson.

Cutting operations are as follows:

1. DWCM to be deployed from a multi-purpose vessel. The DWCM has an endless circular cutting wire with diamond embedded abrasives cast onto it. The wire is powered by a hydraulic motor which is in turn powered form the deck of the support vessel. Noise levels underwater are kept to a minimum as the main fluid pumps for the hydraulics are powered on the surface vessel.
2. A support WROV will be deployed from the ROV Support Vessel to grab the DWCM and guide it onto the monopile where the cut is to take place. The WROV will also observe the

cut taking place whilst remaining suspended in the water column. The WROV will not land on the seabed (Figure 2-6).

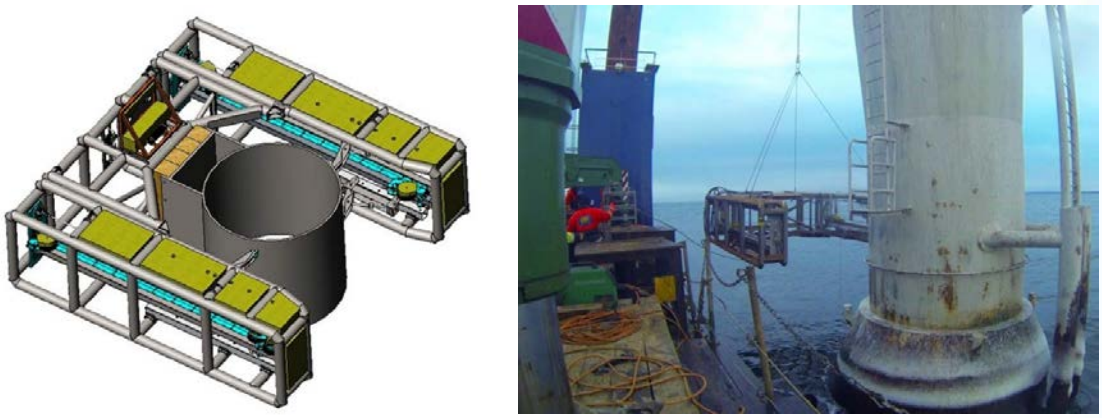

Figure 2-5. Example image of a DWCM cutting tool in operation.

Figure 2-6. Cutting supported by WROV from support vessel

Once clear of the pile stub, the monopile and platform will be lifted with use of the chain pullers. Initiating pull on the chain pullers will bring the monopile and platform up to a level where the monopile will want to ease over onto the barge, making use of the gimbled pile catcher (Figure 2-7).

Figure 2-7. The barge has hold of the monopile and platform in the gripper with use of chain pullers

Once the platform is at the desired height, it will be manoeuvred onto the barge with use of crawler crane or vessel winch or excavator. The weight of the cut monopile and platform will be c. 130 t inclusive of marine growth.

Once the lattice and monopile are onboard the barge, she will be towed to a nearby port where the lattice, platform, TP and monopile will be offloaded for onshore processing. Any marine growth will also be brought onshore for processing through the appropriate SEPA route.

Figure 2-8 shows the whole process of the recovery of the lattice and platform.

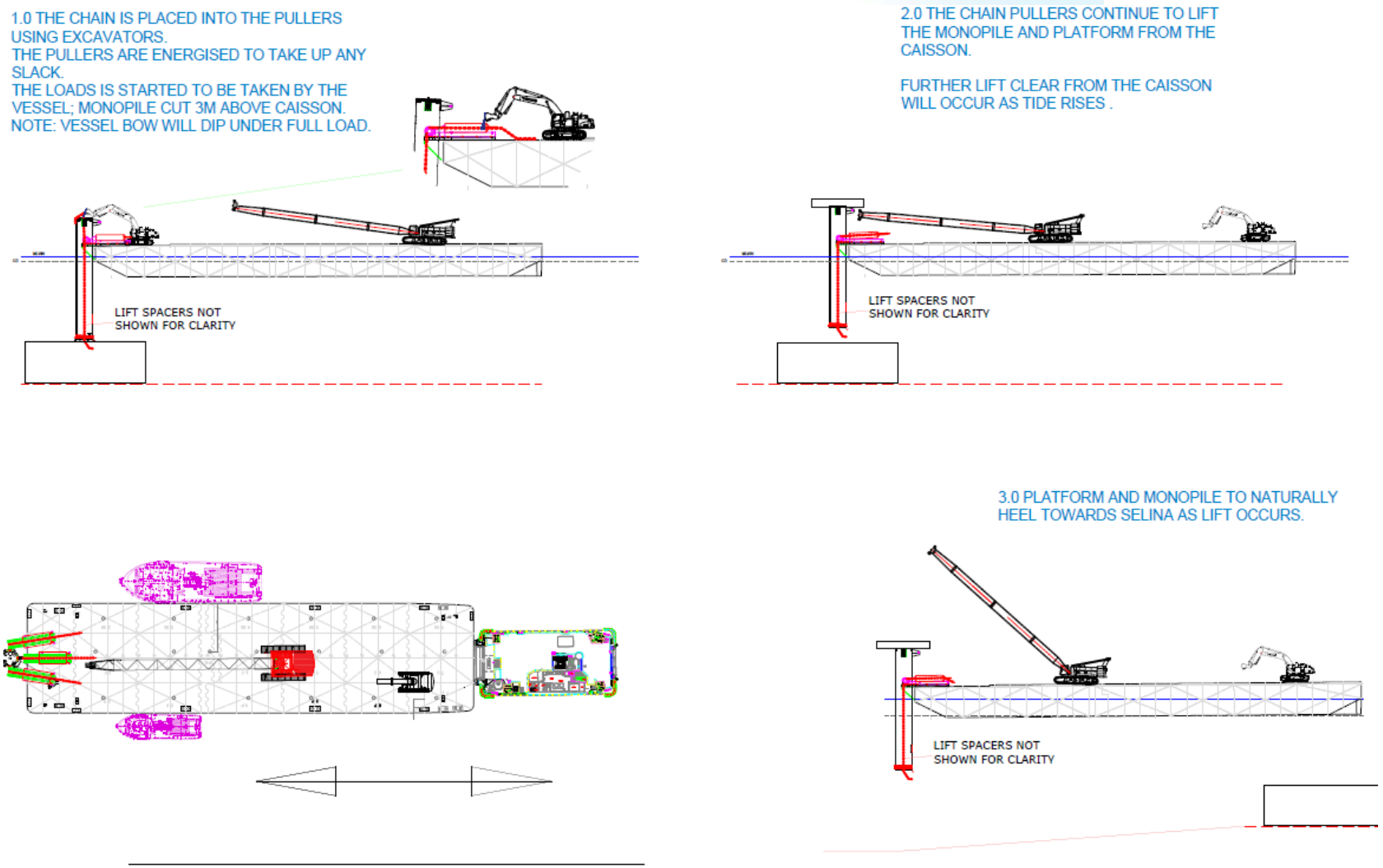

Figure 2-8. Storyboard of the lift & pull of the mast & platform with indicative deck layouts.

2.1.5 Shipping and Navigation Considerations

For the period between Phase 1 (the removal of the meteorological mast topsides) and Phase 2 (the removal of the GBS and associated scour protection), the location of the GBS will be marked with a buoy as a navigational aid (subject to receipt of required permission from the NLB). This buoy would be kept on location by means of a clump weight on top of the GBS. A management plan will be prepared to describe the actions to be taken to alert other sea users of the position of the submerged structure in the unlikely event that the marker buoy becomes non-operational or off station.

2.2 Phase 2 – Gravity Base Structure Decommissioning

The current structural integrity of the gravity base is uncertain after the unintended impact during installation and the damaged structure being submerged. There is also limited experience in the removal of concrete gravity base structures in the industry. In order to ascertain the best method of the GBS removal, a Front End Engineering Design (FEED) study will be undertaken prior to making any further arrangements for the removal. This will ensure more knowledge of the gravity base and a more accurate schedule, budget and plan will be drafted. It is anticipated that Phase 2 will take place after 2 – 3 years of commercial operations of the Moray East Offshore Windfarm (with removal expected no later than 2024).

This section provides a high-level description of the likely methods to be used during Phase 2 of decommissioning. All methods described are indicative only and subject to change. A further, more detailed environmental assessment will be carried out once the results of the FEED study are available and a detailed methodology has been written for Phase 2.

2.2.1 Phase 2 - Recovery of Concrete Mattress

The concrete mattresses (Figure 2-9) were placed for scour protection and to support the meteorological mast structure. Depending on the outcome of the FEED study, a decision will be made as to whether the mattresses are recovered before or after caisson removal.

There are two main challenges in recovering the concrete mattresses: first, the size of the mattresses is considerably larger than a ‘standard’ concrete mattresses used in the offshore industry. Typical mattress will be 6 m x 3 m x 0.3 m compared to these mattresses at 10.4 m x 3 m x 0.5 m. Secondly, because of the large size, the weight of the concrete mattresses also increases to 23.4 Te compared with 8-9 Te for a ‘standard’ mattress. Both these present a considerable challenge during their recovery and being handled subsea or on deck.

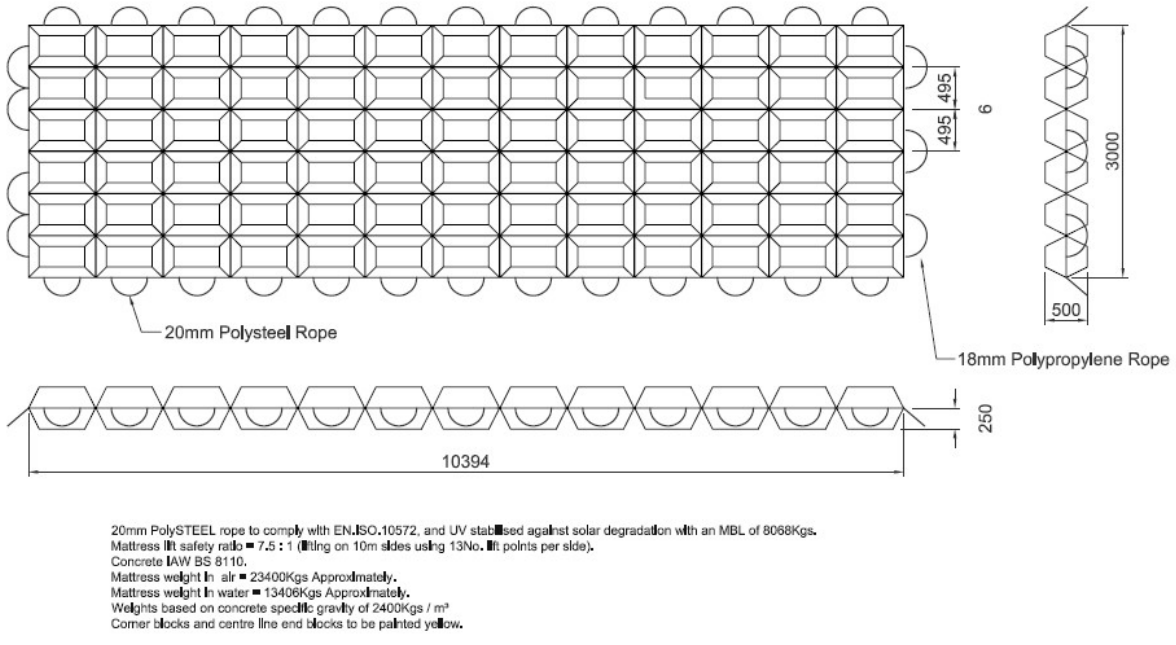

Figure 2-9. Details of the concrete mattress.

Prior to the recovery of the mattresses, a WROV would be deployed to carry out a multibeam sonar survey of the area to determine the as-found status of the mattresses. For the mattress recovery operation, it is proposed to utilise a large construction support vessel, as the size of the main deck is sufficient to store mattresses, has two cranes (continuous operations and full coverage of deck) and availability of WROVs (cutting and survey).

Due to the mattresses being larger than the 'standard' subsea mattresses, it is proposed to cut the mattresses subsea with the use of a WROV and hydraulic chain saw with a diamond tip chain. This would make the subsea recovery safer as this will create a 'standard'-sized mattress, ensuring the mattress recovery tool (MRT) can fully grip the mattress and create no overhang at each end. This would also make the handling of the mattresses on deck more manageable and safer.

After a sufficient number of mattresses have been cut, the MRT will be deployed to recover the mattresses to the waiting vessel. If any of the mattresses were to fail, subsea baskets would be deployed and a utility ROV (UTROV) fitted with an MRT or tine grab will be used to collect all broken pieces of the mattress.

An alternative approach being considered is the recovery of the mattresses using a WROV and handling frame connecting the slings and ROV hooks. The exact method to be used will be determined during the FEED study and the environmental assessment will be carried out once the exact method is known.

2.2.2 Phase 2 – Recovery of GBS

Before starting the decommissioning operation, a visual inspection of all top slab penetrations must take place, to determine the condition and water tightness of all penetrations. In addition, all valves in the ballast and air venting lines must be closed or blind flanges installed to close any penetrations found or suspected to be leaking.

In each of the 16 compartments inside the GBS, one suction pipe with a pre-fitted pump will be installed through a prefabricated manhole cover. Due to the complexity of the installation of the fabricated manholes the work will be executed by divers.

The suction pipe will be outfitted with an airline to equalise the pressure inside the cells once water is being pumped out. Alternatively, if the air venting lines are found to be in good condition during the pre-works inspection, these can be used to equalise the pressure during dewatering. The dewatering is done until enough buoyancy is achieved to lift the GBS from the bottom and onto the receiving vessel.

Airbags will be connected to the GBS in order to secure the stability during the pump operations. Figure 2-10 provides an example of airbags being utilised during the re-floating of an underwater structure. The towing lugs already present on the GBS will be used as connection points for the airbags.

Figure 2-10. Example of airbags being used to re-float an underwater structure.

Due to the draft and weight of the GBS, for the final transport towards the dismantling yard, a semi-submersible vessel will be used (Figure 2-11). Once on site, the semi-submersible will be moored with anchors and tugs. The vessel will pre-ballast to 1 m freeboard and the GBS will be loaded onto the vessel deck. Once the GBS is installed on the semi-submersible, the vessel will de-ballast and head back to shore.

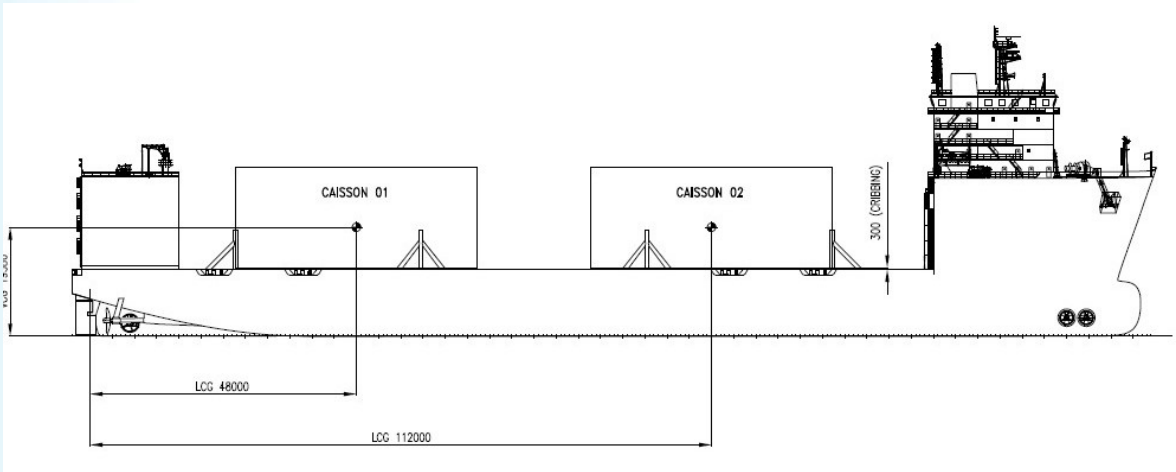

Figure 2-11. Example of a semi-submersible stowage plan

2.3 Programme

The duration of Phase 1 works is expected to be approximately 41 days; note that this does not account for any downtime due to adverse weather.

As indicated in section 2.2, Phase 2 works is expected to take place after 2 – 3 years of commercial operations of the Moray East Offshore Windfarm (with removal expected no later than 2024).

3 Existing Environment

3.1 Overview

A detailed description of the baseline environment for each environmental parameter is available from the Moray East Environmental Statement (ES) (Moray East, 2012). The following sections provide an overview of the key receptors that may be potentially affected by the meteorological mast decommissioning activities.

The information utilised to provide details of the key receptors has been drawn from the Moray East ES, the results of more recent post-consent / pre-construction surveys and other publicly available information.

3.2 Physical Processes

The Moray East site encompasses part of the summit and the eastern flank of 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 (295 km^2). Water depths in this area range from approximately -35 to -55 mCD (Chart Datum), with the greatest depths found along the south-eastern margin of the site. Smith Bank is separated from the Caithness coast to the north by a relatively deep channel (up to approximately -75 mCD). At the location of the meteorological mast, the water depth is approximately -40 mCD. Seabed sediments across the Moray East site generally consist of Holocene gravelly sand and sand (Moray East, 2012). Fine (silt- and clay-sized) particles are largely absent.

The available evidence suggests that (bedload) material travels into the Firth from the north, passing along the Caithness coast and towards the Inner Moray Firth (Moray East, 2012). Tidal currents are largely incapable of mobilising sediment particles larger than fine sand within the Moray East site and as a result, there is limited net bedload transport of sediment due to tidal currents alone. However, during storm events, it is likely that medium sand particles, common at the site, are regularly mobilised across the site.

During site characterisation surveys for the Moray East ES, levels of sediment contaminants were below guideline levels at all sampling locations within the Development area (Moray East, 2012).

3.3 Benthic Ecology

3.3.1 Offshore Wind Farm

The benthic survey conducted for the Moray East ES showed that the dominant seabed sediment habitat type within the Moray East site was slightly gravelly sand, with patches of shelly gravelly sand, sandy gravel and gravel. The benthic communities associated with these seabed habitat types were found to be rich and diverse and were characterised by polychaete worms (e.g. *Sphiophanes bombyx*, *Notomastus spp*., *Lumbrineris gracilis* and *Chone sp.*), the burrowing urchin (*Echinocyamus pusillus)* and the bivalve *Cochlodesma praetenue*. Statistical analysis showed that benthic communities were most influenced by depth and sediment types.

The biotope habitats identified within 500m of the meteorological mast include:

- *SS.SSa.CFiSa EpusOborApri (E. pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand); and,
- *SS.SCS.CCS. MedLumVen (Mediomastus fragilis, Lumbrineris spp.* and venerid bivalves in circalittoral coarse sand or gravel).

No rare or protected species with respect to the EC Habitats Directive 92/43/EEC and / or the Wildlife and Countryside Act 1981 (as amended) were found within the boundary of the Moray East site. A juvenile

Icelandic cyprine or ocean quahog *Arctica islandica* was recorded, which 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). Other PMFs recorded in the general area include: the coarse sand biotope, *MoeVen* (*Moerella* spp. with venerid bivalves, recorded at one reference station outside the boundary of the Moray East site); and the sandeel species-complex *Ammodytes marinus, A. tobianus*. *"Subtidal sands and gravels"* are a UK Biodiversity Action Plan (UK BAP) priority habitat as a result of its importance for the conservation of biodiversity. Although the UK BAP has been succeeded by the post 2010 Biodiversity Framework, *"Offshore subtidal sands and gravels"* are included in the Scottish PMF list.

3.4 Fish and Shellfish

3.4.1 Commercial Species

The Moray Firth supports a number of commercially targeted fish and shellfish species. The principal shellfish and cephalopod species landed are: scallops (*Pecten maximus*), squid (*Loligo* spp.), edible crabs (*Cancer pagurus*), and Nephrops (*Nephrops norvegicus*). The majority of finfish landings constitute of: haddock (*Melanogrammus aeglefinus*), whiting (*Merlangius merlangus*), monkfish / anglerfish (*Lophius spp*.), and cod (*Gadus morhua*) (ICES, 2018).

3.4.2 Spawning and Nursery Grounds

There are defined spawning and nursery grounds for a number of species within and in the immediate vicinity of the Moray East site (Ellis *et al.*, 2010), including: cod, herring, lemon sole (*Microstomus kitt*), Nephrops, plaice (*Pleuronectes platessa)*, sandeel (*Ammodytidae* spp.), and sprat (*Sprattus sprattus*). There are also potential nursey grounds for: anglerfish, blue whiting (*Micromesistius poutassou*), haddock, hake (*Merluccius merluccius*), ling (*Molva molva*), mackerel, saithe (*Pollachius virens*), spotted ray (*Raja montagui*), spurdog (*Squalus acanthias*), and thornback ray (*Raja clavata*). The Moray East site does not overlap with the spawning grounds of either the Orkney / Shetland or the Buchan herring stocks (the two stocks known to have spawning grounds in the vicinity of the Moray Firth), but it is located within high intensity herring nursery grounds as defined by Ellis *et al.* (2010).

3.4.3 Species of Conservation Importance

A number of species of conservation importance are found in the Moray Firth and may, therefore, transit through the Moray East site. These include diadromous migratory species (those using both marine and freshwater environments during their life cycle), elasmobranchs (sharks and rays) and commercial fish species.

Diadromous migratory species potentially present include: European eel (*Anguilla Anguilla*), allis and twaite shad (*Alosa alosa, A. fallax*), sea and river lamprey (*Lampetra fluviatilis, Petromyzon marinus*), smelt (*Osmerus osperlangus*), salmon (*Salmo salar*), and sea trout (*Salmo trutta*).

Commercially exploited fish species with conservation status that may be present in the meteorological mast decommissioning survey area include: anglerfish, mackerel, cod, herring, and sandeel. Atlantic salmon and sea lamprey are SAC qualifying features of rivers in the Moray Firth area.

3.5 Marine Mammals

3.5.1 Commonly Sighted Species in the Moray Firth

The Moray Firth is an important area for marine mammals, with at least 14 species of cetacean and two species of seal being recorded in and around the Moray Firth. The bottlenose dolphin (*Tursiops truncates)*

and harbour seal (*Phoca vitulina)* populations are both considered to be nationally and internationally important and are primary features of the Moray Firth Special Area of Conservation (SAC) and Dornoch Firth and Morrich More SAC (Moray East, 2012), respectively. Bottlenose dolphin, harbour porpoise (*Phocoena phocoena)*, harbour seal and grey seal (*Halichoerus grypus)* are all listed under Annex II of the Habitats Directive as requiring protection through the designation of SACs (Moray East, 2012). Large cetacean species, including minke whale (*Balaenoptera acutorostrata)*, humpback whale (*Megaptera novaeangliae)* and less frequently killer whale (*Orcinus orca)* and long-finned pilot whales (*Globicephala melas)* have been recorded within the Moray Firth during the summer months.

This section sets out the spatial and temporal sensitivities of the key marine mammal species recorded in Moray Firth.

3.5.1.1 Harbour Seal

A number of haul-out sites for harbour seal are located within the Moray Firth, primarily in the Beauly, Loch Fleet, and Findhorn (Special Committee on Seals (SCOS), 2018). Since 2010, there has been substantial re-distribution in the area as counts at the Inner Firth have declined, whilst counts at Culbin Sands and Findhorn have increased rapidly (SCOS, 2018). In 2017, the total harbour seal count within the Moray Firth was 879; 6.5% lower than the 2016 count of 940 harbour seal. The majority of these harbour seals (59.8 %) were observed between Culbin and Findhorn, confirming the significant redistribution within the inner estuaries to other areas (SCOS, 2018). The harbour seal population in the Moray Firth declined by 50% prior to 2005, remained reasonably stable for four years, then increased by 40% in 2010, and has been fluctuating since (SCOS, 2018). Harbour seals occur throughout the year in these areas, with peak numbers at haul-out sites between June and August when they are used as breeding sites (Thompson & Miller, 1990; Thompson *et al*., 1996). The most recent harbour seal counts in the Moray Firth, between 2015 and 2017, recorded 879 seals, the majority of which were recorded within the Inner Firth at Culbin, Loch Fleet and Findhorn (Figure 3-1) (SCOS, 2018). The total population of harbour seals in Scotland was 26,565 in 2015-2017, with 879 within the Moray Firth Management Unit (MU) (SCOS, 2018).

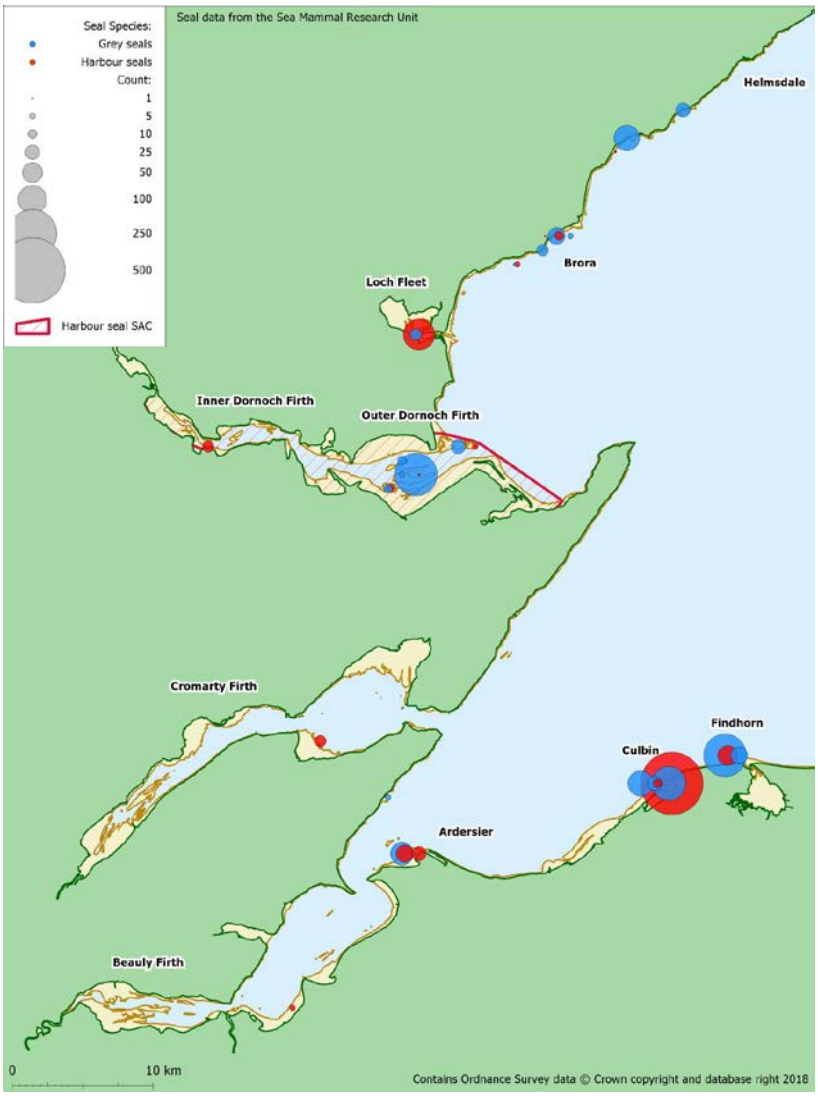

Figure 3-1 Distribution of harbour seal (shown in red) and grey seal (shown in blue) aggregated by 1km squares, from the annual Moray Firth seal survey, between Helmsdale and Findhorn (aerial survey carried out August 2017) (SCOS, 2018).

Harbour seals within the Moray Firth typically forage in waters of 10 to 50m depth over areas with predominantly sandy seabeds. Tagging studies within the Moray Firth have found that harbour seals generally travel no more than 60km from their haul-out sites (Thompson *et al.,* 1996), with a tendency to forage slightly further afield in the winter (Thompson *et al.,* 1996). The closest haul out site to the Project is Brora, which is 55km to the east of the south-western Project boundary. Findhorn is 61km to the south west of the Moray East site, followed by Culbin which is 63km to the south west of Moray East.

Boat-based marine mammal surveys were conducted in the Moray Firth between April 2010 and March 2012, commissioned by Moray East as part of the Environmental Impact Assessment (EIA), in order to provide site specific marine mammal distribution data at an appropriate scale. During the boat-based survey of the Moray East site plus 4 km buffer, six animals were confirmed as harbour seal. A number of seals observed during the surveys were not identified to species level, some of which may have been harbour seals.

The harbour seal density across the Moray East site is 0.016 individuals per km^2, as calculated from the Russell *et al.* (2017) seals at sea density maps, summarising the mean at sea densities from all 5x5km grid cells overlapping with the Moray East site.

Dornoch Firth and Morrich More SAC

The Dornoch Firth and Morrich More SAC is located 62km from the Development, and lists harbour seal as a primary reason for site designation. The site supports a significant proportion of the inner Moray Firth population of harbour seals (JNCC, 2018). In the 2017 aerial surveys conducted by SMRU, 39 harbour seals were sighted in the Dornoch Firth SAC itself; the lowest number recorded at the site since 1992, while 145 were recorded from Dornoch Firth to Ardensier (SCOS, 2018).

The Conservation Objectives for the site are:

- To ensure for the qualifying species that the following are established then maintained in the long term:
    - Population of the species as a viable component of the site;
    - Distribution of the species within the site;
    - Distribution and extent of habitats supporting the species;
    - Structure, function and supporting processes of habitats supporting the species;
    - No significant disturbance of the species.
- The Moray Firth Seal Management Plan sets out further conservation objectives for interactions between seals and salmon within the Dornoch Firth and Morrich More SAC. The aims of the plan are to:
    - Manage seal and salmon fishery conflicts within the Moray Firth to have minimal impact on wildlife and tourism;
    - Restore and 'favourable conservation status' of harbour seals and salmon in their SACs;
    - Reduce the impact of shooting on the harbour seal population, through licensing and targeting key areas where they may be conflicts;
    - Reduce the impact of seal predation, especially on spring salmon stocks;
    - Develop non-lethal methods, such as seal scarers, to reduce the number of seal-salmon interactions particularly within rivers; and
    - Monitor and research the status of seal populations, salmon stocks and interactions between them.

Loch Fleet National Nature Reserve

The Loch Fleet National Nature Reserve (NNR) is located 78km from Moray East, and lists marine mammals as an interest feature, particularly harbour seal which haul-out at the site year-round. Surveys carried out by SMRU in August 2017 recorded 138 harbour seals in Loch Fleet NNR (SCOS, 2018).

There are no specific conservation objectives for the site; however, the overall objective is to allow natural change to occur through the site with minimal disturbance to habitats and species.

3.5.1.2 Grey Seal

Grey seals within the Moray Firth are predominantly observed during the summer period, although smaller numbers are present throughout the year. Non-breeding grey seals have been observed at intertidal sites within the Moray Firth, also used by harbour seals. In August 2017, surveys carried out by SMRU recorded a MU population of 1,189 grey seals within the Moray Firth, 548 of which were recorded at the Culbin and Findhorn sites, 273 at Outer Dornoch Firth, and 201 from Helmsdale to Brora (SCOS, 2018).

Breeding grey seals are mostly found at the rocky beaches and caves to the north (Thompson *et al.,* 1996). It is thought that grey seals travel into the Moray Firth from different breeding sites (such as Orkney, Firth

of Forth and Farne Islands) and use the area for food and non-breeding haul-out (Thompson *et al.,* 1996). The closest breeding site to the Development is Orkney, approximately 42km to the north of the Moray East site. The closest haul out site is Helmsdale, which is approximately 42km from Moray East.

Tagging studies within the Moray Firth have identified grey seals foraged over a much wider area than the harbour seal, with great variation between individuals (Thompson *et al.,* 1996). Grey seals are thought to forage on two geographical scales: on short repeated trips to discrete foraging areas and on long distant trips from one haul-out site to another which can be up to 2,100km (McConnell *et al.,* 1999). The majority of trips recorded by McConnell *et al.* (1999) from grey seals tagged at Abertay and the Farne Islands were short and for foraging, around 40km. High-usage corridors can connect haul out sites to foraging areas, which can be up to 100km offshore (Jones *et al.,* 2015). Although it is thought that most seals breed in the same region as they forage, Russell *et al.* (2013) found between 21% and 58% of females foraged in a different region from where they bred around the UK.

The grey seal density across the site is 0.315 individuals per km^2, as calculated from the Russell *et al.* (2017) seals at sea density maps, summarising the mean at sea densities from all 5x5km grid cells overlapping with the Moray East site.

3.5.1.3 Harbour Porpoise

Harbour porpoise are distributed throughout the Moray Firth (Hastie *et al.,* 2003b; Thompson *et al.,* 2010; Robinson *et al.,* 2007). During the warmer months (May to July) there is a seasonal increase of harbour porpoise along the coast due to lactating females and their calves moving inshore, who are then followed by males (Robinson *et al.,* 2007). As bottlenose dolphins are known to attack harbour porpoise where they are present in the same area, the densities of harbour porpoise tend to be lower in areas where bottlenose dolphins are prevalent (Spitz *et al.,* 2006; Evans *et al.,* 2015).

The Joint Cetacean Protocol (JCP) Phase III report (Paxton *et al*., 2016) demonstrated that the Outer Moray Firth has high persistent densities of harbour porpoise during the summer period, with an estimated abundance of 9,000 (Lower Confidence Interval (CI) = 5,800, Upper CI = 13,500), which represents 1.3% of the North Sea MU population (Paxton *et al*., 2016). The Phase III JCP report outlines the densities of harbour porpoise within specific "*areas of interest for offshore development"* around the UK, including the Moray Firth, both inner and outer, which includes the Development area. The harbour porpoise density in this "*Moray Firth offshore development area"* (an area defined within the JCP Phase III Report and covering the Moray Firth) is estimated at 13,500 in the winter period (97.5% CI 7,400 – 27,100) and at 5,300 in the autumn (97.5% CI 3,200 – 9,500), with the estimates for the spring and summer period falling between the estimates for the winter and autumn (Paxton *et al*., 2016). This gives a worst-case density estimate of 1.7 individuals per km^2 based on the winter abundance estimate and the total area of the "*Moray Firth offshore development area"* of 7,899km^2.

The second SCANS (Small Cetaceans in the European Atlantic and North Sea) survey (Hammond *et al*., 2013) estimated harbour porpoise densities of 0.274 individuals per km^2 (Coefficient of Variation (CV) = 0.36) in the relevant block for the Development (Block J), with an estimated abundance of 10,254 (CV = 0.36). Results from the more recent aerial SCANS-III surveys showed a slightly lower density estimate of 0.152 individuals per km^2 (CV = 0.28) within the relevant survey block for the Moray Firth (Block S), with an estimated abundance of 6,147 (95% CI 3,401 – 10,065) (Hammond *et al*., 2017). The estimated MU population for harbour porpoise in the North Sea is 345,373 (95% CI 246,526 – 495,752) based on the SCANS-III survey results (Hammond *et al*., 2017).

Relative density estimates from boat-based surveys at the Development (2010-2012) were 0.16 animals per km^2. For the Moray East site plus 4km buffer (including the three sites of Telford, MacColl and Stevenson) (Moray East ES 2012, Chapter 4 Biological Environment; Moray East, 2012), habitat modelling was undertaken for harbour porpoise and bottlenose dolphin to determine the potential harbour porpoise presence in the Moray Firth. This modelling included a number of different surveys and environmental data such as water depth, slope, distance to shore and the sediment type. The results of these models were used to determine the relative density estimates in the Moray Firth on a 4x4km grid.

The result of this shows a high abundance of harbour porpoise along the shorelines, with more individuals in water depths of 40-50m. Within the Development, there were predicted to be more harbour porpoise present within the north and eastern parts of the site, with relatively few in the south and west. The identified densities range from 0.2 to 1.05 individuals per km^2. See Figure 3-2 for the predicted harbour porpoise density in the Moray Firth.

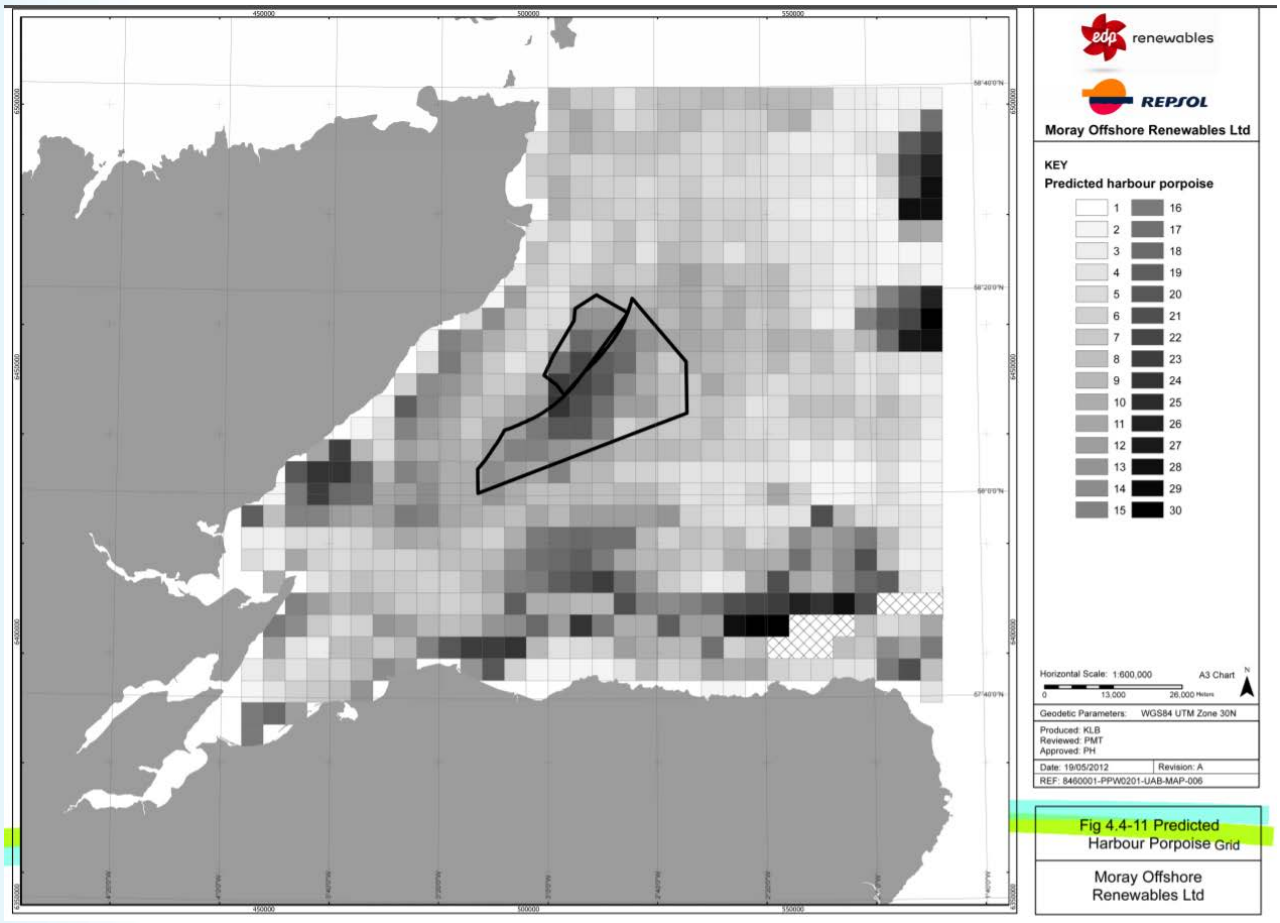

Figure 3-2 Harbour porpoise predicted densities within the Moray Firth (Moray East, 2012)

Data collected from the outer Moray Firth to assess the impact of seismic surveys on marine mammals (DECC funded project), supports the relatively high occurrence of harbour porpoises throughout the Moray Firth with high detection rates of harbour porpoises using autonomous passive acoustic detectors (CPODs) (Bailey *et al.,* 2010; Thompson *et al.,* 2010).

3.5.1.4 Bottlenose Dolphin

A resident population of bottlenose dolphins can be found within the Inner Firth, for which the Moray Firth SAC has been designated. Although the majority of the population (71 to 111 individuals) appear to regularly utilise the Moray Firth SAC (95% CI: 66 to 161), it is clear that a relatively high number of individuals also frequently utilise areas outside the SAC (Thompson *et al.,* 2006; 2009). Further analysis of data from 1990 to 2010 revealed that despite inter-annual variation in the number of dolphins within the SAC, the number had remained stable, however the proportion of the overall population within the SAC had declined, most likely due to an overall population level increase (Cheney *et al*., 2012). Intensive surveys over the entire east coast conducted in 2006 and 2007 found that more than 80% of the photo-identified dolphins within the population were recorded within the SAC (Cheney *et al*., 2013). More recent surveys from 2011 to 2016 show that same trend (Cheney *et al*., 2018); with annual variability in the number of dolphins using the site, but no overall trend, however, this more recent study reports that despite there being no increase in the number of dolphins utilising the SAC (2016 estimate of 103 dolphins

used the site between May and September), there is an overall east coast population increase from 129 (95% HPDI (highest posterior density intervals) 104-155) in 2001 to 189 (95% HPDI 155-216) in 2015 (Cheney *et al*., 2018). This supports the conclusion that the number of dolphins using the site remains stable, with the overall population of the east coast increasing.

The distribution of bottlenose dolphin sightings within the Moray Firth appear to be coastal, with the majority occurring in the Inner Firth and along the southern coast, generally in waters of less than 25m deep (Hastie *et al.,* 2003a; Robinson *et al.,* 2007). Some individuals of the resident population exhibit movement patterns between the Moray Firth and other areas, for example, bottlenose dolphins from the Moray Firth SAC are regularly sighted in the Tay (Thompson *et al.,* 2011). A study conducted by Thompson *et al.,* (2015) used visual data to investigate the abundance and distribution of dolphin species throughout the Moray Firth. A total of 7,870 dolphins were noted during the visual surveys, 7,465 of which were identified as bottlenose dolphin (95%) (Thompson *et al*, 2015). These were predominantly recorded along the coastal areas particularly at the entrance to the inner Moray Firth, with very few recorded in the outer Moray Firth or offshore areas.

The Development area lies within two different bottlenose dolphin MUs; Coastal East Scotland and the Greater North Sea. The Coastal East Scotland MU has an abundance estimate of 195 (95% CI 162 – 253) and the Greater North Sea is estimated at 0 (Inter-Agency Marine Mammal Working Group (IAMMWG), 2015).

Within the JCP Phase III report, the bottlenose dolphin density for the "*Moray Firth offshore development area"* was estimated to be between 250 individuals in the summer (97.5% CI 60-780) and 110 in the autumn (97.5% CI 40-190) (Paxton *et al*., 2016). This gives an estimated density of 0.3 individuals per km^2. The SCANS-III density estimate for bottlenose dolphin in Block S is 0.004 individuals per km^2 (CV = 1.01) , with an estimated abundance of 151(95% CI 0 – 527) (Hammond *et al*., 2017).

Within the Moray East marine mammal baseline surveys, as reported within the EIA, there were relatively few sightings of bottlenose dolphin made within the Moray East site compared to the coastal area, where dolphin species were predominantly bottlenose dolphins (Moray East, 2012). The predictions of bottlenose dolphin abundance were modelled in the same way as outlined for harbour porpoise above, over a 4x4km grid taking into account survey data and environmental variables. Within the Moray East site, 0 – 0.1 bottlenose dolphins were predicted to be present within a 4x4km grid, however the coastline area was predicted to have much higher densities, with up to 0.8 individuals present. The estimated density across the Moray East site is 0.0005 individuals per km^2 (Figure 3-3), much lower than the estimated densities from the JCP Phase III report and from SCANS-III.

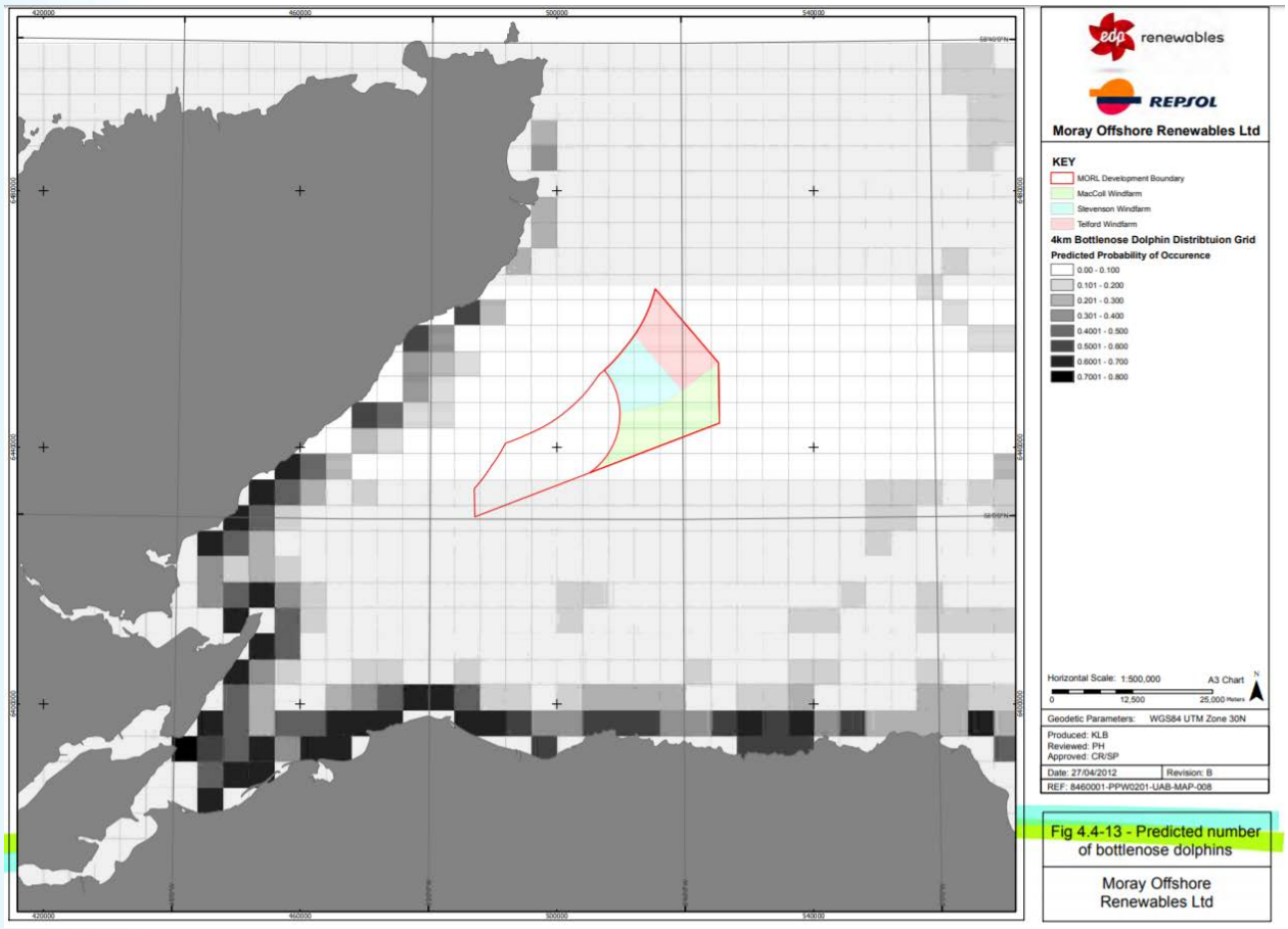

Figure 3-3 Bottlenose dolphin predicted densities within the Moray Firth (Moray East, 2012)

Moray Firth SAC

The Moray Firth SAC is located 38km from the Moray East Site, and lists bottlenose dolphin as a primary reason for site designation.

The Conservation Objectives for the site are;

- To ensure for the qualifying species that the following are established then maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within the site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

The Natura 2000 data form for the Moray Firth SAC (updated in December 2015) records the conservation status of the population of bottlenose dolphins within Moray Firth SAC as "Good" (JNCC, 2016). The bottlenose dolphins that use the Moray Firth are referred to as the Scottish East Coast population and have been recorded between the Firths of Forth and Tay and the Tyne Estuary (Wilson *et al.*, 2004; Thompson *et al.,* 2011). The two most recent assessments found this population to be "Stable (increasing)" (Cheney *et al*., 2012; 2014; Quick *et al*., 2014). As noted above, the most recent population estimate within the SAC itself is 103, while the overall east coast population is estimated to be 189 (Cheney *et al*., 2018)

3.5.1.5 Minke Whale

Minke whale are present within Moray Firth and appear to move south into the North Sea and Western Scotland at the beginning of May and remaining present until October, with occasional sightings outside of this period (Evans, 2008; DECC, 2016). Minke whale are the most abundant whale species within the Moray Firth, with sightings being reported throughout the area (Reid *et al*., 2003; Robinson *et al*., 2007; Thompson *et al.,* 2010). Much of the research has concentrated on the southern coast and deeper trench waters, with observations most commonly occurring in deeper waters further from the shore (Robinson *et al*., 2007; Eisfeld *et al*., 2009). Data indicates that minke whale visit the Moray Firth in late summer to forage with the majority of sightings between May and September (Bailey & Thompson, 2009).

Results of the SCANS-III aerial surveys (Hammond *et al.*, 2017) indicate a minke whale abundance of 383 (95% CI = 0 to 1,364) and a density of 0.010 animals per km^2 (CV = 0.75) within Block S. The Phase III JCP (Paxton *et al*., 2016) project estimated that within the *Moray Firth offshore development area*, there is an abundance of 210 minke whale in the summer (97.5% CI 80 - 540) which drops to 20 (97.5% CI 0 - 60) in the autumn, however in the winter and spring months the abundances of minke whale are much lower. In winter and spring, minke whale abundance estimates within the "*Moray Firth offshore development area"* are 20 (97.5% CI 0 – 130) and 30 (97.5% CI 0 – 260) respectively. This equates to a worst-case density of 0.03 individuals per km^2 when using the summer abundance estimate. This is higher than the 0.01 animals per km^2 calculated from the boat-based surveys for the Moray East site (Moray East, 2012), although the small sample size needs to be taken into account when interpreting these results. Additionally, the boat-based survey showed minke whale have a preference for sandbanks. For minke whale, there is only one identified MU for the whole of the Celtic and Greater North Sea, with an estimated abundance of 23,528 (95% CI 13,989 – 39,572) (IAMMWG), 2015).

Southern Trench proposed Marine Protected Area

Habitat modelling was undertaken to determine if and where there are areas of persistent high densities of minke whale in Scottish waters (Scottish National Heritage (SNH), 2014). The aim was to identify areas that may require further protection through designated sites. Two areas were identified by SNH as having persistent above mean densities of minke whale between 2001 and 2012, these areas were the Sea of the Hebrides and the southern outer Moray Firth (Figure 3-4; SNH, 2014). The coastline of the southern Moray Firth has been estimated to have an average of four individuals per km^2 (Paxton *et al.,* 2014). The draft Conservation Objective for all features of this site (including minke whale) is to conserve (SNH, 2014).

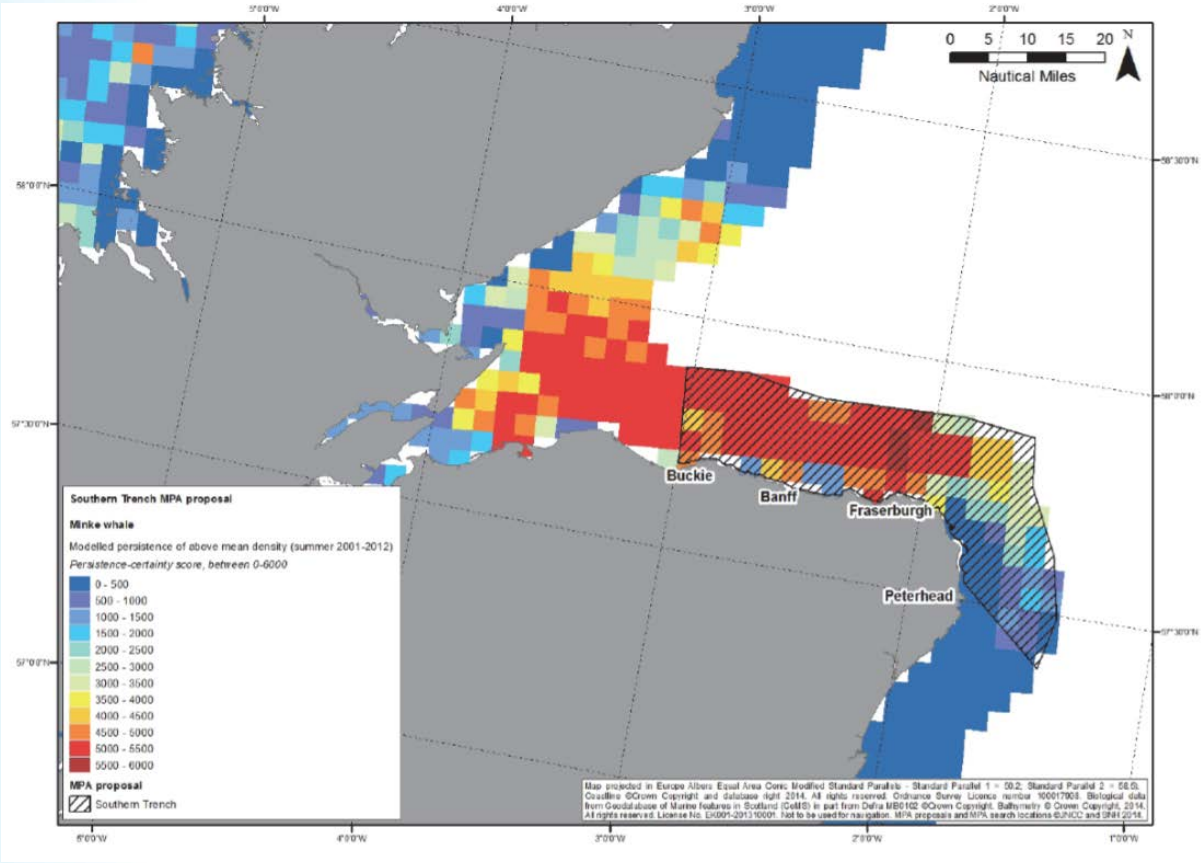

Figure 3-4 Areas with persistently above average density of minke whales in the Southern Trench Moray Firth proposed MPA (SNH, 2014).

3.5.1.6 White-beaked Dolphin

White-beaked dolphin (*Lagenorhynchus albirostris*) are present all year round in Scotland and the east coast of England, however sightings increase in the summer months as animals move towards the shore (Evans, 1992; Northridge *et al.,* 1995; Reid *et al.,* 2003). Sightings within the Moray Firth are low compared to other areas of the northern North Sea.

During surveys carried out in 2011 for the Beatrice Offshore Wind Farm (OWF), most sightings were in offshore areas, with only occasional sightings within the inner Moray Firth (BOWL, 2012). Site specific seasonal variation was not calculated due to the lack of sightings. In surveys of the Moray East site between 2010 and 2012, a total of three of white-beaked dolphins were sighted (Moray East, 2012). The visual surveys conducted between 1980 and 2010 by Thompson *et al.* (2015) recorded a total of 7,870 dolphin individuals; 168 of which were identified as white-beaked dolphin (2% of all sightings). These were concentrated in the offshore areas of the Moray Firth, with very few sightings in coastal areas (**Figure 3-5**).

The Phase III JCP report suggests that numbers within the "*Moray Firth offshore development area"* are highest during the spring, with an estimated abundance of 180 individuals (97.5% CI 80 – 400), with the lowest numbers in winter (40 individuals; 97.5% CI 20 – 110) giving a density estimate of 0.02 individuals per km^2 (Paxton *et al.,* 2016). The reference population for white-beaked dolphin in the Celtic and Greater North Seas MU is 15,895 individuals (95% CI 9,107 – 27,743) (IAMMWG, 2015). Within the SCANS-III Block S, the white-beaked dolphin abundance was estimated to be 868 (95% CI = 0 to 2,258) and a density of 0.021 animals per km^2 (CV 0.69) (Hammond *et al.,* 2017).

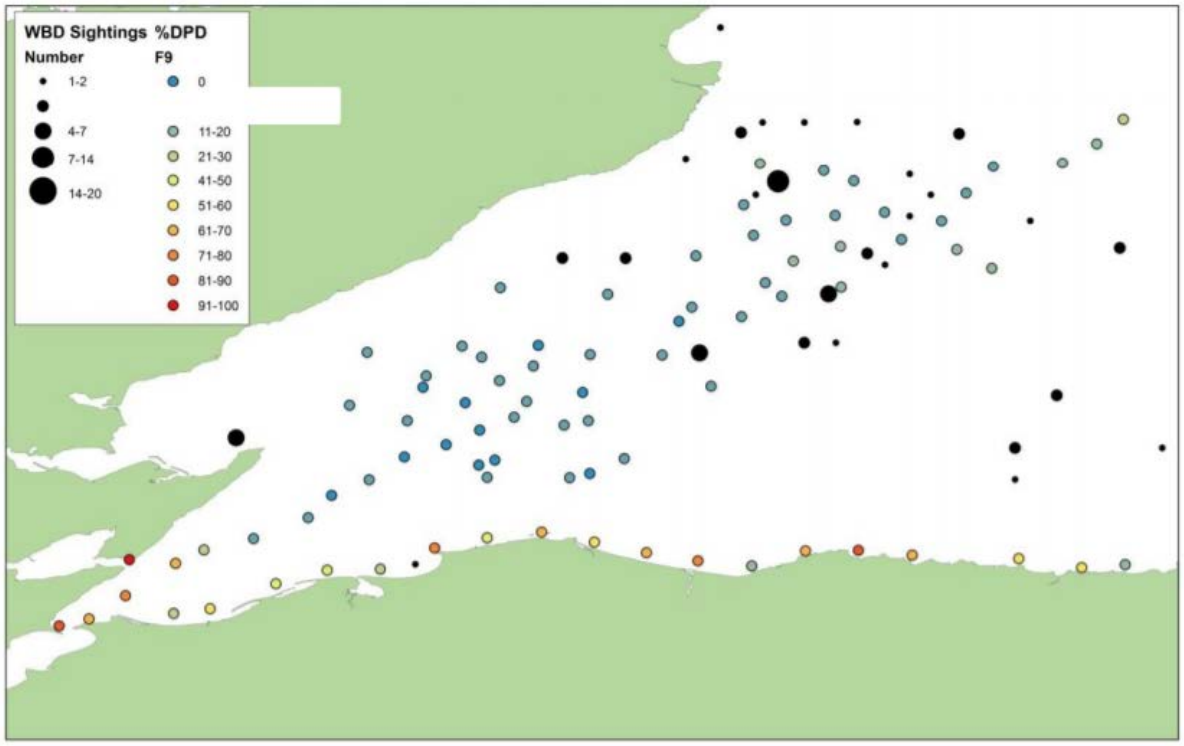

Figure 3-5 White-beaked Dolphin sightings across the Moray Firth recorded between 1980 and 2010 (indicated by the black circles) (Thompson *et al.,* 2015).

3.5.1.7 Common Dolphin

In the UK, common dolphin (*Delphinus delphinus*) are rarely sighted in the North Sea, and are much more likely to be found in the waters off the west coast (Reid *et al.,* 2003). Site specific surveys carried out for the Beatrice OWF sighted 15 common dolphins in total, the majority of which were along the north coast with seasonal peaks in June and July during the calving period (BOWL, 2012). The Cetacean Research and Rescue Unit (CRRU) also reported sightings along the south coast of the Moray Firth between May and August 2006-2009 (Robinson *et al.,* 2010).

Within the JCP Phase III report, the abundance of common dolphin within the *Moray Firth offshore development area* was estimated to be the highest in autumn, with an estimate of 200 individuals (97.5% CI 80 – 570), and the lowest in winter with 10 (97.5% CI 0 – 50). This would give a density estimate of 0.025 individuals per km^2. No common dolphin were recorded in Block S of the SCANS-III survey (Hammond *et al*., 2017). The reference population for common dolphin in the Celtic and Greater North Seas MU is 56,556 individuals (95% CI 33,014 – 96,920) (IAMMWG, 2015). Three common dolphins were recorded during the Moray East surveys carried out between 2010 and 2012 in total (Moray East, 2012).

3.5.1.8 Other Cetacean Species

Risso's dolphin (*Grampeus griseus)* were also recorded in very low numbers in offshore waters off the Moray Firth during site specific surveys for Beatrice OWF, with a total of two sightings (BOWL, 2012). The Moray East site-specific surveys recorded a total of one Risso's dolphin (Moray East, 2012). During the CRRU surveys, five individuals were sighted in total along the southern coastline of Moray Firth between 2001 and 2005, all between 20 to 50m isobaths (Robinson *et al.,* 2007). The JCP Phase III report shows an estimated abundance of 0 in all seasons within the "*Moray Firth offshore development area"* (Paxton *et al.,* 2016), and the preliminary results of the SCANS-III aerial surveys (Hammond *et al*., 2017) did not record Risso's dolphins within survey Block S.

Occasional sightings of killer whale, long-finned pilot whale, fin whale (*Balaenoptera physalus),* humpback whale and sperm whale (*Physeter macrocephalus)* have also been reported in the outer Moray Firth

(DECC, 2016). Killer whale sightings are greatest between April and September, whereas long-finned pilot whales have been sighted in waters off Scotland all year round (DECC, 2016). Due to the rarity of the sightings of these species in Moray Firth, no density estimates are available. A study into the presence of killer whales in the Moray Firth (Robinson *et al.*, 2017), using over 1,900 boat-survey cetacean sightings within the outer Moray Firth area, between May and October, 2001 to 2015, incidental sightings from members of the public (reported to CRRU), and the Sea Watch Foundation data from the same period (which also collates sightings from members of the public) found a total of 143 sightings throughout the whole period. Most of these sightings were made in the outer Moray Firth (~95%), with just nine records within the inner Moray Firth. While killer whales were recorded year-round, the highest numbers were between May and July.

3.5.1 Summary of Species included in the Assessment

As noted in the above section, there are a number of species that are considered to be rare within the Moray Firth area, including Risso's dolphin, killer whale, long-finned pilot whale, fin whale, humpback whale and sperm whale. As such, these species are not considered further for assessment.

A number of seal and cetacean species are found to be present in relatively high numbers, including both grey and harbour seal, harbour porpoise, bottlenose dolphin, minke whale, white-beaked dolphin and common dolphin. These are therefore the species that will be assessed within this application.

Table 3-1 outlines the species included in the assessment, whether they have also been included in the accompanying EPS assessment, and the relevant density estimates and reference populations that each species will be assessed against.

Table 3-1 Summary of species taken forward for assessment, and their density estimates and reference populations

Species	Density estimate	Reference population	Taken forward for EPS Assessment?
Harbour seal	0.016/km^2 (Russell *et al.*, 2017)	879 (Moray Firth MU; SCOS, 2018) 39 (Dornoch Firth and Morrich More SAC count: SCOS, 2018)	No
Grey seal	0.315/km^2 (Russell *et al.*, 2017)	1,189 (Moray Firth MU; SCOS, 2018)	No
Harbour porpoise	1.7/km^2 (*Moray Firth offshore development area*; Paxton *et al.*, 2016)	345,373 (North Sea MU; Hammond *et al.*, 2017)	**Yes**
Bottlenose dolphin	0.3/km^2 (*Moray Firth offshore development area*; Paxton *et al.*, 2016)	195 (Coastal East Scotland MU; Hammond *et al.*, 2017) 103 (Moray Firth population; Chesney *et al.*, 2018)	**Yes**
Minke whale	0.03/km^2 (*Moray Firth offshore development area*; Paxton *et al.*, 2016)	23,528 (Celtic and Greater North Sea MU; Hammond *et al.*, 2017)	**Yes**
White-beaked dolphin	0.021/km^2 (Survey Block S; Hammond *et al.*, 2017)	15,895 (Celtic and Greater North Sea MU; Hammond *et al.*, 2017)	**Yes**
Common dolphin	0.025/km^2	56,556	**Yes**

Species	Density estimate	Reference population	Taken forward for EPS Assessment?
		(Celtic and Greater North Sea MU; Hammond *et al.*, 2017)	

3.6 Ornithology

The Moray Firth's waters are important for the foraging and loafing activities of breeding seabirds. A number of coastal sites in the Moray Firth have been designated as Special Protection Areas (SPAs) under EU Directive 79/409/EEC (the Birds Directive) due to their internationally important seabird breeding populations. Offshore areas are also regularly used by non-breeding sea ducks and divers, and the Moray Firth proposed SPA (pSPA) is currently undergoing the formal process for designation.

The Moray East ES described the offshore ornithological environmental baseline, which identified the key species recorded during boat-based surveys undertaken between April 2010 and March 2012 and aerial surveys and seabird tracking undertaken in summer 2011.

3.6.1 Key Species Commonly Sighted Species in the Moray Firth

Five species were recorded frequently during the boat–based surveys: fulmar (*Fulmarus glacialis*), kittiwake (*Rissa tridactyla*), guillemot (*Uria aalge*), razorbill (*Alca torda*), and puffin (*Fratercula arctica*). All are designated features of at least one of the three local coastal SPAs (East Caithness Cliffs SPA, North Caithness Cliffs SPA, and Troup, Pennan and Lion's Heads SPA).

Population density and abundance estimates for those five species from the boat-based surveys have been provided in Table 3-1 below. Estimated density and abundance in the Moray East site is highest for guillemot and lowest for fulmar.

Table 3-2 Density (Birds / km^2) and Abundance Estimates (Birds Using the Sea) using density surface models, taken from 2010 to 2012 boat-based survey data in the Moray East site (Moray East, 2012)

Species	Breeding Season (Apr – Aug/Sep)				Non-Breeding Season			
	Density		Abundance		Density		Abundance	
	Site	4 km Buffer	Site	4 km Buffer	Site	4 km Buffer	Site	4 km Buffer
Fulmar	2.77	1.91	782	750	0.25	0.20	197	189
Kittiwake	7.90	4.69	1,963	1,532	0.79	0.29	261	204
Guillemot	25.57	18.60	6,732	6,943	2.84	3.47	990	1,021
Razorbill	6.03	3.53	1,661	1,674	2.64	3.04	892	899
Puffin	6.55	5.55	1,916	1,971	0.75	1.05	450	463

3.6.2 Sites Designated for Ornithological Receptors

A number of sites designated for ornithological receptors were considered in the Moray East ES. A summary of SPAs relevant to the meteorological mast decommissioning activities are provided in Section 3.11 below. Sites include: East Caithness Cliffs SPA; North Caithness Cliffs SPA; Troup, Pennan and Lion's Heads SPA; and Moray Firth pSPA.

3.7 Marine Archaeology

The assessment of marine archaeology within the Moray East site, undertaken by Headland Archaeology Ltd for the Moray East ES (2012), demonstrated the presence of four previously recorded wreck sites, a single recorded obstruction of potential archaeological interest and 20 further anomalies of possible archaeological interest seen in the marine geophysical data assessed for the project. The Moray East site has subsequently been subject to further investigation as part of seabed preparation activities including boulder clearance and Unexploded Ordnance (UXO) investigation and clearance.

As part of the UXO investigation and clearance works a further 20 archaeological finds were identified across the Moray East Site and OfTI comprising 18 historic UXO or UXO-related finds, a concentration of metallic debris and an aircraft engine block. Fifty further items of possible archaeological interest were identified comprising 37 items of metal debris (encompassing a large variety of objects including metal bars, pipes, tubes, plates, beams and scrap metal), 11 items of fishing gear and two sections of rope. Five further items of possible archaeological interest, not previously identified as part of the UXO identification campaign, were also identified during the boulder clearance works, all comprising unidentified items of debris of unknown nature, origin and date.

The location of the meteorological mast was compared to the mapped locations of these previously identified heritage assets using Geographical Information Systems (GIS) and none of the previously identified wrecks, obstructions, anomalies or finds of possible archaeological interest are located within the 150 m radius around the meteorological mast. However, as demonstrated by the debris encountered during the UXO and boulder clearance campaigns, there is potential for further previously undiscovered items of archaeological (or possible archaeological) interest to be present within this 150 m area around the location of the meteorological mast.

With respect to the potential for submerged prehistoric archaeology to be present, the Moray East ES (2012) concluded that, whilst the absence of organic sediments such as peats within later sediments indicates that there is no potential for palaeoenvironmental data relating to the Holocene, the presence of residual, scattered flints and lithic artefacts within the marine sediments remains a possibility.

3.8 Commercial Fisheries

The meteorological mast is located within ICES statistical rectangle 45E7. The latest ICES data (ICES, 2018) show that the principal species targeted in 2018 were: haddock (34% of landings from 45E7, by value), scallops, (30%), crabs (11%), squid (8%), cod (5%), monkfish / anglerfish (4%) and Nephrops (3%). The 2018 data show the species composition of landings are largely similar to the baseline reported in the Moray East ES. The following commercial fishing methods are primarily employed: otter trawls and seine nets to target whitefish; dredges to target scallops; demersal trawls to target squid; and otter trawls to target Nephrops (Moray East, 2012).

Landings values for all species from rectangle 45E7 are broadly highest between May and October, although in 2018 there were substantial landings recorded through to December. The total value of landings from 45E7 ranged between approximately £1.6 million and £3.2 million per year during the period 2014 to 2018. The majority of landings from rectangle 45E7 are into ports in the Moray Firth area, the principle port being Fraserburgh with around 45% of landings (by value) (Moray East, 2012).

3.9 Shipping and Navigation

AIS data was recorded between 4 and 31 March 2018. Analysis showed an average of approximately 11 unique vessels per day was recorded. The majority of vessels recorded were cargo and fishing vessels in both 2010 and 2018 (Moray East, 2018b).

The meteorological mast is located within the vicinity of the Jacky Oil Field and the Beatrice Oil Field. The closest platform is located at the Jacky Oil Field, approximately 5nm west of the meteorological mast.

3.10 Designated Sites

There are a number of nature conservation designations within the Moray Firth and in the vicinity of the meteorological mast. Designated sites have been included in the assessment where there is spatial overlap and/or there are mobile features which may occur within the Moray East site. A summary of the

designated sites that have the potential to be impacted by the meteorological mast decommissioning is provided in Table 3-2.

Table 3-3 Designated sites with the potential to interact with meteorological mast decommissioning activities

Site name	Screened in qualifying features
Moray Firth SAC	Bottlenose dolphin
Dornoch Firth and Morrich More SAC	Harbour Seal
East Caithness Cliff SPA	Migratory species during breeding season: guillemot, herring gull, kittiwake, razorbill and shag Birds present during breeding season: puffin, great black-backed gull, cormorant, fulmar, razorbill, guillemot, kittiwake, herring gull and shag.
North Caithness Cliff SPA	Migratory species during breeding season: guillemot Species present during breeding season: puffin, razorbill, kittiwake, fulmar and guillemot
Troup, Pennan and Lion's Head SPA	Migratory species during breeding season: guillemot Species present during the breeding season: razorbill, kittiwake, herring gull, fulmar and guillemot.
Moray Firth pSPA	The European Shag is proposed as a breeding and non-breeding species. The following non-breeding species have also been proposed: Common eider; Common goldeneye; Common scoter; Great northern diver; Greater scaup; Long-tailed duck; Red-breasted merganser; Red-throated diver; Slavonian grebe and Velvet scoter.

4 Assessment of Effects

4.1 Approach to Assessment

The following sections provide an assessment of the potential environmental effects of Phase 1 of the meteorological mast decommissioning (i.e. removal of the lattice and monopile / platform structures) in relation to the following topics: physical processes, benthic ecology, fish and shellfish resources, marine mammals, ornithology, marine archaeology, commercial fisheries, and shipping and navigation. A summary of the designated sites that may be affected by the decommissioning works is provided in Section 4.11.

The impact assessment process follows the Chartered Institute of Ecology and Environmental Management (CIEEM) (2018) *Guidelines for Ecological Impact Assessment in the UK and Ireland – Terrestrial, Freshwater, Coastal and Marine*. The impact significance criteria used are provided in Table 4-1 below.

Table 4-1 Impact Significance Definitions

Impact Significance*	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or, could result in an exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision-making process.
Negligible	No discernible change in receptor condition.
No impact	No change in receptor condition, therefore no impact.

*A significant impact is any impact significance greater than a minor impact.

4.2 Impacts During Phase 2 of Decommissioning

While many of the impacts addressed in the following sections are relevant to the activities that will be undertaken as part of Phase 2, there are elements of the Phase 2 decommissioning works that are currently undetermined and will be provided at the FEED stage. As such, a further environmental assessment will be undertaken and reported prior to the Phase 2 works being commenced. Where possible, the following sections have identified the potential impacts that will be considered in the Phase 2 assessment.

4.3 Physical Processes

4.3.1 Increases in SSC and Sediment Deposition

Should a JUV be employed during the decommissioning works, there is potential that seabed disturbance, resulting in an increase in suspended sediment concentration (SSC), may occur as a result of:

- deployment and retraction of the JUV spud cans; and,
- deployment and retraction of vessel anchors associated with other decommissioning vessels (e.g. flat top barge).

The actual process of removing the lattice and monopile structure is not anticipated to result in any notable increase in SSC.

Fine silt / clay particles are largely absent within an 800 m radius of the meteorological mast (the anticipated maximum distance at which the flat top barge anchors may be deployed). Given that the tidal currents are generally incapable of transporting coarser sediment (see Section 3.2), sediments mobilised into the water column as a result of the above activities would be expected to resettle almost immediately (i.e. both the spatial extent and duration of sediment plumes would be very small). As such, increases in SSC and subsequent deposition will be limited to locations within close proximity to the JUV and vessel anchors, and only during the period of deployment and retraction. The deployment of the JUV will only occur at one location during Phase 1, within a 150 m radius of the meteorological mast.

Due to the short-term, temporary and localised nature of the decommissioning works, the effects on SSC and sediment deposition levels are considered to be **negligible,** and no mitigation is considered necessary.

4.3.2 Potential Impacts During Phase 2

While the Phase 2 works may also result in seabed disturbance and potential suspension of sediment during redeployment of the JUV (if required), floating of the GBS and removal of the concrete mattresses, this will be fully assessed when the FEED has been issued, prior to the Phase 2 works being commenced.

4.4 Benthic Ecology

4.4.1 Habitat Disturbance

Should a JUV be deployed during decommissioning, there may be potential damage to sensitive components of the benthic habitat as a result of:

- deployment of the JUV spud cans, the overall footprint of which (i.e. the combined area of each spud can) would equate to a maximum area of c.1,260 m2, based on a conservative estimate of a spud can diameter of 20 m;
- deployment and drag of vessel anchors associated with other decommissioning vessels (e.g. flat top barge); and
- chain / rope drag from the marker buoy installed on top of the caisson.

The dominant substrates across the Moray East site, including at the site of the meteorological mast, are subtidal sands and gravels. Biotope habitats recorded within an 800 m radius of the meteorological mast (the anticipated maximum distance at which the flat top barge anchors may be deployed) are *SS.SSa.CFiSa EpusOborApri (Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand) and *SS.SCS.CCS MedLumVen (Mediomastus fragilis, Lumbrineris spp.* and venerid bivalves in circalittoral coarse sand or gravel). These substrates and biotopes are typical of the dominant seabed across the wider Moray East site (Moray East, 2012). Taking into account the footprint of the spud cans, plus the limited area in which anchor and marker buoy chains may drag, the affected area would represent a minuscule proportion (less than 0.1%) of similar substrate and habitat characterised in the Moray East site, which in itself is understood to be representative of the dominant substrates and habitats across the Moray Firth (Moray East, 2012).

Whilst acknowledging that the dominant substrate (subtidal sands and gravels) is a PMF under the Scottish PMF List, such substrates and the benthic communities associated with the above biotopes are considered to have high resilience to disturbance of the seabed and substrate (Tillin, 2016a and 2016b). As such, they would be expected to recover suitably from a one-off, temporary event such as the deployment of the JUV, vessel anchors and / or marker buoy. There were no other benthic species or habitats of conservation concern recorded within the affected area during the benthic ecology study for the Moray East ES.

Due to the ubiquitous nature of the benthic habitats that may be affected during the decommissioning works, coupled with their expected recoverability and the temporary nature of the works, the effects of

JUV deployment and marker buoy /anchor chains on benthic habitat and communities are considered to be **negligible,** and no mitigation is considered necessary.

4.4.2 Increase in SSC and Sediment Deposition

The sensitivity of benthic communities across the whole of the Moray East site was assessed in relation to seabed disturbances and increases in SSC in the Moray East ES (Moray East, 2012). Given that the biotope habitats within the vicinity of the meteorological mast are predominately sedimentary and characterised by sediment-burrowing animals, such as polychaetes and bivalves, they are expected to be tolerant to temporary increases in SSC and light deposition.

Due to the low sensitivity of the benthic communities present and the negligible magnitude of the SSC increases as result of JUV deployment and use of vessel anchors (see Section 4.3.1), the impacts of increased SSC and sediment deposition on benthic ecology are considered to be **negligible**. Furthermore, since the sediment characterisation surveys undertaken for the Moray East ES indicate there are no concerns regarding contaminant concentrations (Moray East, 2012), there is considered to be no risk of effects on benthic life due to release of contaminants from disturbed sediment.

4.4.3 Spread / Introduction of Invasive Non-Native Species

All vessels involved with the decommissioning of the meteorological mast will strictly adhere to national and international best practices, as advised by SEPA, for avoiding the spread and / or introduction of invasive non-native species (INNS). Marine growth on the monopile will be removed once in port, under controlled conditions, following SEPA licence regulations, thereby ensuring that there is minimal risk of non-native species present on the structures returning into the marine system. Given the methods in place, there will be **negligible** effects on native benthic species.

4.4.4 Potential Impacts During Phase 2

During Phase 2 of decommissioning, removal of the GBS and concrete mattresses may represent a potential disturbance to benthic habitats. Impacts arising as a result of this will be fully assessed following issue of the FEED, prior to Phase 2 being commenced.

The risk of introducing and / or spreading INNS during the flotation and removal of the GBS and concrete mattresses will also be assessed prior to Phase 2 being commenced.

4.5 Fish and Shellfish

4.5.1 Underwater Noise Disturbance

Potential impacts from underwater noise associated with anthropogenic works may have the following effects on fish species (Popper *et al.*, 2014):

- physical barotrauma injury and, in severe cases, death;
- temporary or permanent hearing loss;
- disturbance and behavioural modification (including auditory masking); and
- population-level effects on fitness and survival.

The sources of underwater noise associated with the decommissioning works are likely to include the following:

- JUV, flat top barge and other vessel engine noise; and
- DWCM operation.

Noise disturbance during the decommissioning is expected to be at its peak during cutting operations for the removal of the monopile structure in Phase 1. The use of DWCM is generally regarded as a "low noise" activity (Twachtman *et al.*, 2004; Pangerc *et al.*, 2016) and is used as a low-impact alternative to other cutting methods. The main fluid pump (the primary noise source in the system) for the DWCM hydraulics will be powered on board the support vessel. However, while it has been reported that DWCM is often not audible above associated vessels, particularly at low frequencies (Pangerc *et al.*, 2016), a combined use of DWCM with support vessels, WROV, flat top barge and JUV may result in a level of underwater noise that causes fish / shellfish to avoid the immediate area. The extent of the impact would relate to the proximity of the receptor to the vessels and cutting activity (Popper *et al.*, 2014).

It is possible that the timing of Phase 1 decommissioning activities (including use of the DWCM) will coincide with the spawning periods for a number of marine species (including hearing specialists such as herring) and the migration runs of diadromous species. Hearing specialists (i.e. those with a swim bladder involved in hearing) and larvae are at risk of behavioural modification or masking effects in the near field when continuous anthropogenic sound sources are present (Popper *et al.*, 2014).

However, given that the noise generated will be temporary (decommissioning vessels would only be on site for approximately five days and the cutting operation is envisaged to take approximately seven hours, provided there are no obstructions), non-percussive by nature and localised even in the context of the Moray East site, there will be a **negligible** effect at a population level to any fish and shellfish species in the Moray Firth. Given the distance from the coast, there would be no risk of forming noise barriers to migration routes.

4.5.2 Increase in SSC and Sediment Deposition

As set out in Section 4.3.1, sediment disturbance (i.e. an increase in SSC) due to the decommissioning activities would be highly localised, and resettlement would occur almost immediately due to the nature of the sediment and hydrodynamic conditions. When looking at different life stages, fish and shellfish eggs and larvae have comparatively high sensitivity to an increase in SSC and sediment deposition. However, in the context of the defined spawning and nursery grounds (Ellis *et al.*, 2010), the extent of the affected area is negligible.

Mobile fish and shellfish species would be able to avoid localised areas of increased SSC. Juveniles and adults within the immediate vicinity of the JUV deployment would be able to relocate to adjacent unaffected areas without leaving their normal distribution range.

Given the above, there would be a **negligible** effect on fish populations resulting from sediment suspension and resettlement, when set into the context of the defined nursery and spawning grounds (Ellis *et al.*, 2010). Furthermore, the sediment chemistry characterisation indicates that there would be no concerns regarding contaminant concentrations in disturbed material (Moray East, 2012).

4.5.3 Damage to Supporting Habitat

As described in Section 4.4.1, any damage to subtidal habitat would represent an extremely small fraction of the available habitat across the wider Moray East site (and within the context of nursery and spawning grounds). Subtidal habitats affected by deployment of the JUV, anchor chains and / or marker buoy would be expected to recover once the decommissioning works have been completed, thus presenting no significant or long-term changes to the habitat available for fish and shellfish. Although the sandeel species-complex forms a PMF on the Scottish Biodiversity List, the effects on subtidal sand habitats, described in Section 4.4.1, would not constitute a significant change in the availability of such habitats for sandeels.

Due to the ubiquitous nature of the supporting habitat, coupled with the temporary nature of the decommissioning works and the expected recoverability of the habitat affected, the indirect impact of Phase 1 decommissioning activities on fish and shellfish resources is considered to be **negligible**, and no mitigation is considered necessary.

4.5.4 Potential Impacts During Phase 2

During Phase 2 of the decommissioning, removal of the GBS and concrete mattresses may represent a disturbance to potential supporting habitat within the footprint of the structures. Impacts arising as a result of this will be fully assessed prior to Phase 2 being commenced.

4.6 Marine Mammals

4.6.1 Marine mammal assessment methodology

In addition to the methodology for the impact assessment outlined in section 4.1, the magnitude of impact on marine mammals also took into account the criteria outlined below in Table 4-2. The thresholds used to define the level of magnitude for each impact have been defined by expert judgement, current scientific understanding of marine mammal population biology and JNCC *et al.* (2010) draft guidance on disturbance to EPS species. For each effect, the assessment describes the magnitude in a qualitative or quantitative way.

Table 4-2 Definitions of impact magnitudes for marine mammals

Magnitude	Definition
High	Permanent irreversible change to exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that more than 1% of the reference population are anticipated to be exposed to the effect. OR Temporary effect (limited to phase of development or proposed scheme timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that more than 10% of the reference population are anticipated to be exposed to the effect.
Medium	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that between 0.01% and 1% of the reference population anticipated to be exposed to effect. OR Temporary effect (limited to phase of development or proposed scheme timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that between 5% and 10% of the reference population anticipated to be exposed to effect.
Low	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that between 0.001% and 0.01% of the reference population anticipated to be exposed to effect. OR Intermittent and temporary effect (limited to phase of development or proposed scheme timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that between 1% and 5% of the reference population anticipated to be exposed to effect.

Magnitude	Definition
Negligible / very low	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that less than 0.001% of the reference population anticipated to be exposed to effect. OR Intermittent and temporary effect (limited to phase of development or proposed scheme timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that less than 1% of the reference population anticipated to be exposed to effect.

4.6.2 Underwater Noise Impacts

The activities and noise sources during Phase 1 of the proposed meteorological mast decommissioning that could impact marine mammals include:

- cutting of the monopile; and
- vessels.

The potential impacts from underwater noise on marine mammals are:

- physical injury, and in extreme cases, fatalities;
- permanent auditory injury / permanent loss of hearing sensitivity (Permanent Threshold Shift (PTS));
- temporary auditory injury / temporary loss in hearing sensitivity (Temporary Threshold Shift (TTS));
- disturbance and behavioural effects, including auditory masking; and
- barrier effects.

The potential impact of underwater noise will depend on a number of factors which include, but are not limited to:

- source levels of noise;
- frequency relative to the hearing bandwidth of the animal (dependent upon species);
- propagation range, which is dependent upon;
- sediment/sea floor composition; and
- water depth;
- duration of exposure;
- distance of the animal to the source; and
- ambient noise levels.

4.6.2.1 Monopile cutting

There are two options for cutting the monopile into two sections, which will involve subsea cutting:

i. cut and lift transition deck piece; and

ii. cut and lift monopile section, or cut and remove in one (i.e. monopile complete with transition deck piece.

For the cutting of the monopile, it is proposed to use a DWCM. The DWCM will be crane deployed and final positioning will be provided by an ROV. The DWCM would be lowered onto the base, clamp on, and cut. An initial estimate is that the cut would take approximately seven hours. However, if there are internal obstructions, such as pipes, hoses and ladders, the cut could take longer.

There is limited information on the level of noise arising from cutting equipment (BEIS, 2018; Shell, 2018). However, one published study measured the level of noise from a DWCM during the cutting of 0.76 m diameter conductor at an offshore gas platform in the North Sea, was barely discernible above background noise levels including the noise of associated vessel presence. The cutting increased noise levels of between 4 dB and 15 dB above background levels at higher frequencies, predominantly above 5 kHz, 800 m from source. At lower frequencies, there was no increases in sound levels above that from the associated vessels (Pangerc *et al.,* 2016).

As outlined in the BEIS (2018) draft Review of Consents (RoC) Habitats Regulations Assessment (HRA) for the Southern North Sea (SNS) SAC for harbour porpoise, although the information available is limited, it is predicted that noise from cutting equipment would not occur at levels at which the onset of permanent auditory injury (PTS) is predicted to occur in high frequency species, such as harbour porpoise, and, therefore, is also below the PTS threshold for other medium and low frequency marine mammal species, such as dolphin species, minke whales, grey or harbour seal.

The BEIS (2018) draft RoC HRA concluded that although there is potential for a localised disturbance impact, it will not be significantly greater than that arising from the accompanying vessels and, therefore, no additional impacts beyond those estimated to arise from the accompanying vessels are predicted to occur. Any impacts, should they occur, will be temporary with any marine mammals returning to the area once the noise has stopped.

Taking a precautionary approach, the number of each of the included marine mammal species has been assessed for disturbance impacts from the monopile cutting operations, based on the estimated distance at which underwater noise from the activities can be heard above background noise (a range of 800m, or an area of 2.01km^2). This is considered to be precautionary as it is unlikely that all marine mammals would be disturbed from this area as a result of these activities. Table 4-3 presents the assessment for each species, using the potential disturbance area and estimated density for each species, and comparing to the overall population (or management unit). See Table 3-1 for the density and reference population of each species used in this assessment.

Table 4-3 Impact assessment for the disturbance of marine mammals from monopile cutting

Marine mammal species	Number of individuals potentially disturbed (% of the population)	Magnitude of impact
Harbour seal	0.03 (0.003% of the reference population; 0.07% of the Dornoch Firth and Morrich More SAC count)	Temporary impact, with a **negligible** magnitude of impact.
Grey seal	0.63 (0.05%)	
Harbour porpoise	3.42 (0.001%)	
Bottlenose dolphin	0.60 (0.31% of the reference population; 0.58% of the Moray Firth SAC population)	
Minke whale	0.06 (0.0003%)	
White-beaked dolphin	0.04 (0.0003%)	
Common dolphin	0.05 (0.00009%)	

As shown by the assessment in **Table 4-3** above, there will be a negligible impact to all marine mammal species and populations, including those within nearby designated sites, as a result of disturbance from underwater noise associated with monopile cutting activities.

4.6.2.2 Vessels

The Phase 1 decommissioning activities will utilise a variety of vessels, which could include jack-up barge or jack up drill rig, transport barge with four-point mooring, diamond wire cutting vessel, and ROV and CTV support vessel; totalling four vessels that may be used during this phase. However, not all these vessels will be on site at any one time. The estimated duration of vessels on site for Phase 1, including transit and positioning, removal of mast, removal of main deck and monopile is 5.5 days plus 3 days to tow to quays side and off load.

The primary sources of sound from vessels are propellers, propulsion and other machinery, with the majority of vessel noise resulting from propeller cavitation, which are particularly prominent for dynamic positioning systems (DPS).

In general, vessel sound is continuous and results from narrowband tonal sounds at specific frequencies as well as broadband sounds. Acoustic broadband source levels typically increase with increasing vessel size, with smaller vessels (<50 m) having a source root mean square (rms) sound pressure level (SPL) of 160-175 dB re 1 µPa at 1m, medium size vessels (50-100 m) 165-180 dB re 1 µPa at 1m and large vessels (> 100 m) 180-190 dB re 1 µPa at 1m (Richardson *et al.,* 1995), although sound levels depend on the vessel.

Kyhn *et al.* (2014) identified noise generation from various activities of a drillship (the Stena Forth) equipped with six dynamic positioning thrusters and determined that the dynamic positioning control system generated noise at around 100 dB re 1 µPa (rms) at frequencies between 20 – 35k Hz.

Radiated vessel noise relates to factors including ship size, speed, load, condition, age and engine type (Hawkins *et al.,* 2014). Noise levels reported by Malme *et al.* (1989) and Richardson *et al.* (1995) for large surface vessels indicate that physiological damage to auditory sensitive marine mammals is unlikely. However, the levels could be sufficient to cause local disturbance to marine mammals in the immediate vicinity of the vessel, depending on ambient noise levels.

Modelling by Heinänen and Skov (2015) indicates that the number of ships represents a relatively important factor determining the density of harbour porpoise in the North Sea MU, with markedly lower densities with increasing levels of traffic. A threshold level in terms of impact seems to be approximately 20,000 ships per year (approximately 80 vessels per day within a 5km^2 area). The number of vessels on site, including other vessels in the surrounding area, would be significantly lower than this threshold; therefore, the significant disturbance of sensitive species such as harbour porpoise is unlikely.

A study into the impact of bottlenose dolphin foraging activities (Pirotta *et al*., 2015), as a result of vessel presence and noise, in the inner Moray Firth, found that the presence of vessels led to a reduction in the probability of a buzz (used by bottlenose dolphins during foraging) occurring by 49%, but the level of noise associated with a vessel did not change the probability of a buzz occurring. This suggests that the reduction in foraging buzzes may be due to the presence of the vessel itself, and the noise level associated with that vessel (and the vessel type) does not make a difference to the change in foraging behaviours observed. This change was present when the vessel was present only, and no change was observed following the presence of the vessel. The observed change also increased with the number of vessels present in the area (Pirotta *et al*., 2015).

Underwater noise modelling for vessels has been undertaken for several offshore wind farm projects (e.g. Norfolk Boreas Limited, 2019) using sound sources of 171dB re 1µPa @1m for large vessels and 164dB re 1µPa @1m for medium vessels. The results of the underwater noise modelling indicated that any marine mammal would have to remain in close proximity (i.e. less than 100m) of a large vessel for 24 hours to be exposed to levels of sound that are sufficient to induce PTS as per the Southall *et al.* (2019) threshold criteria. It is considered highly unlikely that any marine mammal would remain within such close proximity to any vessel, for any length of time, and that therefore there is no potential for permanent auditory injury for marine mammals, as a result of the presence of vessels. The possible behavioural response of harbour porpoise to underwater noise from each vessel, based on the Lucke *et al.* (2009) unweighted sound exposure level (SEL) of 145 dB re 1 µPa, was up to 150m for large vessels and less than 50m for medium vessels.

The number of vessels that are predicted to be on site are low, and would be present for a short term. In addition, the potential disturbance ranges are very small, and are considered to be not significant for any marine mammal species. The potential from the disturbance from vessels would be less than that for the monopile cutting, as presented in **Table 4-3** above.

There is therefore a no risk of auditory injury (PTS) or significant disturbance to marine mammals, as a result of vessels during the decommissioning of the met mast.

4.6.2.3 Vessel interaction

Increased vessels on site and moving to and from the site can results in:

- increased risk of collisions between vessels and marine mammals; and
- disturbance at seal haul-out sites.

Once on-site vessels will remain in position and when vessels are underway, they will maintain a steady speed and course; therefore, any increased collision risk for marine mammals would be negligible as marine mammal species would be able to detect and avoid the vessels.

To reduce the risk of collisions with vessels and disturbance from vessels (including disturbance at seal haul-out sites), it is recommended that vessel movements, where possible, are incorporated into recognised vessel routes and to areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk or increased disturbance. All vessel movements should be kept to the minimum number that is required to reduce any potential collision risk or disturbance from vessels. Additionally, vessel operators will use good practice to reduce any risk of collisions with marine mammals.

4.6.2.4 Recommended mitigation

Although the assessment indicates no potential risk of injury, auditory injury or significant disturbance to marine mammals, where possible, marine mammal observations will be conducted during the decommissioning activities, especially those associated with increased underwater noise (such as cutting the monopile).

As there is no risk of injury or auditory injury to marine mammals and any disturbance from underwater noise would be localised and temporary, non-dedicated Marine Mammal Observers (MMOs) can be used. A non-dedicated MMOs refers to trained MMOs who may undertake other roles on the vessel when not conducting their mitigation role. This person or persons can be a member of the vessel's crew provided that during the mitigation period, they do not undertake any other roles on the vessel. More than one trained observer may be required to ensure entire mitigation zone around the vessel(s) can be continuously observed.

The procedure for marine mammal mitigation is based on the current JNCC (2017) '*Guidelines for Minimising the Risk of Injury to Marine Mammals from Geophysical Surveys*':

- A pre-activity search of the mitigation zone (800 m around the met mast) prior to any underwater activity commencing, for a period of at least 30 minutes by MMO(s) depending on visibility conditions (pre-activity searches only to be undertaken in daylight and in good visibility).
- If a marine mammal is sighted within the 800 m mitigation zone during the pre-activity search, where possible, commencement should be delayed until the mitigation zone has been clear of marine mammals for a period of at least 20 minutes, and the pre-activity search has been completed.

In addition, marine mammal observations, where possible, during the decommissioning activities (especially those associated with increased underwater noise such as cutting the monopile), will be

undertaken to determine if marine mammals approach the area or are observed avoiding the area. Again, this can be conducted by non-dedicated, but trained, MMOs. This information is useful for informing future assessments of similar activities.

JNCC recording forms will be used by the MMOs to record start and end of survey periods, activities and operations, marine mammal sighting and actions taken (such as delaying the start of any activities). Further details on the forms can be provided, if required.

4.6.2.5 Reporting

A report will be prepared once the decommissioning of the met mast has been completed, which will provide an outline of the operations and summarising the marine mammal sightings and actions taken. The MMO recording forms will be included as an Appendix of the report.

4.7 Ornithology

4.7.1 Visual and Noise Disturbance to SPA Qualifying Features and Other Seabirds

The decommissioning activities have the potential to cause visual and noise disturbance to loafing and foraging birds in the vicinity of the meteorological mast and vessels. The nearest designation, East Caithness Cliffs SPA, is located over 20 km from the meteorological mast; therefore, there is no risk of disturbance to birds within SPAs during the decommissioning works. However, given that decommissioning activities may be undertaken during the breeding season, it is possible that qualifying breeding features of East Caithness Cliffs, North Caithness Cliffs and Troup, Pennan and Lion's Heads SPAs and Milford Haven pSPA may be present, as evidenced by boat-based surveys reported in Section 3.6.1.

Given the distance from the nearest breeding coastal colonies, it is anticipated that the visual and noise disturbances caused by the decommissioning activities would have no significant bearing on the foraging ability of qualifying SPA features (or any other seabirds) from those colonies. There would be numerous alternative foraging (and loafing) locations within the expected foraging range of all species. Based on a conservative assumption of total avoidance by birds to a distance of 500 m around the meteorological mast during decommissioning, this would represent an exclusion area of 0.8 km^2 in a site where there are already existing (and ongoing) disturbances in the form of construction work for the Moray East OWF. Putting the scale of the exclusion area into context, the Moray Firth pSPA covers an area of 1,762 km^2.

Any visual and noise disturbances would be limited to the approximate five-day period during which the decommissioning vessels are on site, and conditions would return to baseline upon completion of the activities. As such, any impacts on seabirds in the context of populations within the Moray Firth would be **negligible**.

4.7.2 Impacts on Prey Availability

Given that potential impacts to benthic ecological communities and fish and shellfish resources are assessed to be negligible (Section 4.3 and Section 4.4 above), it stands to reason that the indirect impact on foraging seabirds due to the loss of such prey resources would also be **negligible**.

4.8 Marine Archaeology

As stated in Section 3.7 above, there are no previously identified heritage assets or Archaeological Exclusion Zones (AEZs) within the area defined by a 150 m radius from the met mast location.

Whilst the removal and recovery of the lattice structure, monopile and platform themselves will have **no impact** upon archaeology and cultural heritage assets, the placement of jack-up feet or vessel anchors

upon the seabed does have the potential to interact with previously undiscovered material of potential archaeological interest. Similarly, activities associated with the removal of the gravity base structure, which will form the basis of a separate FEED study, could result in interaction with previously unidentified archaeological material.

Any objects identified as potential archaeology during the works will be reported in accordance with the Moray East Marine Archaeological Reporting Protocol (MARP). The approach to implementing the MARP across the project, previously agreed with Historic Environment Scotland (HES) and MS-LOT, comprises adherence to the Offshore Renewables Protocol for Archaeological Discoveries (ORPAD) (The Crown Estate, 2014). The aim of ORPAD is to reduce any adverse effects of the project on the historic environment by enabling people working on the development to report unexpected discoveries of archaeological material in a manner that is both convenient to their everyday work and effective with regard to the requirements of Archaeological Curators. Moray East will be responsible for ensuring that the relevant staff on all decommissioning vessels, will be informed of the Protocol, details of the find types that may be of archaeological interest, and the potential importance of any archaeological material encountered.

With the application of ORPAD to ensure prompt reporting / recording to MS-LOT and HES of archaeological remains encountered or suspected during the works, the potential impact of the decommissioning of the met mast upon marine archaeology is considered to be **negligible**.

4.9 Commercial Fisheries

4.9.1 Interference with Commercial Fishing Activity

During both Phase 1 and Phase 2 of the decommissioning of the meteorological mast, there is expected to be no significant interference with commercial fishing activity since the area is marked by construction buoyage (during Phase 1) and there will be existing Safety Zones in place due to the construction and operation (during Phases 1 and 2 respectively) of the wind farm (within which the met mast is located). Weekly Notices of Operations and Notices to Mariners are issued to inform mariners, including fishermen, of all proposed works within the Moray East site. As Phase 1 is expected to take place during construction of the wind farm, an Offshore Fisheries Liaison Officer service will be provided for the wind farm construction area, encompassing the met mast location.

In advance of works are taking place at the meteorological mast, Notices to Mariners will be issued to inform other sea users of the works. When decommissioning vessels are restricted in their ability to manoeuvre (displaying RAM status), other vessels will be requested (via the Notice to Mariners and verbally in sécurité VHF warnings) to remain clear of the works at an advisory safety passing distance (typically these would be expected to be a 500 metre radius). As a result, impacts are considered to be **negligible**. Once both Phase 1 and Phase 2 have been completed, the existing obstruction to fishing activity caused by the presence of the met mast will have been removed.

Any impacts on commercial fishing vessels with regard to nautical safety are addressed in Section 4.10.

4.9.2 Submerged Obstructions to Fishing Gear

Given that towed gear is used widely in the Moray Firth, the presence of submerged structures could potentially pose a threat to fishing activities by causing damage to gear. However, the risk of this will be addressed through the installation of the lit marker buoy to identify the location of the caisson and monopile stub (subject to the receipt of required permissions from the NLB). The marker buoy would remain on location between Phase 1 and Phase 2 of the decommissioning and will be placed after consultation with the Northern Lighthouse Board (NLB). A management plan will be prepared to describe the actions to be taken to alert other sea users of the position of the submerged structure in the unlikely event that the marker buoy becomes non-operational or off station. With this in place, there will be **negligible** impact on fishing activity during the interim period between the two phases.

4.10 Shipping and Navigation

4.10.1 Risks to Navigation

During both Phase 1 and Phase 2 of the decommissioning, in advance of works are taking place at the meteorological mast, Notices to Mariners will be issued to inform other sea users of the works. When decommissioning vessels are restricted in their ability to manoeuvre (displaying RAM status), other vessels will be requested (via the Notice to Mariners and verbally via sécurité VHF warnings) to remain clear of the works at an advisory safety passing distance (typically these would be expected to be a 500 metre radius). With this in place, there will be **no impacts** expected with regard to interactions between decommissioning activities and passing vessels.

It is envisaged that, during Phase 1, the monopile will be cut at a suitable depth to ensure that the remaining submerged stub section and GBS would pose no hazard to marine traffic. However, the location of the substructure will be clearly marked with a buoy as a navigational aid (if agreed with the Northern Lighthouse Board). An application will be submitted to the Northern Lighthouse Board for a statutory sanction to establish a navigational mark/light. This will remain in place until Phase 2 decommissioning activities commence and the submarine structures are removed. A monitoring plan will be prepared to describe how the buoy will be monitored[2] and the actions to be taken to alert other sea users of the position of the submerged structure in the unlikely event that the buoy becomes non-operational or off station. With the buoy in place, it is expected that impacts can be appropriately mitigated and there will be **negligible** impacts during the interim between Phase 1 and Phase 2.

Once both Phase 1 and Phase 2 have been completed, the existing obstruction to navigation caused by the presence of the met mast will have been removed.

4.11 Designated Sites

Details of the potential effects on bottlenose dolphin (as the qualifying feature for the Moray Firth SAC) and for harbour seals (as the qualifying feature for the Dornoch Firth and Morrich More SAC) are provided in Section 4.6. Potential effects on the qualifying avian features of East Caithness Cliffs SPA, North Caithness Cliffs SPA, Troup, Pennan and Lion's Heads SPA and Moray Firth pSPA have been considered in Section 4.7.

The information provided in those sections will be used by Marine Scotland (the competent authority) to undertake a Habitats Regulations Appraisal of the decommissioning works, in accordance with the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) and the Conservation of Offshore Marine Habitats and Species Regulations 2017. Overall, there are no likely significant effects that could adversely affect the integrity of the designated sites. Furthermore, given that the *de minimis* effects of the decommissioning works are negligible when considered in isolation, the works are not anticipated to significantly contribute to adverse effects when considered in combination with other plans and projects.

4.12 Cumulative Impacts

The main activity occurring within the vicinity of the Moray East site is the ongoing construction works at Moray East OWF, the overall construction site of which encompasses the meteorological mast. Works at Moray East OWF will continue for the duration of the Phase 1 decommissioning activities. However, since impacts from the meteorological mast decommissioning have been considered negligible in all instances, **no cumulative impacts** are predicted. A further assessment of cumulative impacts will be undertaken following completion of the Phase 2 FEED and prior to the commencement of Phase 2 works.

[2] Automatic Identification System (AIS) transmitter will be considered, and discussed with the NLB.

5 Summary

This Environmental Report is submitted in support of the Marine Licence application submitted by Moray East for the decommissioning of the meteorological mast. An assessment of the potential impacts of the decommissioning activities has been carried out in relation to key receptors including: physical processes, benthic ecology, fish and shellfish, marine mammals, ornithology, marine archaeology, commercial fisheries, and shipping and navigation.

The following mitigation will be carried out to reduce any potential effects upon the identified receptors:

- For minimising the risk of injury to marine mammals from noise generated from the DWCM, the following mitigation should be applied:
    - a pre-activity search of the mitigation zone (800 m around the met mast) prior to any underwater activity commencing, for a period of at least 30 minutes by MMO(s) depending on visibility conditions (pre-activity searches only to be undertaken in daylight and in good visibility);
    - if a marine mammal is sighted within the 800 m mitigation zone during the pre-activity search, where possible, commencement should be delayed until the mitigation zone has been clear of marine mammals for a period of at least 20 minutes, and the pre-activity search has been completed;
    - undertake marine mammal observations, where possible, during the decommissioning activities where there is an increase in underwater noise, e.g. during cutting of the monopile; and
    - JNCC recording forms to be used by the MMOs to record start and end of survey periods, activities and operations, marine mammal sighting and actions taken (such as delaying the start of any activities). Further details on the forms can be provided, if required.
- The preparation and application of an ORPAD to ensure prompt reporting / recording to MS-LOT and HES of archaeological remains encountered or suspected during the works.
- Use of an advisory safe passing distance when vessels are displaying RAM status around the meteorological mast during decommissioning activities to minimise any interference with commercial fishing activity and shipping.
- To reduce the risk of the submerged caisson to fishing gear, Moray East will apply to the NLB for permission to install an aid to navigation (buoy) , which would be placed to identify the location of the caisson and monopile stub. This will be carried out in accordance with guidance from the NLB. The position of the buoy will be managed through a monitoring plan which will include actions should the buoy become non-operational or off station.

A summary of the outcome of the environmental assessment is presented in Table 5-1 below. Overall, no significant impacts are predicted due to the proposed Phase 1 decommissioning activities.

Table 5-1 Summary of potential impacts

Receptor	Potential Impact	Assessment of impact (post mitigation)
Physical Processes	Increase in SSC and sediment deposition	Negligible
Benthic Ecology	Habitat damage	Negligible
	Increase in SSC and sediment deposition	Negligible
	Spread / introduction of INNS	No impacts
Fish and Shellfish	Noise disturbance	Negligible
	Increase in SSC and sediment deposition	Negligible
	Damage to supporting habitat	Negligible
Marine Mammals	Noise disturbance from monopile cutting	Negligible
	Auditory injury from vessels	No impact
	Noise disturbance from vessels	Negligible
	Vessel interactions	Negligible
Ornithology	Visual and noise disturbance	Negligible
	Impacts on prey availability	Negligible
Marine Archaeology	Direct disturbance	Negligible
Commercial Fisheries	Interference with commercial fishing activity	Negligible
	Submerged obstructions to fishing gear	Negligible
Shipping and Navigation	Risks to surface navigation	Negligible
Cumulative Impacts	Cumulative impacts with Moray East OWF	No cumulative impacts

6 References

Bailey, H. and Thompson, P.M., (2009). Using marine mammal habitat modelling to identify priority conservation zones within a marine protected area. Marine Ecology Progress Series, 378, pp.279-287.

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(6), pp.888-897.

BEIS (2018). Record of the Habitats Regulations Assessment Undertaken Under Regulation 65 of the Conservation of Habitats and Species (2017), and Regulation 33 of the Conservation of Offshore Marine Habitats and Species Regulations (2017). Review of Consented Offshore Wind Farms in the Southern North Sea Harbour Porpoise SCI.

BOWL (2012) Beatrice Offshore Wind Farm Environmental Statement.

Chartered Institute of Ecology and Environmental Management (CIEEM) (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. CIEEM, September 2018.

Cheney, B., Corkrey, R., Quick, N.J., Janik, V.M., Islas-Villanueva, V., Hammond, P.S. & Thompson, P.M. 2012. Site Condition Monitoring of bottlenose dolphins within the Moray Firth Special Area of Conservation: 2008-2010. Scottish Natural Heritage Commissioned Report No. 512.

Cheney, B., Graham, I.M., Barton, T.R., Hammond, P.S. and Thompson, P.M. 2014. Site Condition Monitoring of bottlenose dolphins within the Moray Firth Special Area of Conservation: 2011-2013. Scottish Natural Heritage Commissioned Report No. 797.

Cheney, B., Thompson, P.M., Ingram, S.N., Hammond, P.S., Stevick, P.T., Durban, J.W., Culloch, R.M., Elwen, S.H., Mandleberg, L., Janik, V.M. and Quick, N.J., 2013. Integrating multiple data sources to assess the distribution and abundance of bottlenose dolphins *Tursiops truncatus* in Scottish waters. Mammal Review, 43(1), pp.71-88.

Cheney, B., Graham, I.M., Barton, T.R., Hammond, P.S. & Thompson, P.M. 2018. Site Condition Monitoring of bottlenose dolphins within the Moray Firth Special Area of Conservation: 2014-2016. Scottish Natural Heritage Research Report No. 1021.

DECC (now Department for Business, Energy and Industrial Strategy) (2016). UK Offshore Energy Strategic Environmental Assessment 3 (OESEA3).

Eisfeld, S., Keith, S., Pope, A., Still, D., Dolman, S. and Simmonds, M., (2009). Outer Moray Firth Cetacean Research 2008. Project report for the BBC Wildlife Fund. Whale and Dolphin Conservation Society, 23pp.

Ellis, J.R., Milligan, S., Readdy, L., South, A., Taylor, N. and Brown, M., (2010) Mapping spawning and nursery areas of species to be considered in Marine Protected Areas (Marine Conservation Zones).

Evans, P.G.H., Pierce, G.J., Veneruso, G., Weir, C.R., Gibas, D., Anderwald, P. and Begoña Santos, M. (2015) Analysis of long-term effort-related land-based observations to identify whether coastal areas of harbour porpoise and bottlenose dolphin have persistent high occurrence and abundance. JNCC report No. 543, JNCC, Peterborough.

Evans, P.G.H. (1992) Status Review of Cetaceans in British and Irish waters UK Dept. of the Environment, London. 98pp.

Evans, P.G.H. (Ed) (2008) Selection criteria for marine protected areas for cetaceans. Proceedings of the ECS/ASCOBANS/ASCOBAMS Worskshop held in San Sebastian, Spain, 22nd April 2007, European Cetacean Society Special Publication Series, 48, 1-104.

Hammond P.S., Macleod K., Berggren P., Borchers D.L., Burt L., Cañadas A., Desportes G., Donovan G.P., Gilles A., Gillespie D., Gordon J., Hiby L., Kuklik I., Leaper R., Lehnert K, Leopold M., Lovell P., Øien N., Paxton C.G.M., Ridoux V., Rogano E., Samarraa F., Scheidatg M., Sequeirap M., Siebertg U., Skovq H.,

Swifta R., Tasker M.L., Teilmann J., Canneyt O.V. and Vázquez J.A. (2013). Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. Biological Conservation 164, 107-122.

Hammond, P.S., Lacey, C., Gilles, A., Viquerat, S., Boerjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M., Scheidat, M. and Teilmann, J. (2017). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. Wageningen Marine Research.

Hastie, G.D., Wilson, B. and Thompson, P.M., (2003a). Fine-scale habitat selection by coastal bottlenose dolphins: application of a new land-based video-montage technique. Can. J. Zool, 81.

Hastie, G.D., Barton, T.R., Grellier, K., Hammond, P.S., SwIFT, R.J., Thompson, P.M. and Wilson, B., (2003b). Distribution of small cetaceans within a candidate Special Area of Conservation; implications for management. Journal of Cetacean research and Management, 5(3), pp.261-266.

Heinänen, S. and Skov, H. (2015). The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area, JNCC Report No.544 JNCC, Peterborough.

IAMMWG (2015). Management Units for cetaceans in UK waters (January 2015). JNCC Report No. 547, JNCC Peterborough.

ICES (2018) Fishing Effort and Quantity and Value of Landings by ICES Rectangle. Available from: https://www2.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/RectangleData.

JNCC (2016) Natura 2000 Standard Data From: Moray Firth. Available from: https://jncc.gov.uk/jncc-assets/SAC-N2K/UK0019808.pdf

JNCC (2017). JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys. April 2017.

JNCC (2018) Donnoch Firth and Morrich More Designated Special Area of Conservation. Available at: https://sac.jncc.gov.uk/site/UK0019806

JNCC, Natural England and CCW (2010). Draft EPS Guidance - 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. Joint Nature Conservation Committee, Natural England and Countryside Council for Wales. October 2010.

Jones, E.L., McConnell, B.J., Smout, S., Hammond, P.S. et al. (2015) Patterns of space use in sympatric marine colonial predators reveal scales of spatial partitioning. Mar Ecol Prog Ser 534:235-249. https://doi.org/10.3354/meps11370.

Kyhn, L.A., Sveegaard, S. and Tougaard, J. (2014). Underwater noise emissions from a drillship in the Arctic. Marine Pollution Bulletin, 86(1), pp.424-433.

Lucke, K., Siebert, U., Lepper, P. A. and Blanchet, M. A. (2009). Temporary shift in masked hearing thresholds in a harbor porpoise (Phocoena phocoena) after exposure to seismic airgun stimuli, J. Acoust. Soc. Am., 125 (6), pp. 4060-4070.

Malme, C.I., Miles, P.R., Miller, G.W., Richardson, W.J., Roseneau, D.G., Thomson, D.H. and Greene, C.R. (1989). Analysis and ranking of the acoustic disturbance potential of petroleum industry activities and other sources of noise in the environment of marine mammals in Alaska. Final Report No. 6945 to the US Minerals Management Service, Anchorage, AK.

McConnell, B.J., Fedak, M.A., Lovell, P. and Hammond, P.S. (1999) Movements and foraging of grey seals in the North Sea. Journal of Applied Ecology 36: 573-590.

Moray East (2012) Moray Offshore Renewables Limited - Environmental Statement: Telford, Stevenson and MacColl Offshore Wind Farms and Transmission Infrastructure.

Norfolk Boreas Limited (2019). Norfolk Boreas Offshore Wind Farm Environmental Impact Assessment.

Northridge, S.P., Tasker, M.L., Webb, A. and Williams, J.M., (1995) Distribution and relative abundance of harbour porpoises (Phocoena phocoena L.), white-beaked dolphins (Lagenorhynchus albirostris Gray), and minke whales (Balaenoptera acutorostrata Lacepède) around the British Isles. ICES Journal of Marine Science: Journal du Conseil, 52(1), pp.55-66.

Pangerc, T., Robinson, S. Theobald, P. and Galley, L. (2016). Underwater sound measurement data during diamond wire cutting: First description of radiated noise. Proceedings of the Fourth International Conference on the Effects of Noise on Aquatic Life, Dublin 2016.

Paxton, C.G.M., Scott-Hayward, L., Mackenzie, M., Rexstad, E. and Thomas, L. (2016). Revised Phase III Data Analysis of Joint Cetacean Protocol Data Resources with Advisory Note, JNCC Report 517, ISSN 0963-8091: http://jncc.defra.gov.uk/page-7201.

Paxton, C.G.M., Scott-Hayward, L.A.S. & Rexstad, E. (2014). Statistical approaches to aid the identification of Marine Protected Areas for minke whale, Risso's dolphin, white-beaked dolphin and basking shark. Scottish Natural Heritage Commissioned Report No. 594.

Pirotta, E., Merchant, N.D., Thompson, P.M., Barton, T.R. and Lusseau, D., (2015). Quantifying the effect of boat disturbance on bottlenose dolphin foraging activity. Biological Conservation, 181, pp.82-89.

Popper, A.N., Hawkins, A.D., Fay, R.R., Mann, D.A., Bartol, S., Carlson, T.J., Coombs, S., Ellison, W.T., Gentry, R.L., Halvorsen, M.B., Løkkeborg, S., Rogers, P.H., Southall, B.L., Zeddies, D.G. and Tavolga, W.N. (2014). Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI.

Quick, N.J., Arso Civil, M., Cheney, B., Islas Villanueva, V., Janik, V., Thompson, P. and Hammond, P.S., 2014. The east coast of Scotland bottlenose dolphin population: Improving understanding of ecology outside the Moray Firth SAC.

Reid, J.B, Evans, P.G.H. and Northridge, S.P. (2003) Atlas of cetacean Distribution in North west European waters. JNCC, Peterborough.

Richardson, W.J., Greene, C.R., Jr, Malme, C.I. and Thomson, D.H. (1995). Marine Mammals and Noise. Academic Press, San Diego. 576pp.

Robinson, K.P., Baumgartner, N., Eisfeld, S.M., Clark, N.M., Culloch, R.M., Haskins, G.N., Zapponi, L., Whaley, A.R., Weare, J.S. and Tetley, M.J., (2007). The summer distribution and occurrence of cetaceans in the coastal waters of the outer southern Moray Firth in northeast Scotland (UK). Lutra, 50(1), p.19.

Robinson, K.P., Eisfeld, S.M., Costa, M. and Simmonds, M.P., 2010. Short-beaked common dolphin (Delphinus delphis) occurrence in the Moray Firth, north-east Scotland. Marine Biodiversity Records, 3.

Robinson, K.P., Bamford, C.C., Airey, A., Bean, T.S., Bird, C., Haskins, G.N., Sim, T.M. and Evans, P.G., 2017. Killer whale (Orcinus orca) occurrence in the Moray Firth, Northeast Scotland: incidental sightings, behavioural observations, and photo-identification. Aquat Mamm, 43, pp.26-32.

Russell, D.J.F., McConnell, B.J., Thompson, D., Duck, C.D., Morris, C., Harwood, J. and Matthiopoulos, J. (2013) Uncovering the links between foraging and breeding regions in a highly mobile mammal. Journal of Applied Ecology, Vol 50, no. 2, pp. 499-509.

Russell, D.J.F, Jones, E.L. and Morris, C.D. (2017). Updated Seal Usage Maps: The Estimated at-sea Distribution of Grey and Harbour Seals. Scottish Marine and Freshwater Science Vol 8 No 25, 25pp. DOI: 10.7489/2027-1.

SCOS (2010). Scientific Advice on Matters Related to the Management of Seal Populations: 2010.

SCOS (2017). Scientific Advice on Matters Related to the Management of Seal Populations: 2017. Available at: http://www.smru.st-andrews.ac.uk.

SCOS (2018) Scientific Advice on Matters Related to the Management of Seal Populations: 2018. Available from: http://www.smru.st-andrews.ac.uk/files/2019/05/SCOS-2018.pdf

Shell UK (2018). Goldeneye Decommissioning Environmental Appraisal Report. GDP-PT-S-HE-0702-00003. https://www.shell.co.uk/sustainability/decommissioning/goldeneye/_jcr_content/par/toptasks.stream/1540994344516/60c614c3c0b7f87dd7d22f9d8539f31a32d5c704/goldeneye-environmental-appraisal-report.pdf

SNH (2014) Scottish MPA Project Data Confidence Assessment: Southern Trench MPA Proposal. Available at: https://www.nature.scot/sites/default/files/2017-11/Marine%20Protected%20Area%20-%20Data%20confidence%20assessment%20-%20Southern%20Trench%20MPA%20proposal.pdf

Southall, B.L., Finneran, J.J., Reichmuth, C., Nachtigall, P.E., Ketten, D.R., Bowles, A.E., Ellison, W.T., Nowacek, D.P. and Tyack, P.L., 2019. Marine mammal noise exposure criteria: updated scientific recommendations for residual hearing effects. Aquatic Mammals, 45(2), pp.125-232.

Spitz, J., Rousseau, Y. and Ridoux, V., (2006). Diet overlap between harbour porpoise and bottlenose dolphin: An argument in favour of interference competition for food? Estuarine, Coastal and shelf science, 70(1-2), pp.259-270.

The Crown Estate (2014). Protocol for Archaeological Discoveries: Offshore Renewables Projects. Published by Wessex Archaeology, Salisbury, on behalf of The Crown Estate. Available at: https://www.wessexarch.co.uk/sites/default/files/field_file/2_Protocol%20For%20Archaeological%20Discoveries.pdf

Thompson, P.M. and Miller, D., (1990). Summer Foraging Activity and Movements of Radio-Tagged Common Seals (Phoca Vitulina. L.) in the Moray Firth, Scotland. Journal of Applied Ecology, 27, pp.492-501.

Thompson, P.M., McConnell, B.J., Tollit, D.J., Mackay, A., Hunter, C. and Racey, P.A. (1996a). Comparative distribution, movements and diet of harbour and grey seals from the Moray Firth, N.E. Scotland. Journal of Applied Ecology. 33: 1572-1584.

Thompson, P.M., Corkrey, R., Lusseau, D., Lusseau, S., Quick, N., Durban, J.W., Parsons, K.M. & Hammond, P.S. (2006) An assessment of the current condition of the Moray Firth bottlenose dolphin population. Scottish Natural Heritage Commissioned Report No. 175.

Thompson, P.M, Cheney, B., Cândido, A.T. & Hammond, P.S. (2009) Site Condition Monitoring of bottlenose dolphins within the Moray Firth Special Area of Conservation: Interim report 2005-2007. Internal report to Scottish Natural Heritage.

Thompson, D., Bexton, S., Brownlow, A., Wood, S., Patterson, T. Pye, K., Lonergan, M. and Milne, R. (2010) Report on recent seal mortalities in UK waters caused by extensive lacerations October 2010. Sea Mammal Research Unit. Available online - http://www.smru.st-and.ac.uk/documents/366.pdf

Thompson, P.M., Cheney, B., Ingram, S., Stevick, P., Wilson, B. Hammond, P.S. (2011) Distribution, Abundance and Population Structure of Bottlenose Dolphins in Scottish Waters. Scottish Natural Heritage Commissioned Report No.354. Scottish Natural Heritage, Perth, UK.

Thompson, P. M., Brookes, K. L., & Cordes, L. S. (2015). Integrating passive acoustic and visual data to model spatial patterns of occurrence in coastal dolphins. ICES Journal of Marine Science: Journal du Conseil, 72(2), 651-660.

Thompson, P.M., Mcconnell, B.J., Tollit, D.J., Mackay, A., Hunter, C. and Racey, P.A., 1996b. Comparative distribution, movements and diet of harbour and grey seals from Moray Firth, NE Scotland. Journal of Applied Ecology, pp.1572-1584.

Tillin, H.M. (2016a). *Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand. In Tyler-Walters, H. and Hiscock, K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews.* Plymouth, Marine Biological Association of the United Kingdom. Available from: https://www.marlin.ac.uk/habitats/detail/1131.

Tillin, H.M. (2016b). *Mediomastus fragilis, Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand and gravel. In Tyler-Walters, H. and Hiscock, K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews.* Plymouth, Marine Biological Association of the United Kingdom. Available from: https://www.marlin.ac.uk/habitats/detail/382.

Twachtman, S., Byrd, Inc. and Center for Energy Studies, Louisiana State University. (2004). Operational and Socioeconomic Impact of Nonexplosive Removal of Offshore Structures. US Dept. of the Interior, Minerals Management Service. OCS Study MMS 2004-074. 50pp.

Wilson B, Reid RJ, Grellier K, Thompson PM, Hammond PS (2004) Considering the temporal when managing the spatial: a population range expansion impacts protected areas-based management for bottlenose dolphins. Animal Conservation 7:331–338.

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