moray offshore renewables ltd

Environmental Statement

Technical Appendix 1.3 E - Preliminary Decommissioning Programme

Telford, Stevenson, MacColl Wind Farms and associated Transmission Infrastructure Environmental Statement

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Contents

Executive Summary

In 2012 Moray Offshore Renewables Ltd (MORL) will submit applications for Section 36 consents for the Telford, Stevenson and MacColl Offshore Wind Farms with a total capacity of 1,500 MW, located within the outer Moray Firth, Scotland, together with Marine Licence applications for the wind farms and the offshore transmission infrastructure. MORL is a joint venture company owned by EDP Renewables (EDPR) (67 %) and Repsol Nuevas Energias UK (33 %).

The Energy Act 2004 requires that MORL prepares and ultimately carries out a Decommissioning Programme for the Telford, Stevenson and MacColl Offshore Wind Farms. This document constitutes the preliminary Decommissioning Programme for the projects and MORL has included it in the consent applications, thus giving regulatory authorities and key stakeholders an opportunity to comment on draft proposals for how the structures comprising the wind farms and offshore transmission infrastructure will be decommissioned.

The onshore aspects of the Project (i.e. onshore cables and converter stations) and their associated decommissioning requirements fall under the Town and Country Planning (Scotland) Act 1997 and so are not covered within this Programme.

The Programme is informed and supported by the Environmental Impact Assessment (EIA) carried out for the 'Project', which is comprised of the three wind farm sites (Telford, Stevenson and MacColl) together with the offshore and onshore transmission infrastructure. The resulting Environmental Statement (ES) has been submitted as part of the Project's application for consent. The ES provides detailed analysis of the baseline physical, biological and human environment. The assessment of the impact of the projects on receptors and stakeholders takes into account decommissioning provisions that are consistent with those presented in this document.

In considering appropriate decommissioning provisions, MORL have sought to adhere to the following key principles:

- Safety for all at all times;
- Consideration of the rights and needs of legitimate users of the sea;
- Minimise environmental impact;
- Adherence to 'polluter pays' principle;
- Promote sustainable development;
- Maximise the reuse of materials;
- Commercial viability; and
- Practical integrity.

The following key documents have also informed the Decommissioning Programme:

- Decommissioning of Offshore Renewable Energy Installations under the Energy Act 2004: Guidance notes for Industry, DECC, January 2011 (revised);
- Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone, International Maritime

Organisation (IMO), 19th October 1989;
- Guidance Notes for Industry: Decommissioning of Offshore Installations and Pipelines under the Petroleum Act 1998, DECC, March 2011;
- OSPAR Guidance on Environmental Considerations for Offshore Wind Farm Development, 2008;
- Guidelines for Environmental Risk Assessment and Management – Green Leaves III, Defra, November 2011; and
- United Nations Convention on the Law of the Sea (UNCLOS), 1982.

MORL's base assumption in establishing the extent of decommissioning is complete removal of infrastructure, although alternative solutions have been identified where appropriate. A summary of the proposals for decommissioning of the offshore components of the Telford, Stevenson and MacColl Offshore Wind Farms are outlined in the table below. It is envisaged that decommissioning will involve the removal of non buried project elements (e.g. wind turbines). Buried elements such as foundations and cables may be removed or left in situ depending on regulatory and project aims at the time of decommissioning.

Component	Decommissioning Proposal
Wind Turbine Generators (WTGs)	Complete removal from site
Substructures and foundations (WTGs)	
Gravity base	Complete removal from site
Lattice jacket	Cut off at or below seabed and removed
Inter-array cabling	Left in-situ
Offshore Substation Platforms (OSPs)	Complete removal from site
Substructures and foundations (OSPs)	
Gravity base	Complete removal from site
Lattice jacket	Cut off at or below seabed and removed
Lattice jack-up	Cut off at or below seabed and removed
Inter-platform cabling	Left in-situ
Export cabling	Left in-situ
Meteorological mast	Removal of mast and cut off at or below seabed and removed
Scour protection	Left in-situ

A decision as to whether the Telford, Stevenson and MacColl Offshore Wind Farms will be repowered will be taken in approximately 15-20 years after operation has commenced. This would most likely involve the replacement of turbines and if necessary, associated cabling, which by then will be near the end of their design life. In the absence of re-powering, MORL intends to begin decommissioning the project at year 25. As the Telford, Stevenson and MacColl Offshore Wind Farms near the end of their operational life, a final 'Decommissioning Programme of Works' will be developed for each of the three wind farm projects, outlining the particular methods, measures and timing that will be employed in decommissioning. The final decommissioning programmes will be submitted to the appropriate regulatory authorities for approval.

1. Introduction

In 2012 Telford Offshore Wind Farm Limited, Stevenson Offshore Wind Farm Limited and MacColl Offshore Wind Farm Limited will submit applications for Section 36 consent for the Telford (up to 500 MW), Stevenson (up to 500 MW) and MacColl (up to 500 MW) Offshore Wind Farms, located adjacent to one another in the Outer Moray Firth offshore wind Round 3 Zone, Scotland.

Telford covers 97 km^2 (52 nm^2) and has water depths of approximately 39-57 m (21-31 ftm). Stevenson covers 77 km^2 (42 nm^2) and has water depths of approximately 37-53 m (20-29 ftm). MacColl covers 125 km^2 (68 nm^2) and has water depths of approximately 37-57 m (20-31 ftm). MORL holds three agreements for lease (AfL) with The Crown Estate for the three sites. Offshore transmission infrastructure will connect the three wind farms to the National Grid via grid connection to Peterhead Power Station, with an offshore export cable making landfall at Fraserburgh Beach. Although the offshore transmission infrastructure will be transferred to, operated and finally decommissioned by an Offshore Transmission Owner (OFTO), MORL intends to consent and potentially construct the infrastructure.

It is expected that the offshore wind farms and associated offshore infrastructure will have an operational life of 25 years. Under the Energy Act 2004, wind farms and associated offshore transmission infrastructure must be decommissioned at the end of their lifetime. A decision as to whether the sites will be re-powered will be taken by MORL approximately 15-20 years after energy generation has commenced.

Upon issue of Section 36 consents for each of the wind farm projects, it is anticipated that DECC will issue a notice under Section 105(2) of the Energy Act 2004 regarding the requirement to prepare a decommissioning programme for the projects prior to construction commencement.

Anticipating this requirement, MORL has drafted a preliminary Decommissioning Programme for the Telford, Stevenson and MacColl Offshore Wind Farms and associated offshore transmission infrastructure (OfTI). This preliminary Decommissioning Programme is being submitted for approval in accordance with the requirements of the Energy Act 2004. The document is structured in accordance with the format recommended in the 'Decommissioning of offshore renewable energy installations under the Energy Act 2004; Guidance notes for industry. DECC, January 2011 (revised).'

The Programme outlines the methods for decommissioning, paying particular attention to:

- Comparing the methods of partial and complete removal of foundations;
- Considering integration and cooperation with other companies during decommissioning;
- The expected timeframes and costs of removal;
- Environmental impacts; and
- Monitoring.

At this stage in project development (i.e. pre-consent), a single Decommissioning Programme has been drafted for the Telford, Stevenson and MacColl Offshore Wind Farms. Separate programmes will be prepared for each wind farm site once consent is achieved and prior to construction commencing.

This Programme is to be reviewed and revised as necessary throughout the lifecycle of the project to reflect changing circumstances and regulatory requirements, and to incorporate improvements in knowledge and understanding of the marine environment and advancements in technology and working practices. As a minimum, this document is expected to be reviewed and updated at the following points in time:

- A review and update will be undertaken prior to construction of the wind farm sites and the final draft programme will be formally submitted for approval to DECC in accordance with the Energy Act 2004 (or relevant legislation in force at that time). At this time, separate programmes will be submitted for each site;
- A review and update for formal submission will be made, if required, after 2 years of operation;
- A review and update will take place when key information changes, e.g. change in ownership of the site. Following the update, a formal submission for acceptance of amendments will be made;
- A review, update and formal submission for acceptance of amendments will be made if the sites undergo repowering;
- A review and update, if required, two years prior to the provision of financial security;
- Halfway through the period during which financial security is provided; and
- A review and Final Programme will be prepared prior to decommissioning of the sites and the programme will be formally submitted for approval to DECC in accordance with the Energy Act 2004 (or relevant legislation in force at that time).

2. Background Information

2.1 Project Overview

The proposed Telford, Stevenson and MacColl Offshore Wind Farms are located in the outer Moray Firth approximately 22 km (12 nm) from the Caithness coastline (Figure 2.2), in the Eastern Development Area (EDA) of the Moray Firth Round 3 Zone. Each wind farm will have a maximum capacity of 500 MW and the total capacity of the Zone will not exceed 1,500 MW. The area of each site and the maximum capacity is provided in Table 2.1.

Table 2.1 Maximum area and capacity of Telford, Stevenson and MacColl.

	Telford	**Stevenson**	**MacColl**	**Eastern Development Area**
Area	93 km^2	77 km^2	125 km^2	**295 km^2**
Maximum capacity	500 MW	500 MW	500 MW	**1,500 MW**

The infrastructure within each wind farm will include:

- Wind Turbine Generators (WTGs) rated between 3.6-8 MW;
- Wind turbine substructures and foundations, of which there are two potential concepts:
  - Jacket substructure with pin pile foundations;
  - Gravity Base Structure with a gravel bed foundation;
- Alternating current (AC) inter-array cabling of a voltage of 33 or 66 kV;
- Scour protection (where applied); and
- A meteorological mast.

For connection to the National Grid, the proposed offshore transmission infrastructure will include:

- Up to six AC collector Offshore Substation Platforms (OSPs);
- Two AC - Direct Current (DC) converter OSPs;
- AC OSP connector cabling of a voltage of 220 kV; and
- Two bundles of DC export cabling of a voltage of 320 kV; and
- Scour/cable protection (where applied).

The substructures and foundations for the OSPs may include:

- Jackets with pin piles;
- Jacket with suction caissons;
- Jack-up with pin piles;
- Jack-up with suction caissons;
- Gravity Base Structures with gravel bed foundation;
- Scour protection (where applied).

Table 2.2 provides a more detailed breakdown of the component parameters assessed.

Table 2.2a Proposed Wind Farm Rochdale Envelope Parameter Plan (at June 2012).

Infrastructure Type	**Parameter**	**Parameter Range**
Wind Turbine Generators (WTGs)	Number in Site 1	63 -139 turbines
	Number in Site 2	63 -100 turbines
	Number in Site 3	63 -100 turbines
	*The order of site construction of the Telford, Stevenson and MacColl wind farms will be determined pending further detailed site analysis, accordingly the order of build is flexible. If the 3.6 MW turbine is selected it will only be built out in site 1.	
	Rating	3.6-8 MW
	Hub Height	97-118 m
	Rotor Diameter	120-172 m

	Blade Width Range	4.2 -5.8 m
	Max Tip Height	162-204 m
	Minimum air draft i.e. minimum clearance between blade tip and LAT	22 m
	Rotational speed range	4 -15.1 rpm
	Spacing Downwind Crosswind	 840-1,720 m 600-1,376 m
Substructure & foundation for WTG's: Concrete Gravity Base Foundations with Ballast and a gravel/grout bed	Work platform size (at base on turbine)	45 x 45 m
	Base Width	65 m
	Gravel/grout bed diameter	75 m
	Excavated bed + scour protection diameter	95 m
	Max dredger affected diameter	125 m
	Max bed excavation depth	5 m
	Max gravel bed depth	2.5 m
Substructure & foundation for WTG's: Steel Lattice Jackets with Pin Piles	Jacket base width	60 m
	Number of legs/piles	3-4
	Max Diameter of piles	2.5 m
	Max Length of piles	60 m
	Max scour protection around each leg plus pile diameter	16 m
Inter-array cabling	Indicative number of strings per site	7-12
	Capacity of each string	Up to 36 MW
	Configuration of strings	Branched or looped
	Voltage of cabling	33 or 66 kV
	Entry/exit method to WTGs and OSPs	J-tube
	Target burial depth in seabed	1 m

	Protection where burial not achieved	Rock placement, concrete mattresses/concrete tunnels/grout bags, Proprietary steel/plastic ducting/protecting sleeves.
Meteorological Mast	Number to installed as part of the proposed project	1
Met-mast style and substructure & foundation: Option 1 – Steel lattice met mast on a monopile	Indicative diameter of monopile	4.5m
	Mast tip height at LAT	Up to 150 m
Met-mast style and substructure & foundation: Option 2 – Steel lattice met mast on a ballasted concrete gravity base with gravel/grout bed	Dimensions are expected to be no greater than those of the gravity base for a WTG	
	Mast tip height at LAT	Up to 150 m
Met-mast style and substructure & foundation: Option 3 – Steel lattice met mast on a steel lattice jacket with pin piles	Dimensions are expected to be no greater than those of the jacket substructure for a WTG	
	Mast tip height at LAT	Up to 150 m
Met-mast style and substructure & foundation: Option 4 – LIDAR on a floating spar with moorings which are weighted or anchored to the seabed	Indicative spar diameter	1-2 m
	Indicative spar height from top to bottom	c. 35 m
	Indicative work platform diameter	3 m
	Indicative height above sea level	10 m

Table 2.2b Proposed OfTI Rochdale Envelope Parameter Plan (at June 2012).

Infrastructure Type	Parameter	Parameter Range
AC OSPs	Number required	3-6
	Indicative topside width x length	100x100 m
	Indicative maximum height above LAT	70 m
AC/DC OSPs	Max number required	2
	Indicative dimensions are as per AC OSPs above	

Substructure & foundation for OSP's: Concrete Gravity Base Foundations with Ballast and a gravel/grout bed	Base Width	Max 130 m
	Gravel/grout bed diameter	Max 140 m
	Excavated bed + scour protection diameter	Max 160 m
	Max dredger affected diameter	190 m
	Max bed excavation depth	5 m
	Max gravel bed depth	2.5 m
Substructure & foundation for OSP's: Steel Lattice Jackets with Pin Piles or Suction Caissons Or Steel Lattice Jack-up with Pin Piles or Suction Caissons	Jacket base width	Up to 100 m
	Number of legs/piles or suction caissons (Jacket)	Up to 8 legged/8 piles
	Number of legs/piles or suction caissons (Jack up)	4 legged/16 piles
	Diameter of piles	3 m
	Length of piles	60 m
	Scour protection around each leg plus pile diameter	16 m
	Diameter of suction caissons	20 m
	Scour protection around each leg plus suction caisson diameter	40 m
Inter-platform cabling	Voltage	220 kV
Peterhead onshore grid connection via Fraserburgh Beach landfall		
Export cabling (offshore)	Cable configuration	2 bundles of 2 cables
	Cable bundle separation distance	4x water depth (200-800 m), as per regulation
	Voltage of cabling	320 kV
	Entry/exit method from OSPs	J-tube
	Target burial depth in seabed	1 m
	Protection where target burial not achieved	Concrete mattresses or rock placement
	Cable corridor width	Two x up to 6 m trench

	Cable corridor length	Approximately 105 km
Export cabling (onshore)	Location	Underground
	Route length	Approximately 30 km
	Number of trenches/conduits	1-2
	Width of trenches/conduits	Single trench – two x 3 m trenches Combined trench – 4-5 m trench
	Voltage of cable	320 kV
	Target burial depth	1m
Onshore converter substation(s)	Number of converter units	2
	Compound dimensions	200x170 m

2.2 Project Status

Consent applications for the Telford, Stevenson and MacColl Offshore Wind Farms and OfTI will be submitted in 2012. Applications (for each project) will be submitted for the following primary consents:

- Section 36 consent under the Electricity Act 1989 (for the construction and operation of offshore wind farms including wind turbines, inter-array cables and offshore substations, granted by the Scottish Ministers);
- Marine Licences under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009; and
- Town & Country Planning Permission under the Town and Country Planning (Scotland) Act 1997 (for onshore transmission works, granted by Aberdeenshire Council).

If consents are attained, construction of the three proposed wind farm sites and the OfTI is expected to take six years from commencement through to wind farm commissioning. Construction of each single wind farm site could take up to two years with construction of the first site commencing in 2015, and the completion of the third site in 2020 (Figure 2.1). The wind farms and associated infrastructure have an operational life of 25 years.

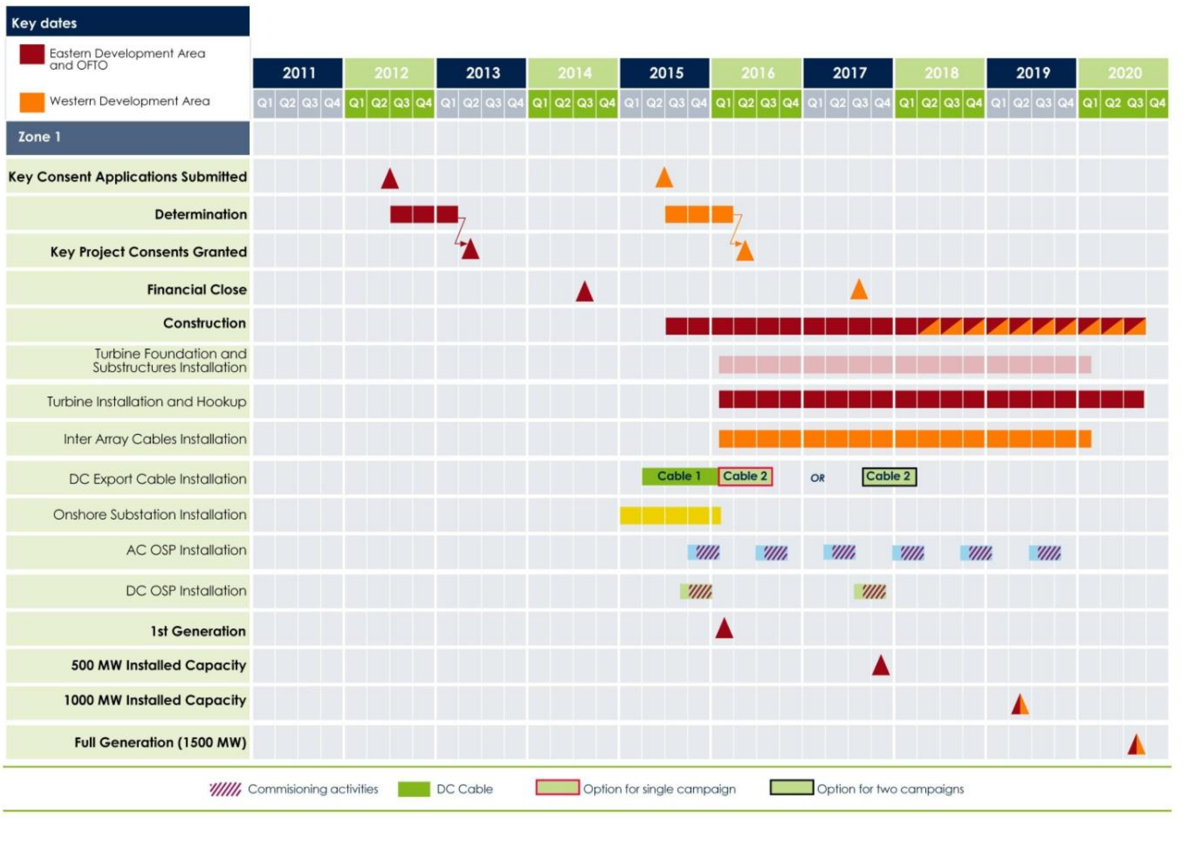


Figure 2.1 Outline consenting and construction schedule.

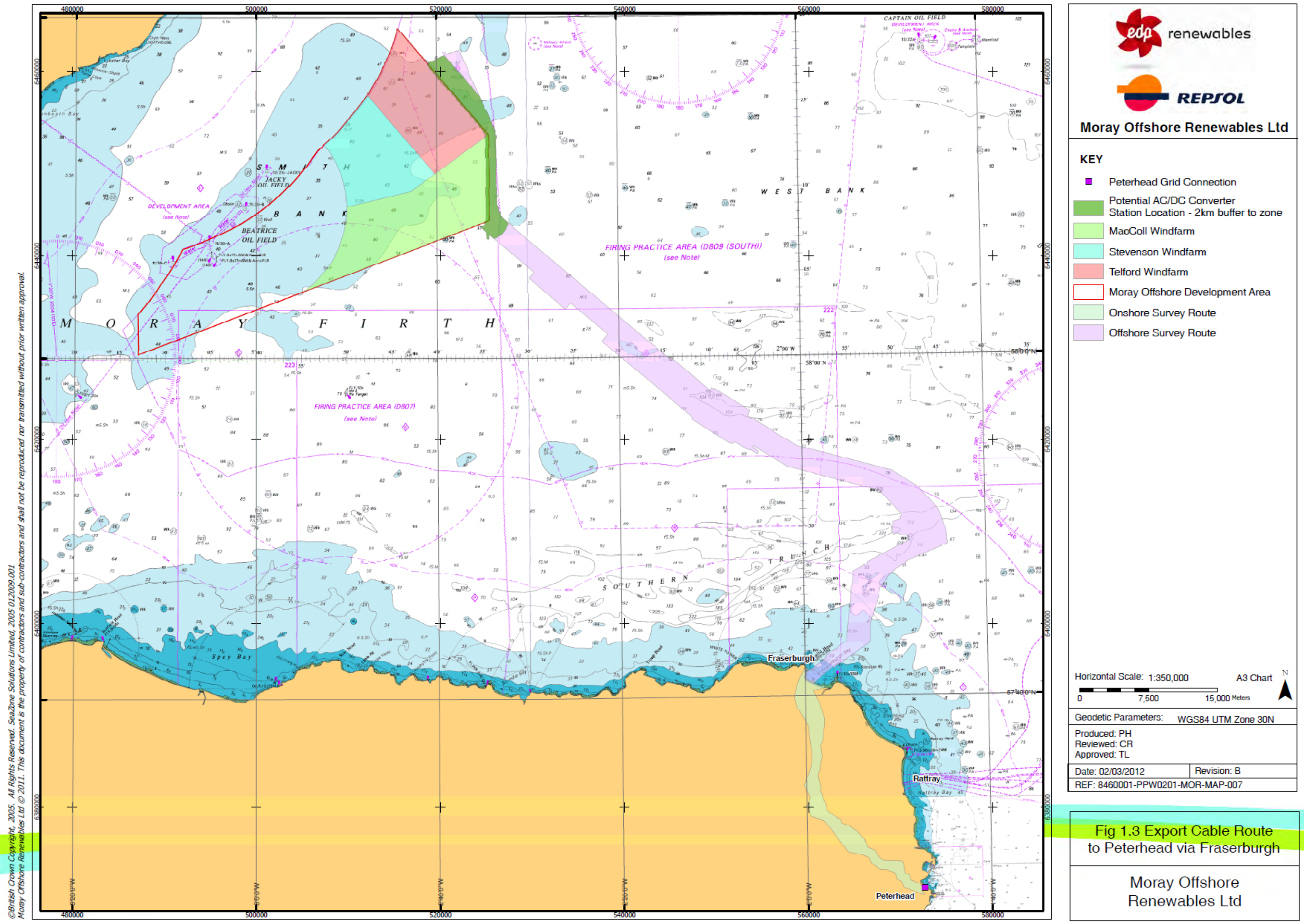


Figure 2.2 Offshore wind farm project boundaries.

2.3 Site Characteristics

In conducting an impact assessment of the likely effects on the environment arising from the construction, operation and decommissioning phases of the three wind farm projects, the MORL EIA gathered and collated a significant baseline dataset that has been used to describe the key characteristics of the development sites; a summary is provided below.

2.3.1 Physical Environment

Bathymetry

The three proposed wind farm sites encompass 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, 20 km wide (295 km^2). Water depths in this area range from approximately 35 to 55 mCD (below Chart Datum). Along the export cable route, water depths are typically 60 – 80 m in the central part of the Moray Firth, increasing for a short distance to approximately 150 m to transit the eastern end of the Southern Trench, and then shoaling gradually from 60 m water depth to the landfall locations.

Official estimates of the effects of global climate change suggest that by 2050, relative sea level in the Moray Firth will have risen between 0.22 and 0.35 m above 1990 levels.

Geology

Smith Bank is a geologically constrained feature, i.e. it is a raised hard rock feature, overlain by a relatively thin veneer of more recently deposited marine sediments. Geophysical surveys commissioned by MORL and undertaken in 2010 and 2011 indicate that within the three proposed wind farms, the thickness of marine sediments is highly variable, between 5 and 150 m, and may become absent near to the crest of Smith Bank. Along the export cable route, survey indicates that surficial sediment layers are typically greater than 3 to 5 m thick.

Wind Climate

In-situ wind measurements have been gathered since 2006 from the Beatrice Alpha oil platform and Met Office hindcast data covering the project area is available. Data shows that winds most commonly originate from south-westerly or south-easterly directions. Wind speeds are speeds in the range 2 to 8 m/s for approximately 70 % of the time and only infrequently (<1% of time) exceed 16 m/s. During extreme events (return period of one in ten years or more), wind speeds might peak as high as 25 or 30 m/s.

Tidal and Wave Regime

The three proposed wind farms are subject to a mean spring tidal range of just under 3 m and a maximum range (HAT to LAT) of approximately 4 m. There is some variation in tidal range along the offshore transmission cable route with the larger tidal ranges experienced towards the landward end where the mean spring range is 3.7 m.

Storm surges may cause short term modification to predicted water levels and under an extreme (1 in 50-year return period) storm surge, water levels may be up to 1.25 m above predicted levels.

Climate change may be expected to slightly increase the mean water level over the lifetime of the proposed development; however, the tidal range about the new mean level will likely remain not measurably affected.

Information available on the strength of tidal currents in this region shows that recorded (depth-averaged) peak spring current speeds are around 0.45-0.5 m/s, with the fastest speeds recorded in the north of the three proposed wind farms. Current speeds decrease with distance into the Moray Firth.

Along most of the cable route, peak current speeds are typically less than 0.4 m/s. However, they increase markedly off Kinnairds and Rattray Head, in a region extending approximately 10 km offshore of the cable landfall. Here, peak spring tidal currents speed are more typically 1.0 m/s (maximum 1.15 m/s) due to acceleration around the headland.

Both storm waves and storm surges may cause short term modification of astronomically-driven tidal currents. During a 1:1 year storm event, orbital currents are likely to approach 1.0 m/s in the relatively shallow water over the crest of Smith Bank. Currents of this magnitude are considerably greater than that observed during peak spring tidal flows. Similarly, under an extreme (1 in 50-year return period) storm surge, current speeds may be more than twice that encountered under normal peak spring tide conditions.

Residual tidal currents (over a period of days to weeks) are directed into the Moray Firth.

The wave regime in the Outer Moray Firth includes both swell waves generated elsewhere in the North Sea and locally generated wind waves. The OFTO transmission cable route is likely to be exposed to waves of equal or larger size than the wind farm itself from exposed offshore sectors.

Wave conditions naturally vary from calm conditions to maximum wave heights of 4 to 9 m depending upon the return period and direction; further natural variability in the order of 10 % is also expected on the basis of historical trends and the generally predicted effects of climate change.

Sedimentary and Coastal Processes

Seabed sediments across the application site generally consist of Holocene gravelly sand and sand; fine (silt and clay sized) particles are largely absent. The proportion of shell in sediment samples from and nearby to the application site are frequently in excess of 50 %. Across much of the area of the three wind farms, surficial marine sediments are generally thin (~0.5 m) with the underlying glacial till very close to the surface.

Near to the three proposed wind farm sites, in intermediate water depths, the offshore transmission cable route will transit areas of mixed sands and gravels, with initially small and variable fines content. Seabed sediments become progressively finer in deeper water along the route, becoming relatively muddy in the deepest parts.

The available evidence suggests that (bedload) material is travelling into the Firth from the north, passing along the Caithness coast and towards the Inner Moray Firth.

Sediment transport is considered unlikely to be driven by normal tidal currents alone and is expected to be dominated by less frequent but more energetic storm events via wave action at the seabed.

During calm conditions, suspended sediment concentrations are typically very low (approximately < 5 mg/l). However, during storm events, near bed current speeds can be significantly increased due to the influence of waves stirring of the seabed, causing a short-term increase in suspended sediment concentration, theoretically in the order of 1000s to 10,000s of mg/l very close to the seabed, 100s or 1000s mg/l in the lower water column but probably only 10s of mg/l in the upper water column.

2.3.2 Biological Environment

Designated Sites

The Telford, Stevenson and MacColl offshore wind farm projects and OfTI are not located within any nature conservation sites designated under European Directives and/or implemented through British legislation. However, many parts of the adjacent coastline do have some form of conservation status.

Table 2.3 lists statutory protected sites (Special Protection Areas [SPAs]; Special Areas of Conservation [SACs], Ramsar sites, Sites of Special Scientific Interest [SSSI]) within the vicinity of the wind farm sites and offshore transmission infrastructure.

Table 2.3 Designated sites

Site	Status	Main Conservation Interest
East Caithness Cliffs	SPA, SSSI	The sea cliffs the comprise East Caithness Cliffs SPA regularly support populations of European importance of a variety of seabird species. Notified interest features: Fulmar, shag, cormorant, peregrine, kittiwake, herring gull, great black-backed gull, guillemot, razorbill, puffin, seabird assemblage.

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

Site	Status	Main Conservation Interest
Rousay	SPA, SSSI	Rousay SPA consists of areas of maritime heath and grassland, and seacliffs. Notified interest features: fulmar, kittiwake, Arctic tern, Arctic skua, guillemot, seabird assemblage.
West Westray	SPA, SSSI	West Westray SPA is an 8 km stretch of sea cliffs, together with adjacent grassland and heathland, along the west coast of the island of Westray in Orkney. The cliffs support large colonies of breeding auks and kittiwakes while the grassland and heathland areas support breeding colonies of skuas and terns. Notified interest features: razorbill, fulmar, kittiwake, Arctic skua, Arctic tern, guillemot, seabird assemblage.
Papa Westray	SPA, SSSI	Papa Westray is a small island lying close to Westray in the northern Orkney islands in Scotland. Notified interest features: Arctic tern, Arctic skua. The SSSI and RSPB reserver is North Hill.
Sule Skerry and Sule Stack	SPA, SSSI	The SPA comprises two uninhabited islands and supports European important populations of seabirds. Notified interest features: gannet, guillemot, Leach's petrel, puffin, shag, storm petrel, seabird assemblage.
Fair Isle	SPA, SSSI	Fair Isle SPA supports internationally important populations of breeding seabirds on its cliffs and maritime heath and grassland. Notified interest features: gannet, Arctic skua, Arctic tern, Fair Isle wren, fulmar, great skua, guillemot, kittiwake, puffin, razorbill, shag, seabird assemblage.
North Rona and Sula Sgeir	SPA, SSSI	The uninhabited islands of North Rona and Sula Sgeir, together with several outlying rocky islets and adjacent waters, lie 65 km north of Lewis. The coastlines of both islands consist mainly of cliffs except for two low-lying peninsulas on North Rona. Notified interest features: gannet, fulmar, great black-backed gull, guillemot, kittiwake, Leach's petrel, puffin, razorbill, storm petrel, seabird assemblage.
Sumburgh Head	SPA, SSSI	Sumburgh Head is located at the most southern tip of the Shetland mainland in northern Scotland. Notified interest feature: Arctic tern
Mousa	SPA, SSSI	Mousa is a small island located off the east coast of the south part of the Shetland mainland in northern Scotland. Notified interest feature: Arctic tern
Noss	SPA, SSSI	Noss SPA is an offshore island lying 5 km east of Lerwick, Shetland. It supports breeding seabirds on cliffs and also on inland heathlands and grasslands. Notified interest features: gannet, fulmar, great skua, guillemot, kittiwake, puffin, seabird assemblage.

Site	Status	Main Conservation Interest
Foula	SPA, SSSI	Foula is the most westerly of the Shetland Islands, which are situated to the north of the Scottish mainland and Orkney. Notified interest feature: Arctic tern
Papa Stour	SPA, SSSI	Papa Stour lies on the west coast of mainland Shetland in northern Scotland. Notified interest feature: Arctic tern
Fetlar	SPA, SSSI	Fetlar is one of the northernmost of the Shetland Islands in northern Scotland. Notified interest feature: Arctic tern
Forth Islands	SPA, SSSI	Forth Islands SPA consists of a series of islands supporting the main seabird colonies in the Firth of Forth. The islands of Inchmickery, Isle of May, Fidra, The Lamb, Craigleith and Bass Rock were classified on 25 April 1990. The extension to the site, classified on the 13th February 2004 consists of the island of Long Craig, which supports the largest colony of roseate tern in Scotland. It is the most northerly of only six regular British colonies. Notified interest features: gannet, Arctic tern, common tern, cormorant, fulmar, guillemot, herring gull, kittiwake, lesser black-backed gull, puffin, razor bill, roseate tern, Sandwich tern, shag, seabird assemblage.
Hermaness, Saxa Vord and Valla Field	SPA, SSSI	Hermaness, Saxa Vord and Valla Field Special Protection Area lies in the north-west corner of the island of Unst, Shetland, at the northernmost tip of Britain. It consists of 100-200m high sea cliffs and adjoining areas of grassland, heath and blanket bog. Notifed interest features: gannet, fulmar, great skua, guillemot, kittiwake, puffin, red-throated diver, shag, seabird assemblage.
Rum	SPA, SSSI	Rum SPA includes the Inner Hebridean Island of Rum, which has a largely rocky coast with cliffs rising to 210m, and adjacent coastal waters. Notified interest features: Manx shearwater, golden eagle, guillemot, kittiwake, red-throated diver, seabird assemblage.
Moray Firth	SAC	Notified interest features: Subtidal sandbanks, Bottlenose dolphin.
Dornoch Firth and Morrich More	SAC	Notified interest features: reefs, subtidal sandbanks, glasswort and other annuals colonising mud and sand, Atlantic salt meadows, estuaries, intertidal mudflats and sandflats, otter, common seal, coastal dune heathland, dunes with juniper thickets, lime-deficient dune heathland with crowberry, shifting dunes, dune grassland, humid dune slacks, shiftings dunes with marram grass.
Berriedale and Langwell Waters	SAC	Notified interest features: Atlantic salmon.
River Oykel	SAC	Notified interest features: Atlantic salmon, freshwater pearl mussel.

Site	Status	Main Conservation Interest
River Thurso	SAC	Notified interest features: Atlantic salmon.
River Evelix	SAC	Notified interest features: Freshwater pearl mussel.
River Moriston	SAC	Notified interest features: Atlantic salmon, freshwater pearl mussel.
River Spey	SAC	Notified interest features: sea lamprey, Atlantic salmon, otter, freshwater pearl mussel.
Rosehearty to Fraserburgh Coast	SSSI	Notified interest features: turnstone, purple sandpiper, curlew, eider.
Rora Moss	SSSI	Notified interest feature: raised bog.
Buchan Ness to Collieston	SPA	Notified interest features: fulmar, guillemot, herring gull, kittiwake, shag, seabird assemblage.
Buchan Ness to Colliestron	SAC	Notified interest feature: vegetated sea cliffs.
Bullers of Buchan Coast	SSSI	Notified interest features: breeding seabird colony, guillemot, kittiwake, shag, coastal geomorphology of Scotland, maritime cliff.
Collieston to Whinnyfold Coast	SSSI	Notified interest features: breeding seabird colony, fulmar, guillemot, kittiwake, razorbill, sea wormwood.

Benthic Ecology

MORL commissioned benthic surveys (grab sampling, video survey, beam trawls) of the three proposed wind farm sites and offshore transmission cable study area, which were completed in 2010 and 2011.

Across the offshore wind farm sites, the survey results were consistent with those of previous studies and showed that dominant seabed sediment habitat type offshore in the wind farm sites 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, though none of the habitats encountered were considered to be geographically restricted or rare and were well represented within and around the three proposed wind farm sites.

Along the offshore cable route, the offshore portion of the study area was dominated by sedimentary seabed habitats including muddy sands, fine sandy mud and mixed sandy gravels. Further inshore and along the Rattray and Fraserburgh connection options, the seabed was dominated by comparatively coarser and more mixed sediment types, including areas of cobbles, boulders and exposed bedrock. Overlying these coarser and rockier seabed habitat types was patches of clean, mobile fine sand in varying thicknesses creating a complex mosaic of habitats.

The following describes benthic features of potential nature conservation importance identified within the cable route study area:

- The SS.SMu.CFiMu.SpnMeg biotope covered large deeper offshore areas consistent with previous records. This biotope is a component of the "burrowed mud" Scottish draft Priority Marine Feature.
- Along both the Rattray and Fraserburgh route options, encrustations grew erect from the seabed in places to resemble EC Habitats Directive Annex I *Sabellaria spinulosa* reef (classified as CR.MCR.CSab.Sspi describing *Sabellaria spinulosa* encrusted circalittoral rock). This feature is listed under Annex I of the Habitats Directive (92/43/EEC) as biogenic reef and is a UK Biodiversity Action Plan (BAP) priority habitat.
- *Salmacina* / *Filograna* reef was found at a single survey station. This type of reef is constructed biogenically as a result of the growth of tightly packed tube worms. *Salmacina dysteri* and *Filograna implexa* are two separate species of tube building worm but current data are not sufficient to confirm species identity in this instance. Both species are Serpulids and members of the Family *Serpulidae*. Whilst these species are not mentioned specifically, Serpulid reefs are listed under Annex of the EC Habitats Directive and, as with *Sabellaria spinulosa* above, are protected by a UK BAP. Serpulid aggregations are listed on the Scottish draft Priority Marine Features list.
- Areas of cobbles and rock outcroppings identified during the site specific study resembled EC Habitats Directive Annex I stony and bedrock reef respectively.

Levels of sediment contaminants were below guideline levels at all locations sampled.

Fish and Shellfish Ecology

The Moray Firth supports a number of commercial fish and shellfish species. Haddock, herring, monks and whiting account for the majority of the fish landings whilst the principal shellfish species landed are king scallops, *Nephrops*, edible crab and squid.

Spawning and nursery grounds have been defined for cod, herring, plaice, sandeel and whiting within and in the immediate vicinity of the three proposed wind farm sites and the offshore transmission infrastructure. King scallops and squid may also use the Moray Firth for spawning and as nursery grounds.

Important prey species include sandeel, herring and sprat. Sandeels are most commonly preyed upon when they are in transit to, or feeding in the water column. They are a key component of the diet of many birds (kittiwakes, razorbills, puffins, common terns, etc), piscean predators such as herring, salmon, sea trout, cod and haddock and marine mammals such as grey seals, harbour porpoises and minke whales. A sandeel survey has been commissioned by MORL. Its findings are reported in the final ES, though in summary, survey indicated that sandeel are present in low numbers across the Round 3 Zone. Herring is fed upon by a number of fish species (e.g. salmon, sea trout, whiting, cod, etc) seabirds and a number of marine mammals such as harbour porpoises, bottlenose dolphins, grey seals and common seals. Similarly, sprat is also fed upon by a number of fish species, sea birds and marine mammals.

A number of species of conservation importance have been identified as potentially present in areas relevant to the three proposed wind farm sites and the offshore transmission infrastructure. These include diadromous migratory species, (those using the marine and freshwater environments during their life cycle) elasmobranchs (sharks and rays) and commercial fish species.

Marine Mammals

The Moray Firth is an important area for marine mammals, with at least 14 species of cetacean having been recorded in and around the Firth. In addition populations of both grey and harbour seal are also present within the Firth. The populations of bottlenose dolphin and the harbour seal population are considered nationally and internationally important, with SACs for both species designated within the inner waters

MORL has commissioned a number of studies to better understand marine mammal distribution, abundance and behaviour within and around the Round 3 Zone. These include:

- Two years of boat-based marine mammal survey within the proposed sites;
- Harbour seal telemetry and habitat association modelling;
- Harbour seal abundance at haul-out sites and at sea;
- Grey Seal telemetry;
- Passive acoustic monitoring to examine cetacean spatial and temporal variation across the Moray Firth;
- Cetacean habitat association modelling;
- Estimation of harbour porpoise density; and
- Estimation of bottlenose dolphin density.

A summary of information relating to the most commonly recorded marine mammal species is provided below.

Harbour seal

Harbour seal is the commonest seal species observed within the Moray Firth, with parts of the Inner Moray First designated a SAC for their protection. Counts made during the breeding season indicate a decline in numbers within the SAC in recent years but an increase in numbers across the Moray Firth as a whole. Tagging studies found the highest rates of occurrence for the harbour seal were within 30 km of their haul-out sites. Habitat association models highlighted areas of preferred habitat, primarily within the inner firth plus some areas close to the proposed developments in the north-eastern part of the Firth. Some preference was also shown for small areas of the south-east Firth in the vicinity of the proposed land-fall sites. Modelling suggests some areas can possibly holding up to 0.5 animals per km^2. To date, only a single animal has been confirmed as a harbour seal during the boat-based surveys within the proposed sites although large numbers of seals are not identified to species level.

Grey seal

Telemetry studies showed that grey seals regularly travel between the Moray Firth and haul-out sites outside the area. Areas with the highest usage within the Moray Firth included the Dornoch and Pentland Firths. Lower levels of usage (between one and five animals per 4 km grid square) were estimated for the proposed sites combined and confirmed by the boat-based surveys. Areas of low usage are also predicted for the proposed land-fall sites.

Harbour porpoise

Passive acoustic monitoring indicates that harbour porpoise can be found throughout the Moray Firth. Harbour porpoise habitat models showed a preference for intermediate depths with increasing levels of sand and gravel, such as the Smith Bank. The boat-surveys backed this up with the highest numbers of porpoises recorded in the south-east part of the survey area. Numbers predicted in the models for coastal areas were low in comparison suggesting no conflict with the proposed land-fall sites. Density estimates from boat surveys at the proposed sites combined (0.24 animals/km^2) were slightly lower than those predicted for the Moray Firth by the SCANS II surveys (0.4-0.6 animals/km^2). Those predicted using aerial data were higher still with 0.81 porpoises per km2 predicted for the area that includes the MORL R3 zone. It should be noted however, that these aerial surveys coincide with the months during which the highest number of porpoise were recorded during the boat-based surveys.

Bottlenose dolphins

A resident population of bottlenose dolphins can be found within the Moray Firth, for which as SAC has been designated. Passive acoustic monitoring indicates that dolphins (various species) can be found throughout the Moray Firth. The EAR data suggest that those dolphins recorded in the vicinity of the proposed developments are unlikely to be bottlenose dolphins, with this species being restricted to coastal waters (including the proposed land-fall site areas). An overall dolphin density of 0.66/km^2 was calculated for the Moray Firth with densities in the vicinity of the proposed sites (any dolphin species) predicted to be low.

Other cetacean species

Of the other cetacean species observed within the Moray Firth, the minke whale is the most abundant. They have been shown to prefer sandbanks, as was shown by their distribution recorded during the boat-based surveys. The SCANS II surveys estimated 0.022 animals per km^2 for the Moray Firth, Orkney and Shetland combined, higher than the 0.01 animals per km^2 calculated from the boat-based surveys for the proposed sites.

Ornithology

The Moray Firth area holds internationally important numbers of breeding seabirds and over-wintering waterbirds (e.g. ducks, divers, grebes and waders). In addition this area is also important during the spring and autumn migration periods as a migratory route and feeding area for migratory species. Within the vicinity of the Moray Firth are several sites designated for ornithological interests.

MORL has commissioned a series of studies to better understand the abundance, distribution and behaviour of bird species within and around the proposed sites, and to understand where birds using the site originate from. Studies included:

- Two years of boat-based bird survey within the proposed sites;
- Aerial surveys of the proposed sites and adjacent waters;
- Seabird tracking of birds at Berriedale Cliffs SSSI within the East Caithness Cliffs SPA; and
- Boat and shore-based migration surveys during spring and autumn periods.

The seabird species recorded most frequently during surveys were fulmar, kittiwake, guillemot, razorbill and puffin (Table 2.4 and Table 2.5). Migratory species observed during survey includes Whooper swan, Pink-footed goose, Greylag goose and Barnacle goose (Table 2.6).

Table 2.4 Distribution of birds at different flight height bands, taken from 2010-2011 boat-based survey snapshot data. Only species with >10 records are included.

Species	**Height band**						**Total**
	0-5m	**5-10m**	**10-20m**	**20-200m**	**200-300m**	**300+**	
Fulmar	3131	93	5				3229
Sooty shearwater	46						46
Manx shearwater	10						10
Storm petrel	32						32
Gannet	248	59	69	62			438
Arctic skua	17	7	4				28
Great skua	83	16	9	1			109
Kittiwake	933	445	517	87			1982
Lesser black-backed gull	3	4	1	3			11
Herring gull	34	18	66	71	1		190

Species	Height band						Total
	0-5m	5-10m	10-20m	20-200m	200-300m	300+	
Great black-backed gull	37	13	21	43			114
Arctic tern	198	201	103	18			520
Guillemot	2824	42	2				2868
Razorbill	728	15	2				745
Guillemot/ Razorbill	1009	5					1014
Little auk	21						21
Puffin	388	2					390
Auk sp.		20					20

Table 2.5 Density (birds km^{-2}) and abundance estimates (birds on the sea) for key species, taken from 2010-2011 boat-based survey data.

	Breeding season				Non-breeding season			
	Density		Abundance		Density		Abundance	
Species	Sites	Buffer	Sites	Buffer	Sites	Buffer	Sites	Buffer
Arctic tern	0.77	5.35	229	1903	n/a	n/a	n/a	n/a
Fulmar	3.29	2.53	793	669	0.66	0.51	195	424
Great Black-backed gull	0.87	1.52	257	542	0.37	0.25	110	89
Guillemot	25.76	21.25	6255	5779	3.75	3.10	1008	1227
Gannet	0.71	0.47	206	163	0.15	0.10	43	30
Kittiwake	7.00	4.54	1972	1712	0.98	0.64	26600	109
Little auk	n/a	n/a	n/a	n/a	0.65	0.37	194	129
Great skua	0.34	0.17	102	60	n/a	n/a	n/a	n/a
Puffin	7.17	5.83	1847	1932	0.50	0.41	137	121
Razorbill	5.14	3.93	1401	1118	3.39	2.59	1090	996
Guillemot & razorbill combined	27.34	19.70	8120	7009	8.54	8.00	2536	2845

Table 2.6 Estimates of annual swans/geese flights and mortality, based on migration surveys.

Species	**Extrapolated number of flights**		
	Possible	**Probable**	**Total**
Whooper swan	0	36	36
Pink-footed goose	6228	23706	29934
Greylag goose	239	2429	2668
Barnacle goose	175	0	175

Intertidal Ecology

Information on intertidal ecology was derived from a biotope mapping survey at Fraserburgh Beach.

Fraserburgh Beach may be regarded as a high energy intertidal environment exhibiting a relatively steep profile, a width of around 120 m, and comprising moderate to well sorted mobile sands. Sediment fauna include a range of polychaetes, crustaceans and molluscs typically found in dynamic, mobile sands, and species diversity is low. No species of nature conservation importance were found during survey.

2.3.3 Human Environment

Commercial Fisheries

Records of fisheries catches from the area within which the three wind farm sites are located records landings values that are of moderate importance on a national and regional scale. Boat dredging for scallops (king scallops) accounts for the majority of landings values (57%) with otter trawling for *Nephrops* constituting 14%. Scottish seining or demersal trawling for whitefish (haddock, monks and cod) and demersal trawling for squid principally constitute the remainder. Landings values for all species are broadly highest between May and September, although there are also relatively moderate landings recorded in April and October. The majority of landings are into ports in the Moray Firth area. Fraserburgh is the principal port. The majority of vessels operating in the area are over15 m in length.

The export cable route passes through area which record landings of regional importance for *Nephrops*, scallops, haddock, squid and crustaceans. The mid section of the cable route passes through an area that records high landings values of *Nephrops* and squid. The southern section of the cable route passes through an area which records moderate landings values of haddock, *Nephrops* and crustaceans (crab and lobster). The majority of landings are into Fraserburgh.

Shipping and Navigation

Work undertaken as part of the Navigational Risk Assessment (NRA) has identified baseline vessel activity and navigational features in the vicinity of the three proposed offshore wind farms and export cable route.

The main data sources used in assessing the existing shipping activities are listed below:

- Automatic Identification System (AIS) and radar survey data for Moray Firth Round 3 Zone from survey vessels operating during spring/summer (April-July 2010) and winter (November-January 2010/11);
- AIS data recorded from a survey vessel for export cable route corridor and land fall options recorded from July to October 2011;
- Fishing surveillance satellite data (2009) and over flight data (2005-09);
- Maritime incident data from the Maritime Accident Investigation Branch (MAIB) (2001-2010) and Royal National Lifeboat Institute (RNLI) 2001-10;
- UK Admiralty Charts; and
- Admiralty Sailing Directions, North Coast of Scotland Pilot (NP 52).

From a commercial vessel perspective the Moray Firth is generally not a busy area. The main commercial shipping routes in the region are either headed into the Moray Firth and Inverness (e.g. shuttle tankers to the Nigg terminal or coastal shipping to Inverness) or using routes off Rattray Head bound for Pentland Firth and the Northern Isles (e.g. Northlink ferries to both Shetland and Orkney from Aberdeen). Other routes crossing the wind farms and export cable route consist of fishing vessels (fishing and steaming) and tankers travelling to local fishing ports and Inverness/Cromarty Firth. There is also some vessel traffic associated with support of the Beatrice and Jacky Oil Fields.

Military and Civil Aviation

Studies and consultation undertaken to inform EIA have identified the following aviation receptors that may interact with wind farm development:

- NERL - Allanshill Primary Surveillance Radar (PSR) supporting Civil Air Traffic Control (ATC) and En-route operations;
- MOD Air Surveillance and Control Systems (ASACS) – Buchan Air Defence Radar (ADR) supporting UK Air Defence operations and training;
- MOD ATC – Lossiemouth PSR used to provide navigational services to aircraft inbound to and outbound from the airfield, to military aircraft operating over the Moray Firth;
- Highlands and Islands Airports Ltd (HIAL) Wick Airport regarding potential effects on aircraft flight patterns and procedures;
- Helicopter Main Routes – HMR X-Ray used by helicopters transiting between Aberdeen, via Wick to the Atlantic Rim offshore installations west of the Shetland Islands;
- Helicopter Approach Procedures to offshore platforms; and
- Minimum Safe Altitude which is the lowest altitude set in areas to ensure separation between aircraft and known obstacles.

Seascape, Landscape and Visual Receptors

The project EIA has been informed by a Seascape, Landscape and Visual Impact Assessment (SLVIA). The SLVIA has been undertaken within a 50 km radius study area of the Telford, Stevenson and MacColl offshore wind farms.

The Telford and Stevenson sites are located approximately 22 km from Caithness, at their closest points. The study area includes the Caithness coast between Duncansby Head and Brora, and extends up to approximately 30 km inland. The choice of study area has been influenced by the landscape character types identified in the Caithness Landscape Character Area. It encompasses the Flat Peatlands and the Moorland Slopes and Hills types, which define the inland extent of visibility of the sea. The Caithness coastline is within National Seascape Unit 7 - East Caithness and Sutherland, and is defined mainly by Seascape Character Type 2: Rocky Coastline with Open Sea Views, with smaller sections of Type 1: Remote High Cliffs and Type 3: Deposition Coastline with Open Sea Views. The 50 km study area includes the North Aberdeenshire / Morayshire coast between Lossiemouth and Banff and is within the North Aberdeenshire / Morayshire Coast National Seascape Unit 5. This coastline is defined mainly by National Seascape Character Type 2: Rocky Coastline with Open Sea Views and Type 3: Deposition Coastline with Open Sea Views. The Moray coast is located approximately 40 km from the MacColl site, at its closest point.

Archaeology

The archaeological potential of the offshore wind farm areas and offshore export cable has been described following a desk-based review of existing data sources and archaeological assessment of marine geophysical and geotechnical data acquired by MORL.

Within the wind farm sites there are no designated wrecks or other cultural heritage assets with legal designations. Desk-based review identified six recorded wrecks in the study area, four of which are located inside the wind farm sites and two wrecks within a 1 km buffer zone. A further two UKHO obstructions have been identified, one within the proposed wind farm sites and one in the 1 km buffer zone. The archaeological geophysical assessment undertaken for MORL identified three anomalies of high archaeological potential that have been positively identified as wrecks and 16 anomalies of medium potential within the wind farm sites and 1 km buffer zone.

There are no designated wrecks or other cultural heritage assets with legal designations within the offshore cable route. There are 14 recorded wreck sites in the study area, where 11 were located in the Inner Study Area and 3 in the Outer Study Area. The archaeological geophysical assessment has identified 15 targets of high archaeological potential positively identified as wrecks and 40 anomalies of medium archaeological potential, all of which are located within the proposed export cable Inner and Outer Study Areas.

Other Human Activities

There are a number of other marine users active in the Moray Firth. These include offshore wind farm operators and developers (there are currently two offshore WTGs in the Moray Firth, which comprise the Beatrice Demonstrator Project), oil and gas operators (there are currently two operational oil production fields in the Moray Firth, with their associated platforms, pipelines and wells), subsea cable operators and developers, and military users undertaking practice and exercise activities.

3. Description of Items to be Decommissioned

At the time of writing, MORL is undertaking design and development work for the Project. This section outlines the range of concepts for each category of infrastructure that will be used within the three offshore wind farm sites and their associated transmission infrastructure. Design concepts are expected to evolve and final infrastructure details will be confirmed by MORL prior to Project construction commencing. At the current time, the range of concepts is the same for each individual wind farm project. However, where there will be differences in the infrastructure within sites because of the timing of construction, this has been clearly indicated. The specific infrastructure required for each site will be determined following further detailed engineering.

3.1 Wind Turbine Generators

Wind turbine generators (WTGs) are classified by turbine rating, which indicates the maximum electricity production possible from the infrastructure. The models of WTGs for the Telford, Stevenson and MacColl sites are expected to be of a rating between 3.6-8 MW. A specific manufacturer of wind turbine generator has not yet been identified because the market is currently undergoing significant changes in maximising the efficiencies of machines and developing and testing higher rated machines. At the current time, the 3.6 MW turbine is used extensively in the offshore wind industry and therefore is the most technically proven option. However, the 8 MW turbine category is the highest rated and largest wind turbine that is expected to be commercially and technically feasible within the project timescales. If a turbine with a higher capacity rating becomes available within the project time scales, and if it fits within the Rochdale Envelope parameters (see Table 3.1), then it may be used.

Any wind turbine model selected will be of proven technology and will conform to the standard design of a horizontal axis wind turbine with three blades attached at the hub to a nacelle, which houses the generator, gear box, and other operating equipment, and a turbine tower which is made up of tower sections, control equipment, a power cable and other ancillary infrastructure.

Table 3.1 provides the range of dimensions associated with the turbine models currently on the market or in development. For the purposes of the project description and impact assessments, the available turbines have been grouped into three categories which correspond with the minimum and maximum ratings expected within each site (see Table 3.1). Figure 3.1 illustrates a potential 7/8 MW turbine.

Table 3.1 Dimensions of the turbines proposed for the Telford, Stevenson and MacColl sites.

Turbine Rating	3.6, 5, 7 and 8 MW
Approximate hub height range	97 - 118 m
Rotor diameter range	120 - 172 m
Maximum blade width range	4.2 – 5.8 m
Maximum tip height @ LAT range	162 - 204 m
Minimum Air draft at HAT	22 m
Range of rotational speeds required for electricity generation	4 – 15.1 rpm

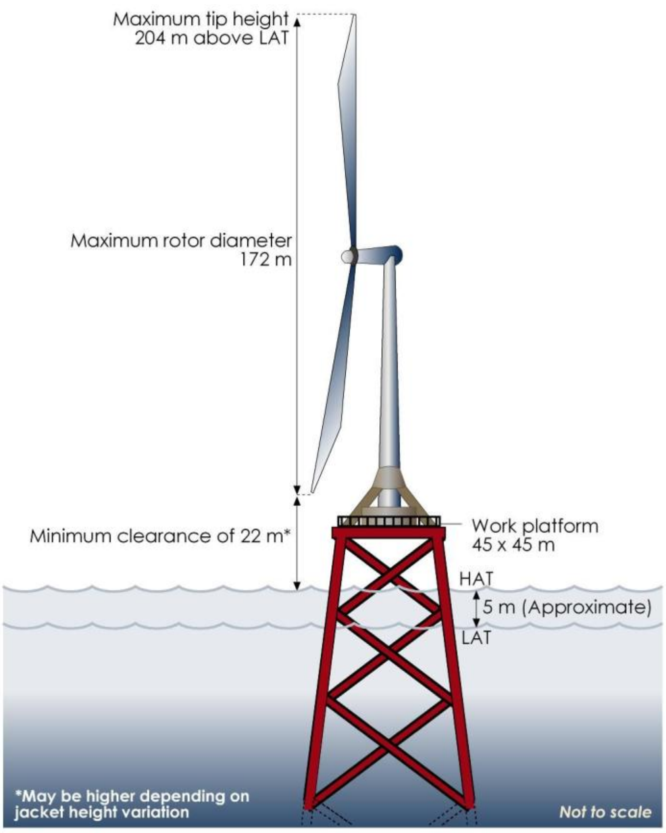


Figure 3.1 Illustration of a 7/8 MW turbine.

3.1.1 Turbine Numbers and Site Layout

Only one rating of turbine will be used within each site, however, different ratings of turbines may be used in different sites. This will allow the project to take advantages of advances in technology as the programme progresses. Table 3.2 presents the various build out scenarios for the sequential development of sites, which gives an indication of the lowest and highest ratings of turbines that MORL expects to be available for the sites. As each site has a maximum capacity of 500 MW and the order of the build-out is not yet known, it is not possible to determine the order in which the sites will be constructed. Impact assessments were completed based on a Parameter Plan which contemplates between 63 and 139 turbines for each site.

Table 3.2 Potential build out scenarios. Site numbers refer to the order in which the sites will be constructed and do not correspond to a particular named site.

a. Build out scenario using the greatest number of turbines

	Expected year for construction to start	Turbine rating	Number of turbines required	Maximum capacity
Site 1	2016	3.6 MW	139	500 MW
Site 2	2017/2018	5 MW	100	500 MW
Site 3	2019	5 MW	100	500 MW
EDA			**339**	**1,500 MW**

b. Build out scenario using the least number of turbines

	Expected year for construction to start	Turbine rating	Number of turbines required	Maximum capacity
Site 1	2016	7 / 8 MW	72 / 63	500 MW
Site 2	2017/2018	7 / 8 MW	72 / 63	500 MW
Site 3	2019	7 / 8 MW	72 / 63	500 MW
EDA			**216 / 189**	**1,500 MW**

The final site layout within the boundaries for Telford, Stevenson and MacColl are yet to be determined. However, the following section provides a summary of the factors which influence the site layout.

The layout of a wind farm site is dependent on several factors including:

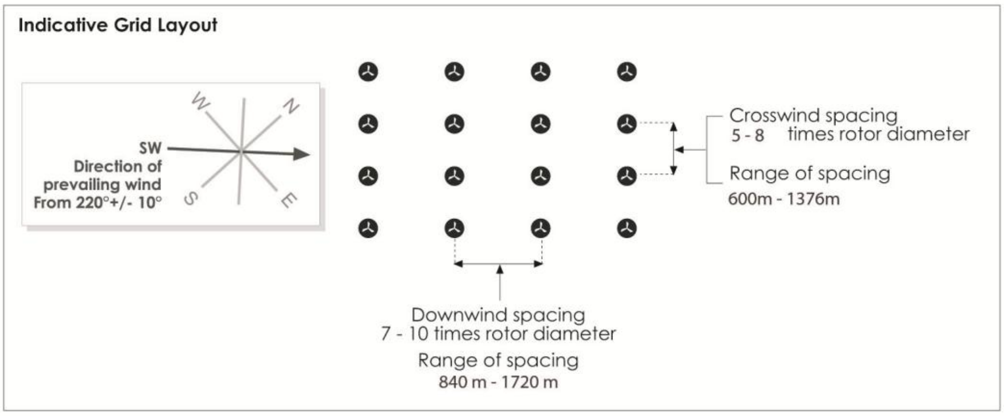
- The prevailing wind direction, as turbine rows must be orientated into the dominant wind direction;
- The rotor diameter of the turbine within the site, as this influences the spacing required between adjacent turbines;
- Distance from adjacent turbines to minimise wake losses;
- Seabed geological conditions;
- Seabed bathymetric conditions;
- Seabed obstructions (micrositing constraint); and
- Environmental issues (micrositing constraint).

The final spacing between the turbines is dependent on detailed analysis of the wind resource, the rotor diameter of the final turbine type selected, technical constraints and the impacts on these features from the spatial “micrositing” constraints associated with the seabed. Micrositing constraints are those features of the sea environment which prevent the installation of a turbine in a particular position.

The standard downwind spacing is expected to be between 7-10 times the turbine rotor diameter and the crosswind spacing will be between 5-8 times the turbine rotor diameter. The minimum downwind spacing will therefore be 840 m, while the maximum will be 1,720 m. With crosswind spacing, the minimum will be 600 m and the maximum 1,376 m. Figures 3.2a and b provide an illustration of the potential configuration of the turbines in relation to each other. The patterns being considered for the MORL site are a regular grid pattern (where turbines are aligned along both the downwind and crosswind axes) and a diamond pattern (where turbines are only aligned along the downwind axis).

It should be noted that, following more analysis of the wind resource, it may be that some rows of turbines are “removed” from the array layout or individual turbines removed or re-positioned. This is to ensure that each wind turbine is working at maximum efficiency and the influence of wake losses from turbines “upstream” is minimised. Furthermore, any two adjacent sites may be developed with different turbine sizes.

a.



b.

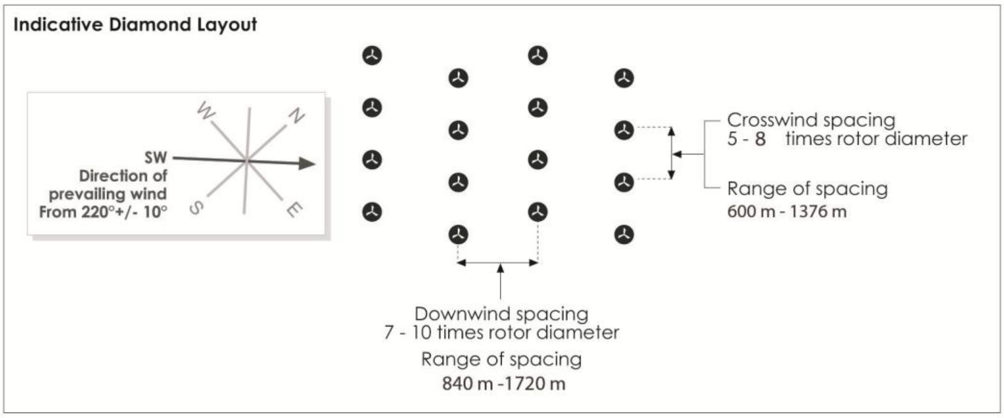


Figure 3.2 Indicative turbine layout patterns. A regular grid layout is presented in the top figure and the diamond layout in the bottom figure.

3.2 Foundations and Substructures for WTGs

The WTGs will be supported by substructures and foundations which hold the machine in place on the seabed. There is an access deck platform between the turbine tower and the substructure, which allows personnel access into the turbine tower.

Two main foundation and substructure concepts, the Gravity Base Structure (GBS) on a gravel bed and the Jacket Structure with pin piles, are proposed to be used within the three proposed wind farm sites; it should be noted that there are multiple variations within these two broad concepts. The choice of which concept is more appropriate within a site is dependent upon the turbine model selected and the ground conditions within the particular site. As a result there may be a mix of GBS and Jacket Structures across the three sites or even within a site.

3.2.1 Gravity Base Structures

There are many variations of the GBS. The main differences are related to the GBS geometry / shape. The foundation can be a square, cross, circular or hexagonal and the side view geometry can be a cone shape, a monotower or even a lattice structure (jacket). An indicative figure is presented below to illustrate some of these different geometries (Figure 3.3 below). These sub–concepts of a GBS are mainly composed by a concrete base, ballast material and a hollow concrete / steel tower or a steel lattice structure (jacket). For the purpose of the EIA, MORL has defined a generic cone shape GBS to represent the worst case scenario and cover all the GBS sub–concepts. This generic GBS is composed by a hollow circular base, filled with ballast for stability, and a monopole tower / top–piece.

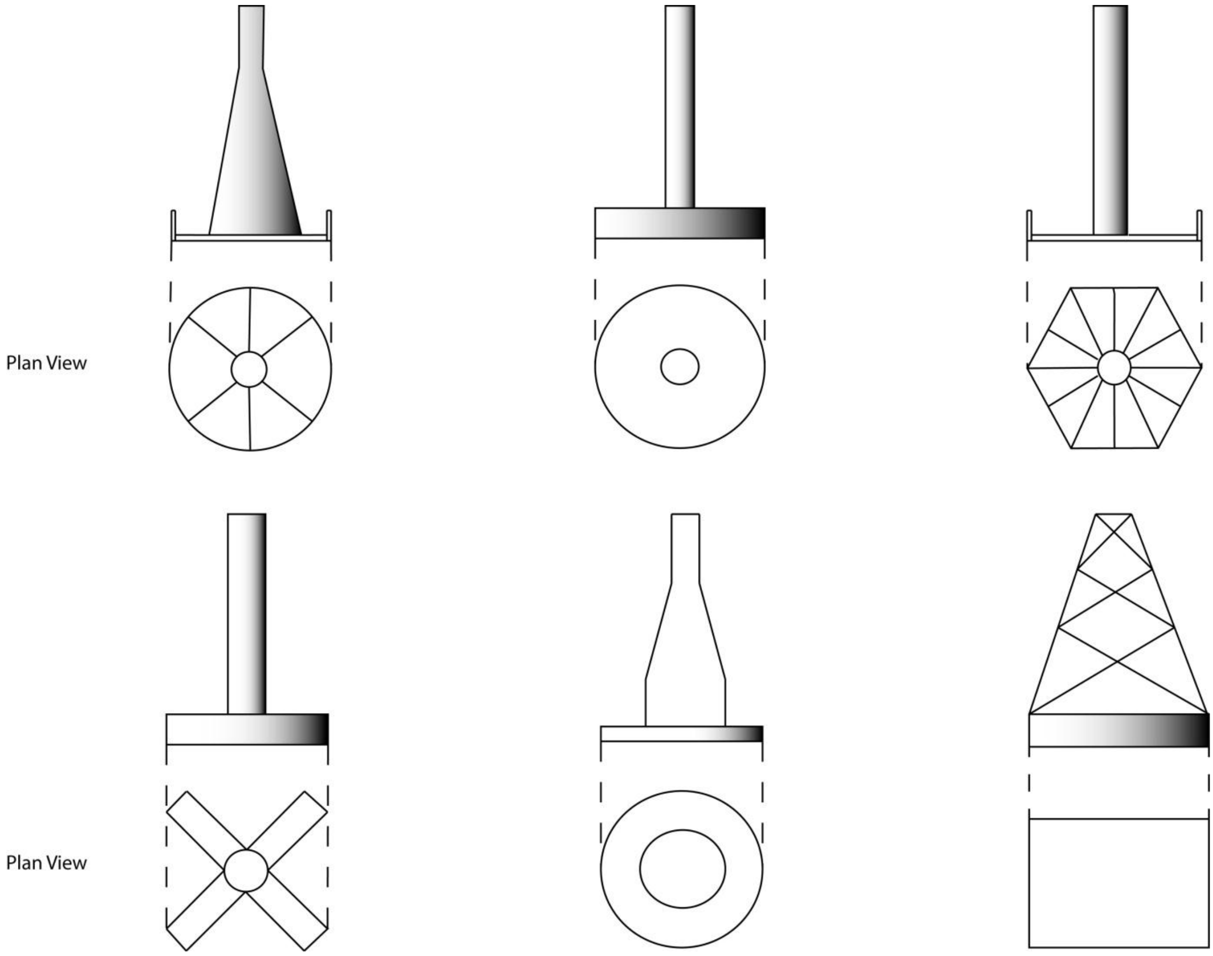


Figure 3.3 Indicative geometry / shape of GBS concepts

The generic GBS is composed of a hollow concrete base, which is filled with ballast for stability, and a steel monopole top–piece (Figure 3.4 below). The GBS may have a steel "skirt" which penetrates the seabed. The concept requires the preparation of the seabed which involves an area of seabed being dredged to allow the installation of a flat gravel bed to provide a stable foundation for the GBS. It is expected that the area of seabed which is excavated will be greater than the final area of the laid gravel bed. In some cases, grouting injected under the GBS may be a suitable alternative to the gravel bed foundation. Scour protection (graded rock placement, concrete mattress or scour mats) are likely to be used around the concrete base. Corrosion protection will be required for the steel tower / top–piece and for the secondary steel work (boat landings and leaders) of the substructure. This is likely to take the form of cathodic protection, painting and mechanical removal of deposits. There is also potential for the use of corrosion inhibitors chemicals inside the J–tubes.

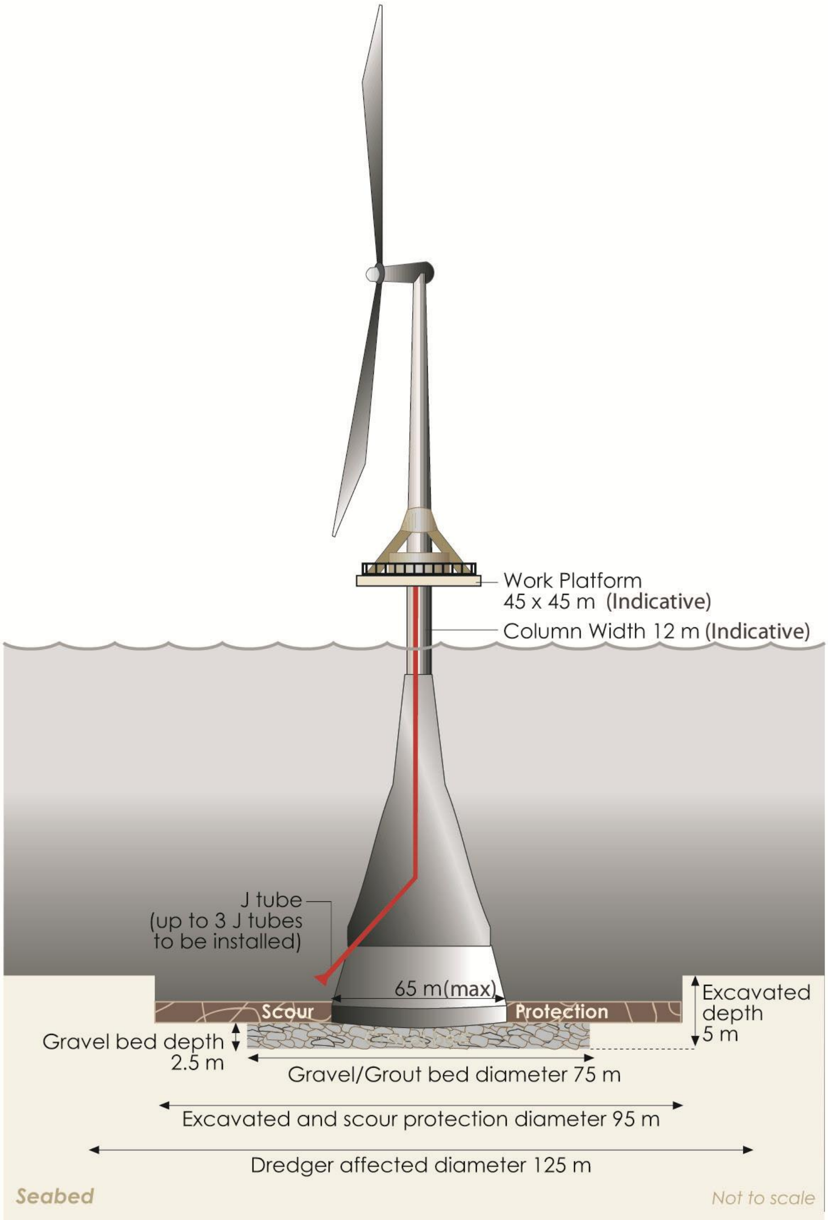


Figure 3.4 Diagram of a typical GBS substructure and gravel bed foundation.

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3.2.2 Jacket Structures

Jackets are steel structures with three or four legs, each of which is fixed to the seabed using a steel "pin" pile (Figure 3.5 below). Jacket structures can assume different configurations. As with the GBS, this concept has various sub–concepts including braced monopods, tripod structures and three or four legged lattice structures. For the purpose of the EIA, MORL has defined a generic 4–legged lattice structure. Scour protection (e.g. scour mats or rock) will be used around each leg. Corrosion protection will be required for the steel top–piece of the substructure. Similar to the GBS this is likely to take the form of cathodic protection, painting and mechanical removal of deposits. There is also potential for the use of corrosion inhibitors chemicals inside the J–tubes.

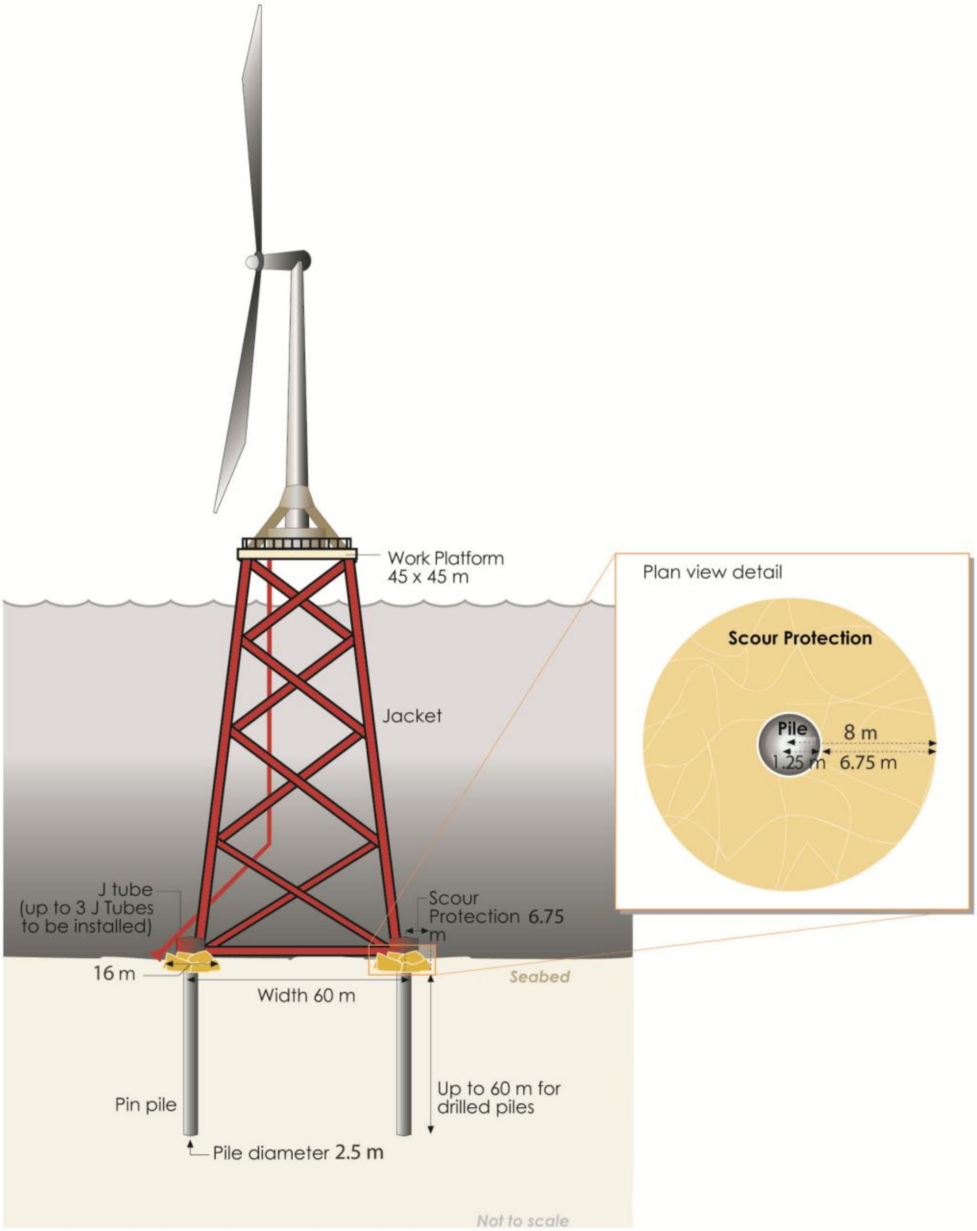

Figure 3.5 Diagram of a typical jacket substructure with pin piles.

3.3 Inter-Array Cabling

Inter-array cabling will run between each turbine in strings and connect each string to an offshore AC OSP. Typically, depending on detailed design, up to 36 MW of turbines will be connected on a cable "string" (e.g. 10 x 3.6 MW turbines or 7x 5 MW turbines). There would indicatively be 7-12 strings within each site. The cabling will be between 33-66 kV. The configuration of the turbines on the strings is expected to be either a branched radial (Figure 3.7) or looped arrangement (Figure 3.6).

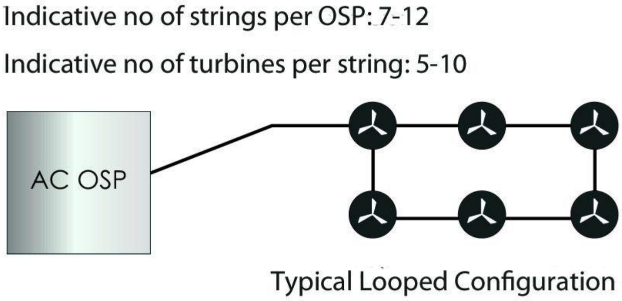

Figure 3.6 Typical Looped Configuration

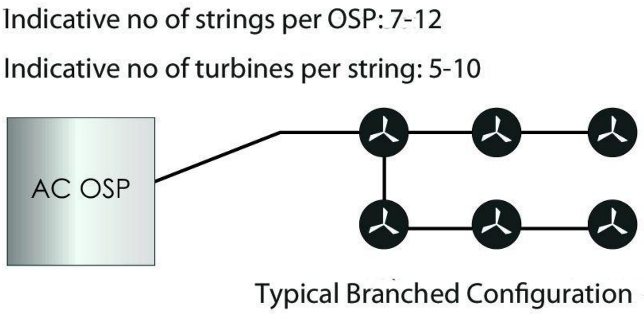

Figure 3.7 Typical Branched Configuration

Inter-array cabling entry to a turbine or substation is facilitated using a J-tube, a steel tube structure which guides the cable from the inside of the turbine into the sea environment. Array cables would normally be installed in trenches for protection but close to each WTG the cables will be laid on the seabed for entry to the J-tubes. After installation the exposed cables will be protected. Typically the length will extend up to 100 m out from the base of the WTG. Each WTG will have up to four J-tubes each with a cable. Protection of the exposed cables will be used, such as pre-formed concrete mattresses consisting of concrete block sections linked together by webbing so that they may drape flexibly over the cable and seabed. Alternatively controlled rock placement using a fall pipe monitored by ROV (Remotely Operated Vehicle) may be used. It is also a possibility that concrete tunnels and grout bags, and propitiatory steel/plastic ducting or protecting sleeves could be utilised to protect the cable.

Further analysis will be carried out of the site seabed conditions as part of the cable protection and burial study. The study will consider the technically and economically achievable burial depths based on the site specific ground conditions. It is normally expected that 1 m will be targeted for burial depth. However, this may not always be feasible due to the nature of the seabed. In instances where adequate burial cannot be achieved, alternative protection will be deployed.

3.4 Meteorological Mast

MORL has consent and will be installing a metrological mast in Q3 2012. The mast will we located 510571E 6449002N (UTM Zone 30 North with WGS 84 datum.

MORL and BOWL intend to use the wind speed data collected from the met mast to enable robust resource calculations and yield estimates for their wind farm designs. The meteorological mast is a permanent structure that is intended to remain on site for the life span of the wind farm.

The met mast will consist of;

- The subsea foundation structure, which will be a tapered monopole (approximately 4.5 m diameter) and will provide the seabed attachment up to a stable platform structure at approximately 16 to 22 m above Lowest Astronomical Tide (LAT);
- An access / impact protection structure;
- The lattice type met mast structure itself, which will be approximately 84 – 88 m tall above its platform attachment; and
- The maximum height of the structure will be 110 m LAT.

MORL are planning to install a second meterological mast to assist in long term wind resource monitoring and wind farm performance. The exact location of this has not yet been determined; it will be in one of the three proposed wind farm sites. This met mast will be one of two broad concepts:

- **Floating Lidar** – the floating lidar system will consist of a buoy or floating substructure (spar–buoy) designed to collect, process and transmit meteorological, oceanographic, directional wave, water quality and currents data with near–real time communications capabilities which will be used to assess the offshore wind resource assessment at the site. The system is the ideal wind and environmental assessment data collection device for extreme marine weather conditions. The buoy platform or floating substructure (spar–buoy) chosen is a well proven, designed specifically for long–term deployments in deep, extreme, marine conditions. The main components of the system will be:
  - Floating platform (buoy) or floating substructure (spar–buoy).
  - Chain moorings.
  - Position monitoring and navigational aids.
  - Measurement instrumentation: Lidar and oceanographic sensors.

- Power supply.
- Data acquisition and transmission system.

- **Non–lidar** – Latice tower, transitional piece and platform supported by a foundation substructure. Within this there are various options for structural foundations:
  - Monopile (same as the first MORL met mast;
  - Gravity Base Structure; and
  - Jacket with pinpiles or suction caissons.

The non–lidar structure itself will be no different to the first MORL met mast in that it will be a lattice structure of similar dimensions. Its maximum height will be 150 m LAT.

3.5 Offshore Transmission Infrastructure

This section outlines the range of concepts for each category of infrastructure required for the offshore transmission infrastructure. A geophysical and geotechnical survey campaign was carried out in 2011 to identify appropriate areas for installation of cables and platforms.

3.5.1 AC Offshore Substation Platform

Between 3–6 alternating current (AC) offshore substation platforms (OSPs) will be required to collect the power generated by the three wind farms. The exact locations of the OSPs are not currently known but it is anticipated that the substations could be located either within the wind farm sites or a maximum of 2 km from the boundary within the export cable route surveyed area (see Figure 2.2). The AC OSPs are enclosed structures housing heavy electrical equipment such as transformers, switchgear and control systems. The function of the AC OSPs is to transform the electricity generated by the turbines from voltages of 33–66 kV to 220 kV for export to the AC / DC OSPs. Table 3.3 below provides the maximum dimensions of the AC and AC / DC OSPs. Please note that the AC / DC OSPs will be part of the offshore transmission infrastructure but are included for comparison in this section.

Table 3.3: Dimensions of the AC and AC/DC OSPs

Platform Parameter	Dimensions	
	AC Platform	AC/DC Platform
OSP 'topside' width x length	100m x100m	100m x100m
Topside max height above LAT	70m	70m

It is highlighted that it may be possible to combine the AC and AC/DC OSPs. This would allow fewer substations to be installed offshore. The dimensions presented for the foundations and topsides are suitable to cover range of dimensions for either the individual or combined substation options.

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3.5.2 AC/DC Offshore Converter Substation Platforms

Up to two AC/DC OSPs will be required to convert the AC electricity generated by the turbines to high voltage DC electricity. The exact locations of the AC/DC OSPs are yet to be decided, however, they will be located either within a wind farm site boundary or within the OfTI corridor, as close to the MORL Zone boundary as possible.

The AC/DC OSPs are enclosed structures housing heavy electrical equipment including AC-DC converter equipment, switchgear, transformers and control systems. The AC/DC OSPs would also contain transformer coolant systems that would use liquid coolant and also a diesel generator for emergency auxiliary supply only.

Other components of the AC/DC OSPs may include a helideck, crane, fire fighting equipment, lighting and a SCADA (Supervisory Control and Data Acquisition) system. Table 4.7 provides the dimensions of the AC/DC OSPs.

As highlighted previously, it may be possible to combine the generating station AC OSPs with the offshore AC/DC OSPs.

3.5.3 Foundations and Substructures for AC and AC/DC OSPs

The AC and AC/DC OSPs will be supported by substructures and foundations, of which there are six concepts identified as suitable for the three sites:

- GBS with a gravel bed foundation;
- Jacket with pin piles;
- Jacket with suction caissons;
- Jack-up with pin piles; and
- Jack-up with suction caissons.

The choice of which concept is more appropriate within a site is dependent upon the ground conditions within the particular site.

Gravity Base Structures

Similar to the GBS for wind turbines, the proposed GBS are composed of hollow concrete bases, which are filled with ballast for stability and requires the preparation of the seabed which involves a flat gravel bed being laid to provide a stable foundation for the GBS. Scour protection (e.g. scour mats or rock) is likely to be used around the concrete base.

The GBS required to support the OSP would be significantly larger than that of the GBS for a wind turbine and a range of design options will be considered, including but not limited to:

- 4 x GBSs of the maximum size used for turbines, located close together;
- 2 x larger GBSs side by side; and
- 1 x very large GBS.

Figure 3.8 provides a plan view of the seabed to show the maximum area affected by the GBS structure.

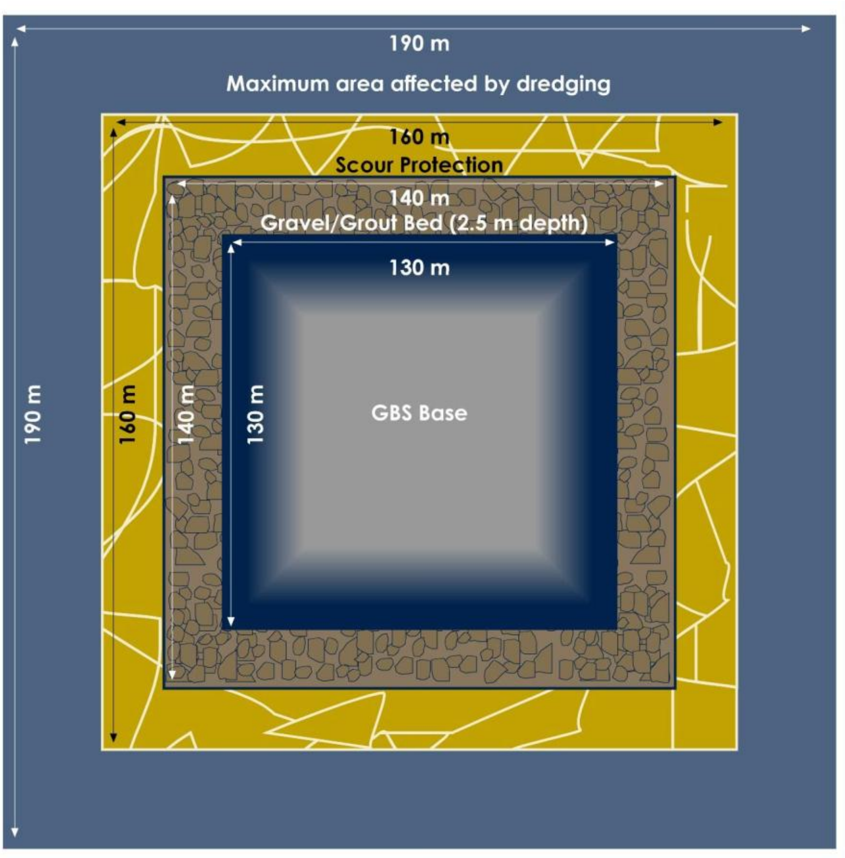


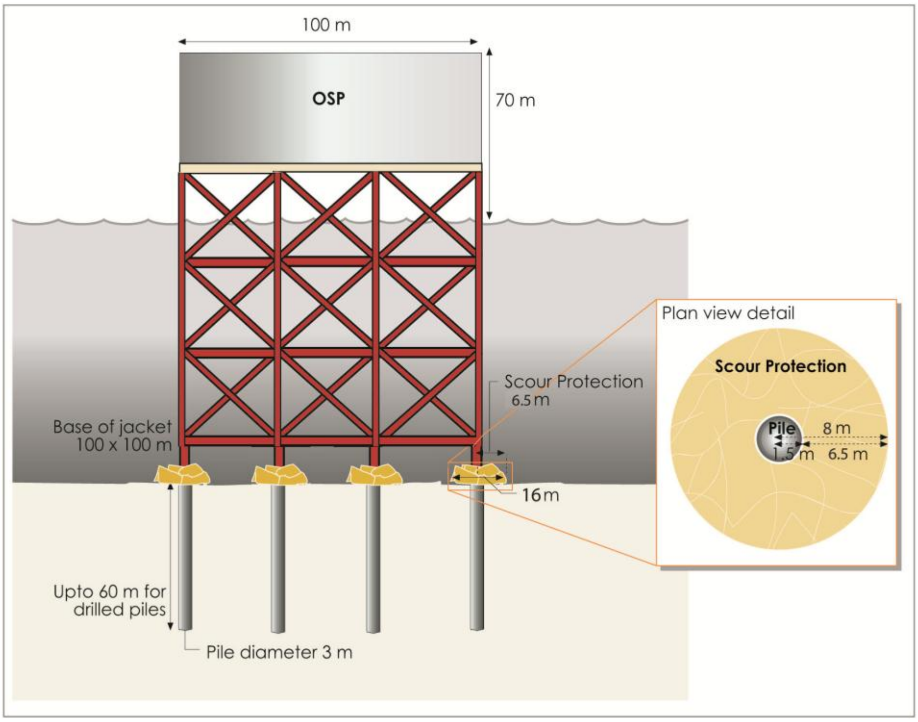
Figure 3.8 Plan view of the seabed, showing the maximum area affected by the platform GBS substructure and gravel bed foundations.

Jackets with pin piles or suction caissons

The jacket substructure with pin pile foundations is similar to that of a wind turbine. However, the jacket structure required to support an AC or AC/DC OSP will have between 4-6 legs. The alternative suction caisson foundation would be an open-ended steel cylinder up to 20 m diameter attached to each leg. The principle is that water is sucked out of the cylinder which then embeds itself in a sandy seabed to depth of up to 20 m. This option cannot be used in many locations across the three sites because only 10% of the seabed in this area is suitable for this concept.

An illustration of an OSP with jacket substructure and pin pile foundations is shown in Figure 3.9a and with suction caisson foundations in Figure 3.9b.

a.



b.

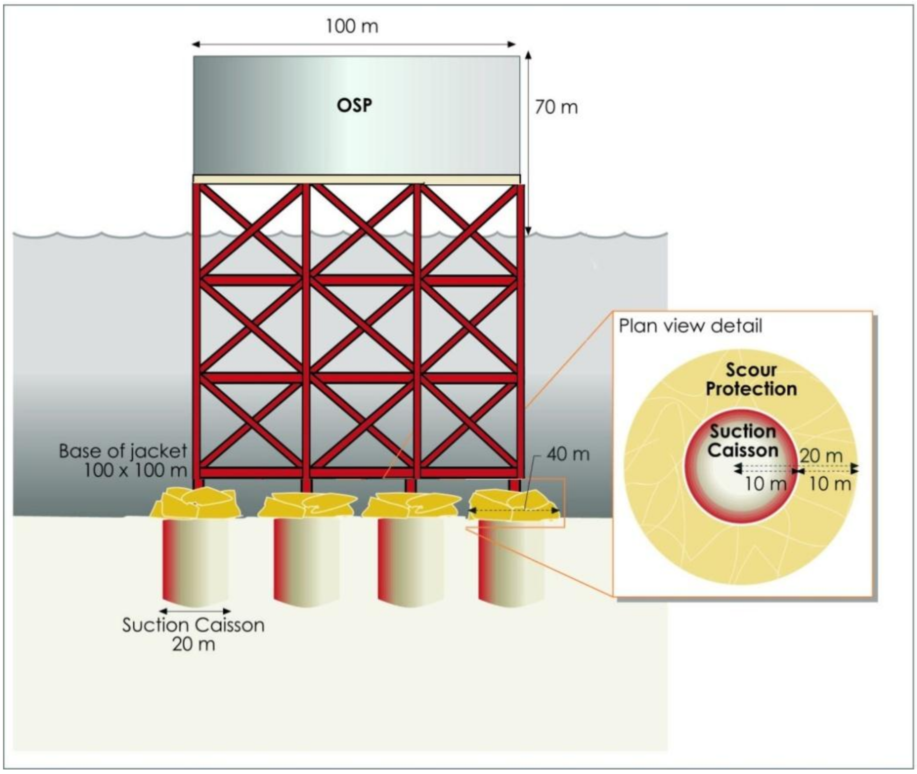


Figure 3.9 OSP with jacket substructure. Pin pile foundations are shown in figure a; and, suction caisson foundations in figure b.

Jack-ups with pin piles or suction caissons

The jack-up concept will have either pin pile or suction caisson foundations similar to those described earlier. The jack-up substructure consists of a topside box with 4-6 support legs that can be raised or lowered using a powerful jacking system operating between each leg and the hull. Water ballast is taken by the jacking system to ensure the legs are fully loaded and secure in the seabed. At the base of each leg a 'spud can', such as a steel cone which penetrates the seabed, may be fitted. For long-term stability it may be necessary to install a pin pile up to 3 m diameter at each leg. Alternatively a suction caisson of 20 m diameter can provide stability. The area around the legs may require scour protection. Corrosion protection would be likely to take the form of painting or cathodic protection.

3.5.4 Inter-Platform Cabling

Cabling at 220 kV will be required to connect the AC OSPs to the AC/DC OSPs. Cables will be buried or protected in the same way as the inter-array cable. Where the AC and AC/DC OSPs are combined, the cabling would be contained within the platform infrastructure rather than be installed sub-sea.

3.5.5 Export Cable

HVDC export cables will be required to connect the AC/DC OSPs to the chosen grid connection point. Two, 320kV export cables per AC/DC OSP will be required resulting in a total of four export cables. However, the export cables from each AC/DC OSP will be "bundled" together with a fibre optic cable to form one large cable. Therefore, there will be two export cable bundles in total to export the production of up to 1,500 MW of electricity.

The site selection work for the cable corridor identified Fraserburgh Beach as the preferred landfall option, which would allow the export cable to be taken onshore to the final connection point at Peterhead. The width of the surveyed offshore corridor, within which the cables and potential AC/DC OSPs will be located, is variable depending on the water depth, seabed conditions and seabed features.

The offshore export DC cables bundles would be buried to a target depth of 1m based on site-specific seabed conditions. Where adequate burial cannot be achieved alternative protection methods, such as mattresses or rock placement, will be used.

The cables or cable bundles will be spaced apart to reduce the potential for damage by unexpected activities such as anchor drag, and to allow safe repair of adjacent cables. The distance between the cables or cable bundles is expected to be four times the water depth, based on current industry best practice. From the bathymetric conditions found in the surveyed area this will result in a cable separation of approximately 200-800 m. In the intertidal zone at the landfall point and onshore, both cables may be accommodated in the same trench or conduit.

3.5.6 Onshore Infrastructure

Two direct current (DC) 750 MW onshore converter units will be required to convert the DC electricity transmitted by the AC/DC OSPs back to high voltage AC electricity in order for it to be connected to the onshore grid network. These two converter units will be co-located within a single compound onshore in close proximity to Peterhead Power Station and AC collector substation. The compound for this substation will cover an area of approximately 100 x 100 m.

In addition to the DC converter equipment located in the compound there will be HVAC switchgear, harmonic filters, HVAC cables, liquid cooled transformers, 33 kV auxiliary supply equipment including distribution transformers and switchgear. There will be control room facilities, including SCADA protection and control systems for the unmanned site located either within the converter building or within a separate building within the substation compound.

It is highlighted that in order to complete the grid connection for the three proposed wind farms, an onshore collector substation will be required to facilitate a final connection to the high voltage AC system owned by SHETL and operated by NGET. A connection between the OFTO assets and the SHETL assets located in a separate compound will be made using 400 kV cables. These will be installed by MORL on behalf of the OFTO. Any works associated with this onshore collector substation will be consented and constructed by SHETL.

The decommissioning of onshore infrastructure is not covered in this Decommissioning Programme, which is concerned with offshore infrastructure.

4. Description of Proposed Decommissioning Measures

4.1 Decommissioning Considerations

Decommissioning Programmes have been developed with reference to the guidance and standards outlined within the following publication: *Decommissioning of Offshore Renewable Energy Installations under the Energy Act 2004: Guidance notes for Industry*, DECC, January 2011 (revised), which in turn draws upon the following:

- Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone, International Maritime Organisation (IMO), 19th October 1989;
- Guidance Notes for Industry: Decommissioning of Offshore Installations and Pipelines under the Petroleum Act 1998, DECC, March 2011;
- OSPAR Guidance on Environmental Considerations for Offshore Wind Farm Development, 2008;
- Guidelines for Environmental Risk Assessment and Management – Green Leaves III, Defra, November 2011; and
- United Nations Convention on the Law of the Sea (UNCLOS), 1982.

In considering appropriate decommissioning provisions, MORL have sought to adhere to the following key principles:

- Safety for all at all times;
- Consideration of the rights and needs of legitimate users of the sea;
- Minimise environmental impact;
- Adherence to 'polluter pays' principle;
- Promote sustainable development;
- Maximise the reuse of materials;
- Commercial viability; and
- Practical integrity.

MORL adhere to the concept of Best Practicable Environmental Option (BPEO); that is the option which provides the most benefit or least damage to the environment as a whole, at an acceptable cost, in both the long and short term.

4.2 Decommissioning Options

When the three proposed wind farm sites can no longer have their life extended or the infrastructure be reused in a beneficial way, the infrastructure will need to be decommissioned. "The 'ideal' decommissioning programme involves removing the whole of all disused installation and structures" (DECC, 2011).

The key aim is to restore the environment so that it can be used for other purposes, including safe navigation. In order to do this it is expected by DECC (2011) that the decommissioning process will remove installations back to land for reuse, recycling, incineration with energy recovery or disposal at a licensed site. The situations in which other solutions (i.e. leaving in place or partially removing) may be considered include:

- The installation or structure will serve a new use, whether for renewable energy generation or for another purpose, such as enhancement of a living resource (provided it is not detrimental to other aims – e.g. conservation). This does not include leaving in place for colonisation and artificial reef purposes. However, in this situation, measures will be expected to put in place should the installation/structure finally become disused;
- Entire removal would involve extreme cost. It is considered that design decisions should, as far as possible, result in installations which are affordable to remove, but it is recognised that some elements, such as deep foundations, may nonetheless be costly to remove;
- Entire removal would involve an unacceptable risk to personnel;
- Entire removal would involve an unacceptable risk to the marine environment; and
- The installation of structure weighing more than 4000 tonnes in air (excluding any deck and superstructure) or is standing in more than 100m of water and could be left wholly or partially in place without causing unjustifiable interference with other uses of the sea.

4.3 Location of the Decommissioning Sites

As outlined in Section 2.3.3, the sites are not within any areas of specific concern to the IMO and therefore, the possibility of leaving a structure partially or in whole within the sea can be considered. Where it is proposed to leave infrastructure on or in the seabed, the following issues have been considered:

- Potential effect on the safety of surface or subsurface navigation;
- Potential impact on other uses of the sea;
- Potential effect on the marine environment, including living resources;
- Costs of removal;
- Risks of injury to personnel associated with removal; and
- The likely effect on the remaining elements where other parts of the installation are removed.

4.4 Potential for Phasing and Integration

It is possible that there may be synergies and interactions between decommissioning activities at the MacColl, Stevenson and Telford sites. MORL will promote formal industry collaboration on this issue and, as a minimum, will approach the developers of the Beatrice Offshore Wind Farm to consider potential opportunities as part of the ongoing review process for the Telford, Stevenson and MacColl decommissioning programmes. However, MORL's starting assumption is that decommissioning will be undertaken in isolation at the three wind farm sites in order that the provisions can be fully costed and sufficient financial security provided. The status and requirements of surrounding projects will be carefully considered in the planning and execution of the decommissioning process.

Any sharing of decommissioning activities would influence the phasing of the works; phasing will be clarified in the draft final Decommissioning Programme.

4.5 Other Potential uses for the Infrastructure

With the exception of re-powering (see Section 1), at the time of writing, the infrastructure is not considered to have the potential for the following purposes:

- The ability to be reused for renewable energy generation other than re-powering; and
- The ability to serve a purpose beyond renewable energy generation.

4.6 Proposed Measures for Decommissioning

Proposed decommissioning measures for each infrastructure component are discussed in more detail below. In broad terms, decommissioning will involve the removal of non-buried infrastructure (e.g. WTGs and OSPs) and buried components (e.g. foundations and cables) may be left in situ or removed depending upon regulatory and project aims at the time of decommissioning. Advances in technology may also allow consideration of alternative decommissioning measures. Table 4.1 summarises the decommissioning measures that MORL currently considers represent the best practicable environmental options.

Table 4.1 Summary of proposed decommissioning measures.

Component	Decommissioning Proposal
Wind Turbine Generators (WTGs)	Complete removal from site
Substructures and foundations (WTGs)	
Gravity base	Complete removal from site
Lattice jacket	Cut off at or below seabed and removed
Inter-array cabling	Left in-situ
Offshore Substation Platforms (OSPs)	Complete removal from site
Substructures and foundations (OSPs)	
Gravity base	Complete removal from site
Lattice jacket	Cut off at or below seabed and removed
Lattice jack-up	Cut off at or below seabed and removed
Inter-platform cabling	Left in-situ
Export cabling	Left in-situ
Meteorological mast	Removal of mast and cut off at or below seabed and removed
Scour protection	Left in-situ

4.6.1 Complete Removal

Wind Turbine Generators

It is intended that the WTGs are fully removed from site. The process of decommissioning of the turbines themselves is likely to involve the following sequence:

- Each turbine is disconnected from the electrical distribution and SCADA system;
- Any hazardous or potentially polluting fluids or materials are removed from the nacelle in so far as risk assessment identifies them as posing a potential hazard to the environment during turbine dismantling;
- A vessel similar to that used during installation is mobilised to site;
- The WTG components will be lifted onto the decommissioning vessel;
- All of the components are transported to port, and dismantled;
- The decommissioned turbines may be overhauled and sold for re-use; and
- Redundant material such as steel from the towers or other components would be recycled where possible and other materials disposed of in an approved manner.

It is possible that the turbines would be decommissioned in parts, with the blades and nacelles of several turbines being removed to a single barge in each trip from/to port. It is anticipated that the towers could potentially also be removed from site in batches.

The port/harbour to which the infrastructure would be removed would be chosen depending on available facilities and the location of the onshore disposal facility to which the materials were being taken.

Offshore Substation Platforms

The decommissioning of the offshore platforms and associated foundations will follow a similar method to that described for the WTGs.

The topside structure will be lifted from the support structure either as a single piece or in parts and taken by a suitable vessel to port where it will be dismantled and the constituent parts processed for reuse, recycling and/or disposal.

Gravity Base Structures

At present it is anticipated that gravity based structures will be removed completely during decommissioning, and foundation concepts currently being evaluated by MORL allow for this. It is envisaged that the GBS would be refloated and towed inshore for dismantling and disposal or recycling onshore.

Meteorological Masts

It is proposed that all met mast equipment and supporting towers are completely removed and deconstructed onshore. The foundations will be removed in accordance with the provisions set out in Section 4.6.2.

4.6.2 Partial Removal

Lattice Jacket and Jack Up Substructures with Piles

Where piles are used, they will have been embedded into the seabed to a depth of between 40-60 m. There are currently no proven methods available for the removal of such piles which are technically or economically feasible and would not cause significant damage to the seabed or potentially significant disturbance to biological receptors.

For jacket substructures it is envisaged that the piles would be cut to below the natural level of the seabed to such a depth to ensure that the remains are unlikely to become uncovered. Complete removal of the pile below the seabed is considered neither practical nor environmentally desirable. The appropriate depth for removal would depend upon the sea-bed conditions and site characteristics at the time of decommissioning.

This approach to decommissioning is in line with the IMO standards and DECC guidelines as complete removal of the foundations would involve an unacceptable risk to the marine environment and are likely to involve extreme cost. If an obstruction exists above the sea bed or an obstruction appears following decommissioning which is attributable to the wind farm, this obstruction will be marked by the owner so as not to present a hazard to other sea users. The marking will remain in place until such time as the obstruction is made safe. The monitoring of this obstruction will be built into the decommissioning monitoring and maintenance programme.

Decommissioning of each substructure, on that basis, is likely to proceed as follows:

- ROV are deployed to inspect each pile footing and reinstate lifting attachments if necessary;
- A jack-up barge or heavy lift vessel is mobilised to the site;
- Any scour protection that has been placed around the base of the support structures is moved where it is obstructing the cutting process;
- Depending upon the cutting techniques to be employed, material within and/or around the piles will be excavated to below the cutting depth (excavated material will be placed on the seabed adjacent to the pile(s));
- Crane hooks are deployed from the decommissioning vessel and attached to the lift points;
- The pile(s) is cut below the natural level of the seabed, as appropriate following pile removal, the seabed is inspected for debris and any found is subsequently removed;
- The pile(s), transition piece and any debris are transported back to shore either by lifting on to a jack-up, barge or heavy lift vessel, or by buoyant tow; and
- The pile and transition piece, which do not contain any hazardous materials, would then be cut up and the steel could be recycled.

Cutting methods to be used are yet to be confirmed.

Lattice Jacket and Jack Up Substructures with Suction Caissons

If it is deemed necessary to leave suction bases in the seabed, the steel tubular mounted in the base would be cut off and the base left in place. The tubular would be removed and disposed of in the same manner as the piles discussed above.

If it is considered necessary to remove the entire base, this would be achieved as follows:

- The suction caisson base is inspected to establish its structural integrity, and reinstate any lifting points if necessary;
- The water pressure under the base is increased using a pumping system, to overcome the suction between the base and the seabed;
- The base is then removed intact from the seabed using a combination of the under-base pressure and a heavy lift vessel;
- The bases are lifted onto a transportation vessel and transported to shore; and
- The steel bases, which do not contain hazardous materials, would be cut up and the material could be recycled.

4.6.3 Left In-Situ

Inter-platform cabling and export cabling

It is intended to only remove those offshore cables, sections of offshore cables or cable ends which are uncovered at the time of decommissioning and identified during ROV survey. This intention is based on the aim of minimising environmental disturbance to the site.

Cables in this category will be removed by lifting cable ends onto the cable retrieval vessel and the cables will be spooled back onto a drum or cut into lengths and stored on deck. If portions of the cable need to be de-buried, a combination of the following techniques may be used:

- Peel-out: using a grapnel to pull the cable out of the seabed;
- Under runner: pulling an under-runner by a steel cable to push the electrical cable from the seabed; or
- Jetting seabed material from the cable using a water jetting tool similar to that used during cable installation.

There is no intention to leave any unburied cables on the seabed surface post-decommissioning.

Any cable requiring removing will be cut as close to the adjacent structure as possible, with the ends weighted down and buried to a proposed depth of 1m below seabed level. The reburying of cut cable ends is likely to be carried out by remotely operated vehicles. Recovered cable will be stripped and recycled at appropriate recycling facilities.

Any sub-sea trenches left after cable removal will be filled by natural tidal action.

Prior to decommissioning, a contingency plan will be developed for resolving the potential issue of cables becoming exposed post-decommissioning.

Scour protection

In recognition of IMO standards and DECC guidance, any scour protection used around the turbine bases or covering cables will be left in situ to preserve the marine habitat that will have established over the life of the wind farm, on the assumption that to do so would not have a detrimental impact on the environment, conservation aims, the safety of navigation and other uses of the sea. Any scour protection that is moved in order to access turbine bases will be left in situ.

4.7 Proposed Waste Management Solutions

Waste management will be carried out in accordance with the all the relevant legislation at the time of decommissioning and paying regard to the waste hierarchy, which suggests that re-use should be considered first, followed by recycling, incineration with energy recovery and, lastly, disposal. It is intended that the vast majority of all elements from the offshore wind farm will be taken back to land for re-use and recycling. A waste management plan will be drawn up prior to commencement of decommissioning to ensure adequate time remains for the proper provisions to be made.

Where possible, all materials which can be recycled (e.g. steel, copper, concrete) will be taken to an appropriate onshore facility.

5. Environmental Impact Assessment

MORL will be finalising the EIA for the Telford, Stevenson and MacColl wind farm projects in 2012 and the resulting ES will be submitted as part of various consent applications. The EIA has included high-level assessment of the potential effects of decommissioning (on the basis that the impacts of decommissioning will not exceed those generated during construction).

Once final decommissioning measures are known, the project ES (and any Appropriate Assessment) will be reviewed to assess the potential effects that may arise and are not covered in the initial EIA process. At this point a decision will be made as to whether a more detailed assessment of potential decommissioning impacts is required. It is expected that the effort expended in preparing and reviewing the ES should be proportionate to the scale of the decommissioning operation and the potential risks to the environment that it may pose. Key criteria that will inform this decision as to whether additional assessment is required include:

1. Identification and assessment of the potential impacts on the environment arising from the proposed decommissioning including such factors as:

- Biological impacts arising from the physical effects of decommissioning (e.g. underwater noise, sediment plumes etc);
- Exposure of biota to contaminants associated with the wind farm;
- Conflicts with the conservation of species or protection of their habitats;
- Identification and assessment of the potential impacts relating to interference with other legitimate uses of the sea including for example commercial fishing, shipping, oil and gas activities;
- Identification and assessment of the potential impacts on amenities (e.g. recreational use of the project area and surrounding coastal areas), the activities of communities and on future uses of the environment; and
- Identification and assessment of the potential impacts on the historic environment.

2. Additional site surveys may be conducted where these are considered necessary to update MORL's understanding of baseline conditions within the project area and to inform the Decommissioning Programme. These could include, for example:

- Physical environment: geophysical surveying of the seabed;
- Benthic: grab sampling and video/photographic surveys;

- Ornithological: A programme to identify key species and assess whether there are particularly sensitive times of year for key bird species;
- Marine mammals: marine mammal surveys to identify, for example, marine mammal distribution, behaviour or migrations in relation to the potential effects of decommissioning (such as underwater noise); and
- Review of Nature Designations: to identify key species or habitats that could be affected by the decommissioning process.

If required, an EIA specifically covering the decommissioning process will be prepared that will fill in any gaps in relation to the above. It will identify potential effects arising from the decommissioning programme and, where these are considered significant, will propose appropriate mitigation measures. In addition, pre, during and post decommissioning monitoring programmes may also be considered appropriate and, where these are identified, will be developed in partnership with the appropriate regulatory bodies. Information to support a decommissioning Appropriate Assessment may also need to be collated if decommissioning activity has the potential to impact the integrity of European designated conservation sites.

The use of explosives is not proposed at any stage of the decommissioning works. However, should they be necessary during the course of decommissioning, the potential impact of these on marine life, particularly marine mammals, will be assessed. Should the need to use explosives arise, MORL will need to provide justification for their use and explain what alternatives have been considered. A comprehensive mitigation strategy will be proposed following all appropriate guidelines and regulations such as those set out by the Joint Nature Conservation Committee (JNCC).

6. Sea-bed Clearance

Following decommissioning, a seabed survey will be carried out using appropriate remote surveying techniques (likely to include sidescan, magnetomer and bathymetric surveys, with possible use of drop-down video or ROV to ground truth the data where necessary) with independent, third party involvement to show that the site has been cleared. The area to be covered will be determined prior to decommissioning but consideration will be given to the guidance for oil and gas installations which specifies a 500m radius around any installation.

These surveys will seek to identify any debris which may have arisen from the decommissioning activities and may pose a risk to navigation and other users of the sea or the marine environment. Where such items are identified, appropriate remedial action will be taken to ensure the safety of other sea users.

If, during decommissioning, discovery of potential archaeological importance is made, the protocol for reporting finds of archaeological interest will be followed. The appropriate competent authority will be approached regarding the identification of other anomalies that may be of archaeological interest.

7. Restoration of the Sites

The project area will be restored as far as possible and desirable to the condition that it was in prior to the original construction of the Telford, Stevenson and MacColl wind farms. Consistent with the decommissioning provisions detailed above, the key restoration work will relate to:

- Ensuring that foundations are cut below the natural level of the seabed (turbines, met mast, platforms) and are made safe and adequately covered; and
- Ensuring that cable ends are adequately buried where cables have been cut and partially removed.

Active restoration relying on intervention with equipment is not proposed as it is considered that such works present unnecessary and unacceptable risk to personnel. Rather, it is considered that allowing the seabed to naturally settle is sufficient and less disruptive to marine life.

8. Post-decommissioning Monitoring, Maintenance and Management of the Sites

Given that the Decommissioning Programme will not fully remove all of the project components (e.g. cables), some post-decommissioning monitoring and management are likely to be required in order to identify and mitigate any unexpected risks to navigation and commercial fisheries activity that may be posed by any remaining obstacles on the seabed.

A post-decommissioning monitoring and maintenance plan will be developed as an output of the review of the project EIA (see Section 5). This will establish what future management of the site may be required and whether this can be carried out as part of an industry-wide programme.

The appropriate regime for monitoring will be determined taking account of factors such as scale, nature and the conditions of any remains, including the risk that any remains below the seabed may be become uncovered and the proximity to other maritime activity. The regime will also be adapted over time (to be agreed with DECC) and will use relevant data from all phases of development, construction and operation.

As a minimum the regime will include a post decommissioning seabed survey to identify any remaining obstacles at the time of completion of decommissioning, with further surveys scheduled for subsequent years, the first of which is not to be more than 4 years following this initial survey. The risk of exposure at the Telford, Stevenson and MacColl sites is expected to be low as a result of the relative stability of the seabed in the area and the depth at which foundations will be cut and cables buried. Survey effort will tail off with time, the exact requirements will be determined, in conjunction with DECC, by the results of the surveys.

In the event of protrusion of a decommissioned element above seabed level, or in the event that scour protection materials are left on site following decommissioning, initially the UK Hydrographic Office will be notified so that suitable notation of a potential anchoring hazard can be marked on relevant charts and mariners informed accordingly. The removal or making safe (e.g. reburying) of this protrusion will be assessed and undertaken at the earliest opportunity.

As indicated in Section 6 above, MORL propose to use an independent survey company to complete the surveys. The company will be requested to report in parallel to both MORL and Government to ensure transparency. Subsequent proposals for any maintenance or remedial work will be agreed with DECC and other relevant stakeholders.

9. Supporting Studies

To date, a number of site investigation and environmental studies have been undertaken to inform project design and to inform EIA for the Project and the OfTI. As explained in Section 5, the resulting ES includes a description of the potential effects of decommissioning on the receiving environment. Table 9.1 lists the relevant studies completed.

Table 9.1 Overview of studies to inform project design and EIA.

Survey/study type	Method used	Wind farm sites	Offshore transmission cable corridor
Metocean	AWACs and wave buoy monitoring	Yes	No
	Numerical hydrodynamic modelling	Yes	Yes
	Wind resource assessment	Yes	No
Geophysical	Side scan sonar	Yes	Yes
	Swathe bathymetry	Yes	Yes
Geotechnical	Boreholes	Yes	No
	Cone Penetration Tests	No	Yes
Benthic ecology	Grab sampling	Yes	Yes
	Trawl sampling	Yes	Yes
	Drop down video survey	Yes	Yes
Fish and shellfish	Desk study	Yes	Yes
	Sandeel surveys	Yes	No
Marine mammals	Boat based observations	Yes	No
	Aerial surveys	Yes	No

Survey/study type	Method used	Wind farm sites	Offshore transmission cable corridor
	CPODs	Yes	No
	EARs	Yes	No
	Underwater noise modelling	Yes	Yes
Ornithology	Boat based observations	Yes	No
	Aerial surveys	Yes	No
	Tagging	Yes	No
	Radar	Yes	No
Shipping and navigation	AIS	Yes	Yes
	Navigational Risk Assessment	Yes	Yes
Commercial fisheries	Desk study and questionnaire	Yes	Yes
Aviation	Desk study	Yes	No
Seascape and landscape	Site visits and visualisations	Yes	No
Archaeology	Desk study	Yes	Yes
	Archaeological review of geophysical and geotechnical survey data	Yes	Yes
Other human activities	Desk study	Yes	Yes
Socio-economics	Desk study	Yes	Yes

A summary of the surveys and studies and the results of impact assessment can be found in the MORL Environmental Statement (MORL, 2012) and full technical details of these surveys can be found in the MORL Environmental Statement Volume 8 – Technical Reports (MORL, 2012).

No studies have to date been undertaken to specifically inform the Decommissioning Programme. Any supporting studies or investigations which are undertaken in support of future Decommissioning Programmes will be included as appendices to the Decommissioning Programme.

10. Consultations with Interested Parties

MORL has maintained a high level of consultation with key stakeholders, both at a local and national level, from project scoping through to ES and consent application submission. A summary of consultation undertaken to date, which has included consideration of decommissioning issues, is provided in MORL Environmental Statement Volume 2, Section 1.

MORL is committed to ensuring that this level of consultation is continued throughout the on-going construction phase, as well as during decommissioning. MORL also proposes to maintain close consultation with the local fishing industry via the existing Fisheries Liaison Officer.

Noting the long period between the production of this initial programme and the actual decommissioning process itself, MORL commits to undertaking a further round of consultation with stakeholders which will be carried out two years prior to decommissioning. An updated Decommissioning Programme will be produced with the bodies listed in Table 10.1 consulted as part of the process (note that this is not an exhaustive list and it is likely that other stakeholders will be consulted).

Table 10.1 Organisations to be consulted during development of the Decommissioning Programme.

Chamber of Shipping	Oil and gas users: Oil and Gas UK; Ithaca Energy; Talisman Energy; Caithness Petroleum
Department for Energy and Climate Change	Port and harbour authorities
Joint Nature Conservation Committee	Maritime and Coastguard Agency
Marine Scotland	Royal Yachting Association
Northern Lighthouse Board	Whale and Dolphin Conservation Society
Scottish Natural Heritage	Scottish Fishermen's Federation
Subsea cable owners: Faroese Telecom; SHETL	Royal Society for the Protection of Birds
The Crown Estate	Beatrice Offshore Windfarm Limited
UK Hydrographic Office	

It is expected that an appropriate program of consultation will be continued throughout the project lifecycle and particularly in the lead up to the development of the final decommissioning programme and through decommissioning itself. This will range from consultation on any amendments to this draft programme and any accompanying EIA through more specific notices such as the issuing of appropriate Notices to Mariners and other navigational warnings during the decommissioning process. The UK Hydrographic Office will be notified as appropriate on the progress and completion of the works.

MORL will also consider the potential for coordination of decommissioning activities with Beatrice Offshore Windfarm Ltd (BOWL), should both the MORL and BOWL sites be constructed.

11. Schedule

It is difficult to determine the decommissioning schedule prior to construction, as unforeseen issues can arise during the installation and operation of the wind farm that ultimately could affect the decommissioning. At the time of writing, no offshore wind farms worldwide have been decommissioned, so knowledge of the operational challenges is limited. Information gathered during construction and operation of the Telford, Stevenson and MacColl wind farms, and information available from the decommissioning of other wind farms will provide valuable insight into the timing, costs and operational challenges faced.

At present it is envisaged that the three proposed wind farm sites may be decommissioned in approximately 50 years from the date of construction. This includes an anticipated repowering of the sites after approximately 25 years. At the time of any repowering, decommissioning of redundant parts will be carried out as soon as reasonably practicable and with due regards to health and safety considerations. The order in which the sites will be decommissioned has not yet been determined.

The timing of any decommissioning is expected to be influenced by consideration of potential environmental impacts, market factors, vessel availability, synergy and co-ordination with other offshore works, the potential for phasing within and across the sites and available weather windows, which may mean that activities have to be spread over several seasons. However, in the case where decommissioning is delayed, a robust case will be submitted for the deferral.

Decommissioning of each single wind farm site could take up to several years with decommissioning of the first site commencing in 2042 based on the current project schedule.

A detailed schedule of the decommissioning works will be prepared at least a year before the start of the works taking account of the results of the review of the EIA and an appropriate consultation process. The schedule will clearly map out the sequence of decommissioning activities, providing detail for the offshore removal works.

12. Project Management and Verification

Once the wind farms are nearing the end of their agreed operational life, MORL will initiate a final review of this document and the proposed programme of works. Once this review is complete a 'Decommissioning Programme of Works' will be developed outlining the discrete methods, measures and timing that will be employed. It will also identify those individuals and organisations that are responsible for ensuring decommissioning tasks are managed and completed.

Within four months of the completion of decommissioning, a post-decommissioning report will be prepared and submitted to DECC, detailing how the programme was carried out. The report will include:

- Confirmation that decommissioning has been carried out in accordance with the approved decommissioning programme or an explanation of any major variances from the programme;
- Information on the outcome of decommissioning, including confirmation of sea-bed clearance;
- Confirmation that appropriate bodies, including the United Kingdom Hydrographic Office, the Kingfisher Information Service at the Sea Fish Industry Authority, Hull (Seafish), and the international Maritime Organisation, have been notified of removal and of any remains;
- Confirmation that appropriate aids to navigation have been installed, where required, for any remains of installations which protrude above the seabed and are considered to be a danger to navigation; and
- Information on the actual costs of decommissioning and an explanation of any major variances from forecast costs.

13. Costs

At present a range of infrastructure concepts are being considered for the Telford, Stevenson and MacColl wind farm sites and the OfTI. Further detailed engineering studies are required to determine the final infrastructure to be installed. This detail will be required in order to present a realistic overall cost estimate for the decommissioning works.

Costs are expected to be outlined in the draft Decommissioning Programme which will be submitted for formal approval prior to wind farm construction. This draft plan is expected to include the overall estimated cost, in £ sterling, for the Decommissioning Programme and is expected to include a breakdown of costs for the following:

- Removal of the wind farm site infrastructure;
- Management of the waste;
- Pre- and post-decommissioning surveys; and
- Post-decommissioning monitoring, maintenance and management of the site where any elements of the installation are not entirely removed.

The OFTO would be responsible for the decommissioning of the offshore transmission network and hence these costs will be excluded from future estimates.

14. Financial Security

MORL fully accept responsibility to provide funds to cover the main decommissioning activities that are expected to take place at year 25 should the wind farms not be re-powered, or at year 50 should re-powering occur. MORL are yet to confirm the means by which they will secure decommissioning obligations.