10 Biological Environment

10.1 Benthic Ecology

10.1.1 Summary of Impacts and Mitigation

10.1.1.1 This chapter provides an assessment of the likely significant effects on benthic ecology of the installation, operation and decommissioning of the subtidal components of the export cable route and associated infrastructure, including offshore substation platforms (OSPs), between the offshore generating stations at the Telford, Stevenson and MacColl sites and the cable landfall site at Fraserburgh Beach. Effects of the offshore transmission infrastructure (OfTI) on intertidal ecology at the landfall site are addressed in Chapter 10.5 (Intertidal Ecology). Likely significant cumulative effects are addressed in Chapter 14.1 (Benthic Ecology).

10.1.1.2 Information supporting this assessment has been collected from a site specific survey and data review as explained in Chapter 4.2 (Benthic Ecology).

Summary of Impacts

10.1.1.3 The effects on benthic ecology that were assessed for the OfTI include:

- Permanent net reduction in the total area of original habitat as a result of the placement of A / C OSPs and AC / DC converter OSPs;
- Temporary seabed disturbances and effects on fauna as a result of seabed preparatory works, cable laying activities and contact of legs of construction and decommissioning vessels on seabed;
- Habitat and associated community change as the result of the introduction of hard structures and subsequent colonisation by encrusting and attaching fauna;
- Temporary fining of particulate habitats, smothering and scour effects on benthic fauna; and
- Seabed contamination and increased bio–availability of pollutants to seabed faunal and flora populations.

Proposed Mitigation Measures and Residual Effects

10.1.1.4 Primary mitigation includes best practice construction site management. The Environmental Management Plan (EMP) will control the use and storage of materials during the construction of the OfTI and will mitigate for accidental spillages or releases of chemicals, such as fuels, lubricants and grouting materials, into the marine environment and prevent harm to the benthic ecology.

10.1.1.5 A summary of the impact assessment is at Table 10-1 below.

Table 10.1-1 Impact Assessment Summary

Effect	Receptor	Pre–Mitigation Effect	Mitigation	Post–Mitigation Effect
Construction & Decommissioning				
Temporary Direct Seabed Disturbance	Sand and gravel sediment habitats and communities (biotopes).	Minor	N / A	Minor
Temporary Direct Seabed Disturbance	Annex I Sabellaria spinulosa reef and stony and rocky reef.	Major	Micro–siting of cables	Not significant
	Burrowed mud PMF habitat.	Minor	N / A	Minor
Temporary Indirect (sediment) disturbances	Sand and gravel sediment habitats and communities (biotopes). Annex I Sabellaria spinulosa reef and stony and rocky reef. Burrowed mud PMF habitat.	Minor	N / A	Minor
Seabed Contamination as a Result of Accidental Spillage of Chemicals	Sand and gravel sediment habitats and communities (biotopes).	Up to major	Development of and adherence to an EMP.	Minor
Operation				
Loss of Original Habitat	Sand and gravel sediment habitats and communities (biotopes). Annex I Sabellaria spinulosa reef and stony and rocky reef.	Minor	N / A	Minor
Habitat and Associated Species Change	Sand and gravel sediment habitats and communities (biotopes).	Minor	N / A	minor
Effect of EMFs	Electro–magnetic sensitive and migratory invertebrate species.	Not significant	N / A	Not significant
Effect of Heat	Deep burrowing species such as Nephrops norvegicus.	Not significant	N / A	not significant
Seabed Contamination as a Result of Accidental Spillage of Chemicals	Sand and gravel sediment habitats and communities (biotopes).	Up to major	Development of and adherence to an EMP.	Minor

10.1.2 Introduction

10.1.2.1 The installation, operation and decommissioning of the OfTI has the potential to have a range of direct and indirect effects within the marine environment as summarised in Table 10.1-2 below. This chapter provides an assessment of the likely significant effects of these activities on the benthic ecology and considers the following elements:

- Three to six AC OSPs;
- Two AC / DC Converter OSPs;
- Inter–platform cabling; and
- Offshore export cables.

10.1.2.2 The precise locations of the AC OSPs and the AC / DC converter stations have not yet been defined. It is, however, anticipated that the AC OSPs will be located within the boundary of the three proposed wind farm sites. In the case of the 2 AC / DC converter OSPs, whilst they could be located within the boundary of the three proposed wind farm sites, they may be also placed along the offshore export cable route (within 2 km of the Stevenson / McColl wind farms). For the purpose of this Environmental Statement (ES), both the OSP and converter stations are considered to be part of the OfTI and are accordingly addressed here together with the other offshore elements of the transmission assets (inter–platform cables and export cables).

10.1.2.3 The effects of the installation and decommissioning of the OfTI on benthic ecology are predicted to be localised and recovery of seabed habitats and communities is expected to occur well within the life of the operation of the development. Ecologically sensitive habitats along the offshore export cable route (see 4.2.4 in Chapter 4.2: Benthic Ecology) will be avoided where they form features. Accordingly, only **minor** effects are predicted. As explained in Chapter 7.1 (Benthic Ecology), effects of heat and EMFs during the operation of the cable are considered to be of no significance to benthic invertebrate ecology. This is due to the partial shielding of emissions that will be achieved through cable burial and the general insensitivity of invertebrates based on current observations.

10.1.2.4 Information supporting this assessment has been collected from a site specific survey and data review as explained in Chapter 4.2 (Benthic Ecology).

10.1.2.5 Installation of the OfTI will directly disturb seabed habitats and communities and raise sediment plumes that could have adverse smothering and scour effects on the benthic ecology over surrounding areas. These effects have been assessed to be of **minor** significance and reflect the localised nature of the effects and the ability of the benthic ecology to recover rapidly. Disturbances to sensitive habitats have also been identified and have been judged to be of greater consequence as these could result in damage or loss of protected ecological features. Any activities likely to cause damage to protected ecological features would generally not be permitted. Micro–siting of offshore export cables around sensitive habitats would avoid direct disturbances effects. Accordingly, the residual effects for disturbance to sensitive habitats are assessed to be of **minor** significance.

10.1.2.6 The environmental management plan (EMP) will control the use and storage of materials during the construction of the wind farms and will mitigate for accidental spillages or releases of chemicals, such as fuels, lubricants and grouting materials, into the marine environment and prevent harm to the benthic ecology. Accordingly, the residual effects from accidental seabed contamination are assessed as being of **minor** significance.

10.1.3 EIA Methodology

10.1.3.1 The methodology and criteria used to assess the significance of the effects on benthic ecology are presented in Chapter 7.1 (Benthic Ecology). Table 10.1-2 below summarises the likely significant effects that may arise from the construction, operation and decommissioning of the OfTI. Cumulative effects are addressed in Chapter 14.1 (Benthic Ecology).

Table 10.1-2 Likely Significant Effects on Benthic Ecology

Physical Change		**Anticipated Effects on Benthos**
Direct	• Inter–platform and export cables; • Scour and cable protection material; • Placement of anchors on the seabed during cable placement / burial; and • Foundations of OSPs.	Temporary seabed disturbances as a result of cable laying activities and associated deployment of anchors. Recovery of habitat and species is forecast to occur following cessation of the disturbance.
		Habitat loss as a result of the placement of foundations of OSPs and associated scour and cable protection material.
		Habitat and associated community change as the result of the introduction of hard structures (OSP foundations, scour and cable protection material) and subsequent colonisation by encrusting and attaching fauna.
Indirect	• Re–distribution of fine sediments arising from construction activities; • Change in baseline hydrodynamic conditions; and • Accidental spillages.	Temporary fining of particulate habitats, smothering and scour impacts on benthic fauna.
		Change in physical processes (sediment erosion / Accretion rates) as a result of the cable.
		Change in physical processes (sediment erosion / Accretion rates) as a result of the placement of OSPs.
		Seabed contamination and increased bio–availability of pollutants to seabed faunal and flora populations .
Cumulative Effects (see Chapter 14.1)	Effects resulting from the combined effects of the three proposed wind farm sites and offshore transmission infrastructure with other sea and land projects and activities generating similar effects both temporally and spatially and considered in the context of background variability.	

10.1.3.2 It is currently anticipated that export cables remain *in situ* during decommissioning. As such, there will be no effects on benthic ecology. Removal of OSP foundations will result in some localised sediment disturbances but these are usually regarded as being no more significant than those that will occur as a result of construction activities. Construction and decommissioning effects on benthic ecology are therefore considered jointly in this assessment.

10.1.4 Rochdale Envelope Parameters Considered in the Assessment

10.1.4.1 Parameters defining the 'Rochdale Envelope' realistic worst case scenario for each potential effect on benthic ecology have been drawn from the Project design statement presented in Chapter 2.2 (Project Description), and are presented in Table 10.1-3 below. Parameters are grouped on the basis of the different benthic ecological effects that are predicted to arise from the OfTI elements of the Project.

Table 10.1-3 Rochdale Envelope Parameters Relevant to the Benthic Ecology OfTI Impact Assessment

Likely Significant Effect	Rochdale Scenario Assessed
Construction	
Temporary Direct Seabed Disturbances.	**Maximum footprint = 2.07 km² based on:** • Length of cable trench" = 103 km; • No. of cable trenches = two (laid at least one year apart); • Width of trench affected area = 6 m; • Length of inter–platform cabling = 90 km; • Area of seabed prepared for each OSP and converter station foundation = 36,100 m²; • Maximum no. AC OSPs = six; • No. AC / DC converter OSPs = two; and • Area affected by anchors = 10,740 m² (assumes six 12 Te anchors each 4.5 m wide x 3.64 m long, penetrating to a depth of one metre deployed in a radial pattern around barge and re–positioned every 500 m and each affecting a nominal area of seabed of 5 m²).
Temporary Indirect (sediment) Disturbances	Fine sediment arising from installation of two export cables and inter–platform cables (total length 296 km) via ploughing or jetting and transported / dispersed via tidal currents and wave events.
Operation	
Loss of Original Seabed Habitat.	**Total footprint = 0.58 km² based on:** • Area per OSP / converter station GBS foundation = 16,900 m²; • Area of scour material per AC OSP / AC / DC converter station GBS foundation = 8,700 m²; • Cable protection (assuming protection is required to a distance of 100 m from the foundation to a width of 10 m and up to 20 J tubes (or cable connections) per OSP and converter station = 20,000 m²; • No. AC OSPs = six; • No. AC / DC converter OSPs = two; • Area of cable protection material required in shallow inshore rocky seabed areas per cable bundle = 190,000 m²; • No of cable "bundles" = two; and • Use of rock cutting equipment in water depths <10 m.
Habitat and Associated Community Change	**Total footprint = 0.61 km² based on;** • Area of scour material per AC OSP / AC / DC converter station GBS foundation = 8,700 m²; • Cable protection (assuming protection is required to a distance of 100 m from the foundation to a width of 10 m and up to 20 "J" tubes (or cable connections) per OSP and converter station = 20,000 m²; • Maximum no. AC OSPs = six; • No. AC / DC converter OSPs = two; and • Area of cable protection material required in shallow inshore rocky seabed areas per cable bundle = 190,000 m².
Effects on Physical Processes and Related Biological Changes.	Development of secondary scour. Change in tidal flow and sediment transport rates.

Likely Significant Effect	Rochdale Scenario Assessed
Decommissioning	
Removal of sections of cable and any protective armouring together with activities of decommissioning vessels and associated seabed impacts of anchors etc., are likely to raise suspended sediment concentrations and disturb seabed habitats. The maximum effects of these activities are expected to be less significant than those generated during the installation of the cables since it is expected that the majority of cabling will remain in situ.	
Cumulative	
Cumulative Effects – Construction and Operation Phases (see Chapter 14.1).	Potential for interaction of sediment plumes arising from cable installation and associated infrastructure from marine plans and projects.

10.1.5 Primary Impact Assessment

10.1.5.1 Receptors brought forward for assessment include:

- Benthic biotopes; and
- Annex I (EC Habitats Directive) habitats.

10.1.5.2 There are described in Chapter 4.2 (Benthic Ecology).

Construction

Temporary Direct Seabed Disturbances

10.1.5.3 Seabed habitats and their characterising species (collectively termed biotopes) will be directly disturbed as a result of the installation of the export and inter–platform cables as well as preparatory works associated with the placement of foundations for AC OSPs and AC / DC converter stations. Direct disturbance effects are of potential interest as they may result in the reduction of species diversity, abundance and biomass within the effect footprint as well as impact upon features of nature conservation importance.

10.1.5.4 Effects on benthic ecology may include abrasion and compaction as well as removal / displacement of fauna leading to a loss in species diversity, abundance and biomass. In addition, the periodic deployment of anchors on the seabed to facilitate positioning of the cable laying barge may damage and kill fauna. Based on the design parameters presented in Chapter 2.2 (Project Description) and summarised in Table 10.1-2 above, the total footprint of temporary seabed disturbance will be 2.07 km^2. Two cable trenches are proposed, each with an affected width of 6 m. The effect will be limited to the direct footprint of impact. As such, the spatial effect will be low at any one particular point along the export cable route. Effect magnitude is therefore considered to be low.

10.1.5.5 Disturbance effects are temporary and will cease following completion of construction activities allowing habitats to recover and fauna to re–colonise via passive import of larvae and active migration of adults from adjacent non affected areas. The rate at which seabed habitats and fauna recover typically depends upon a number of factors including the prevailing hydrodynamic and sediment transport regime, the severity of the original effect and the nature of the baseline community and surrounding populations. Habitat restoration is facilitated through natural backfilling as part of the cable laying process whilst longer term morphological recovery will take place under the natural wave and tidal driven sediment transport mechanisms.

10.1.5.6 The OfTI coincides with a number of different types of seabed habitat and biotope types as presented in Chapter 4.2 (Benthic Ecology). Biotopes close to the boundary of the wind farm sites on Smith Bank and within the vicinity of the offshore end of the export cable were classified as SS.SSa.OSa.OfusAfil, SS.SSa.IMuSa.FfabMag and SS.SSa.CFiSa.EpusOborApri. These classifications reflect the dominant fine sand and slightly muddy sand communities present at this location. Sensitivity assessment (Rayment, 2008) (assessed as the effect of sediment removal on FfabMag) shows that these biotopes are highly intolerant of disturbance but that recovery is high with full recovery expected within a few months to five years. With respect to the criteria provided within the current assessment methodology (Chapter 7.2: Fish and Shellfish Ecology) this equates to low receptor sensitivity. This reflects the opportunistic traits of key characterising species, such as high fecundity and rapid larval dispersal, and the small spatial scale of the effect such that the surrounding populations will be left unaffected providing a large pool of surviving adults for recruitment and colonisation of affected areas.

10.1.5.7 The majority of the central portion of the offshore export cable route coincides with the SS.SMu.CFiMu.SpnMeg biotope describing a relatively more cohesive fine muddy sand biotope characterised by seapens and burrowing megafauna, such as large crustaceans. This biotope is a component of the Scottish draft Priority Marine Feature (PMF) "*burrowed mud*" and is very widespread throughout the southern half of the Moray Firth as explained in Chapter 4.2 (Benthic Ecology). The characterising species are thought to be relatively slow growing and long lived. Although British sea pen species are not well studied, other species may live as long as 15 years and take up to five or six years to reach sexual maturity (Hughes, 1998). Similarly, some of the larger characterising crustaceans, such as mud shrimp *Calocaris macandreae,* are long lived (nine to ten years) and do not reach sexual maturity for five years. As such, species recovery in this particular biotope may take longer to occur following disturbance and may not occur for up to 10 years (Hill, 2008) following cable installation. Also, this biotope occurs in deeper water where the natural sediment stirring and weathering of large wave / storm events might be limited in comparison to shallower water areas over the Smith Bank. As such, morphological recovery of this biotope through natural dynamic process may occur more slowly relative to the recovery of biotopes within the three proposed wind farm sites (see Chapter 4.2: Benthic Ecology). With reference to the assessment criteria (see Chapter 9.2: Sedimentary and Coastal Processes) receptor sensitivity is judged to be medium to high based on value (as a draft PMF feature) and recoverability.

10.1.5.8 Physical impacts on the seabed within the Southern Trench may be particularly persistent due to the limited influence of large wave events on seabed transport and weathering in deep water environments. Instead, the presence of bottom or slope currents may be more important in the restitution of seabed habitats following impacts of cable installation although it is presently unclear over what timescale this might be achieved. Despite the potential for a protracted recovery period, the deep water habitats of the Southern Trench did not support any features of nature conservation importance and so receptor sensitivity is judged to be low. No deep water coral *Lophelia pertusa* reefs where found during the site survey.

10.1.5.9 The seabed closer inshore is dominated by coarser more mixed substrate types represented by the SS.SMx.CMX.FluHyd, OphMx and CR.MCR.CSabSpi biotopes. These biotopes are characterised by epifaunal and / or encrusting species reflecting the coarser and harder nature of the seabed habitats present. The key species of these biotopes are highly intolerant to significant disturbance or removal of substrate onto which they attach although those of the FluHyd biotope are capable of rapidly colonising disturbed areas with full recovery expected within a few months to five years (Tyler–Watts, 2008. Recovery of the CSabSpi biotope is also assessed as high (recovery forecast within five years) since this biotope is typically found in turbid conditions where sand is in suspension permitting the characterising species, *Sabellaria spinulosa*, to construct its tubes (Marshall, 2008) (see also Chapter 4.2: Benthic Ecology). Accordingly, receptor sensitivity is judged to be low based on the criteria presented in the assessment methodology (see Chapter 10.1: Benthic Ecology).

10.1.5.10 Chapter 4.2 (Benthic Ecology) also explains that these coarser sediment areas are associated with potential Annex I (EC Habitats Directive 92 / 43 / EEC) stony reef and *Sabellaria spinulosa* reef in places. These discrete features where they occur are of high importance to nature conservation. Activities likely to cause damage to Annex I features will generally not be permitted under the EC Habitats Directive and associated UK legislation. Accordingly, receptor sensitivity is very high.

10.1.5.11 Trenching and / or dragging of anchors through a stony reef is likely to result in a permanent linear scar as the overlying wave and tidal process will be insufficient to remobilise cobbles and boulders to complete any natural backfilling and habitat restoration. Trenches through these features may instead be in–filled by fine transient sediments that are present within the ambient bedload transport resulting in a change in the nature of the seabed to a finer sediment habitat. However, the likelihood of this actually occurring is low. This is because stony and rocky reef areas will be unsuitable for trenching. Instead, installation will be more likely to be achieved using concrete matressing or rock placement.

10.1.5.12 Trenching or dragging of anchors through a *Sabellaria spinulosa* reef may damage and remove the feature within the footprint of the activity resulting in a linear scar. However, this feature is developed bio–genically and so may recover to baseline conditions through the re–growth of the *Sabellaria* population and the construction of its tubes. Re–construction of tubes will occur following cessation of the disturbance with recovery forecast to occur within a few months to five years (Marshall, 2008). However, Marshall (2008) goes on to explain that recovery of this feature is highly dependent upon the availability of suitable substrate types so that any infilling of seabed impacts by fine transient sands, for example, will only allow development of poorer quality reefs at most).

10.1.5.13 Despite the low magnitude of this effect, the significance of the impact on Annex I features is considered to be major. This recognises the high nature conservation value of these features and the current legislation which does not permit activities that may damage them. Effects on other biotopes, including the SpnMeg biotope, which is a component of the burrowed mud draft PMF, are considered to be of **minor significance** and reflects the low sensitivity of these receptors and / or their wide geographic distribution.

10.1.5.14 The footprint of the effect is quantified and receptor sensitivity has been assessed through site specific survey and peer reviewed data (MarLIN). Activities that potentially damage Annex I feature will breach current nature conservation legislation. Uncertainty associated with this assessment is, therefore, low.

Temporary Indirect (Sediment) Disturbances

10.1.5.15 Installation of the cables and seabed preparatory work associated with the foundations of the AC OSPs and AC / DC converter stations will raise suspended sediment concentrations (SSCs). This effect is of potential interest as the re–settlement of suspended sediments over surrounding seabed areas and the potential for associated smothering and scour effects on benthic fauna may cause a loss of species diversity, abundance and biomass where effects are significant. Sessile epifaunal species may be particularly affected by increases in SSCs as a result of potential clogging or abrasion of sensitive feeding and respiratory apparatus. Larger, more mobile animals, such as crabs, fish, shrimps and prawns are expected to be able to avoid any adverse SSCs and areas of deposition. Effects will be temporary and will cease on completion of the construction activity.

10.1.5.16 Numerical modelling of the effects of raising SSCs (Technical Appendix 3.4 B) shows that installation activities will increase SSCs by one or two orders of magnitude above the range of that occurs naturally but only over a very small distance from the point of disturbance (i.e. to 125 m) and for a very short duration (i.e. minutes). Fine sediments are more dispersive and are forecast to remain at levels above the natural variation for up to three hours and for a distance of 2.5 km from the point of disturbance. Sediment thickness of re–settled material also exceeds the natural variation but again, this will only occur very close (within tens of metres) to the disturbance with subsequent wave and tidal driven transport processes further dispersing this material over adjacent areas over time. Sand and gravel sediments will be deposited locally at the point of release and will, therefore, be of the same type as the ambient substrate. The short duration and small spatial extent of sediment effects supports a low effect magnitude.

10.1.5.17 As discussed in Chapter 4.2 (Benthic Ecology), MarLIN employs a benchmark for assessment of the sensitivity of biotopes to raised SSCs of a change of 100 mg / l for one month. For the assessment of effects of smothering, a benchmark of 5 cm depth of burial by sediment for up to one month is considered. These benchmark criteria are not forecast to be exceeded and so significant effects on receiving biotopes are not, therefore, expected. The sand and gravel biotopes at the offshore end of the cable route at Smith Bank are predominantly sedimentary and so component species are expected to be tolerant of temporary light sediment effects. Receptor sensitivity is accordingly judged to be low.

10.1.5.18 With respect to the burrowed mud habitat, the characteristic seapen species are able to retract into the sediment and so may be able to avoid temporary adverse effects of sediment smothering and scour. The other characteristic burrowing mud shrimp species will re–locate within the sediment profile and re–establish burrow openings if buried. Again, receptor sensitivity is regarded as low in this respect.

10.1.5.19 Epifaunal communities, such as those characterising the FluHyd and CSabSspi biotopes, are typical of turbid conditions and so are also not expected to be significantly affected by indirect sediment effects unless within a few metres of the disturbance where predicted sediment thicknesses may temporarily bury these species. Soft coral *Alcyonium digitatum* populations, which characterise stony and bedrock reef areas, are similarly tolerant to increases in SSCs and are able to slough off excess fine sediment particles through increased mucus production. Burial up to 5 cm for a prolonged period of time, however, may kill soft coral but such levels are not forecast and effects will be within the range that occurs naturally outside of the immediate vicinity of the installation activity.

Recovery of epifauna populations is, therefore, predicted to be quick (within a few months to five years. Epifauna attached to vertical or sloping rock will not be affected by smothering as fine sediments are unlikely to accumulate on such surfaces. Receptor sensitivity for the FluHyd and CSabSspi biotopes is therefore judged to be low.

10.1.5.20 *Sabellaria spinulosa* has been shown to be highly tolerant to burial, surviving for > 32 days with no effect of burial depth (Last *et al.*, 2011). Consequently, receptor sensitivity is considered to be low and no significant adverse effect on local *S. spinulosa* Annex I reef is expected.

10.1.5.21 Therefore, given the low effect magnitude and low sensitivity of receiving habitats and species, the significance of temporary indirect disturbances on benthic ecology is considered to be **minor**.

10.1.5.22 The effects of raised SSCs have been modelled and the footprint of the effect quantified. Receptor sensitivity has been assessed through site specific survey and peer reviewed data (MarLIN). Uncertainty associated with this assessment is, therefore, low.

Accidental spillages of chemicals

10.1.5.23 As discussed in Chapter 7.1 (Benthic Ecology), accidental spillages or release of chemicals, fuels and oils during the construction, operation and decommissioning phases of the wind farms may potentially contaminate seabed sediments. The severity of this effect on benthic ecology depends upon the quantities and nature of the spillage / release, the dilution and dispersal properties of the receiving waters and the bio–availability of the contaminant to benthic species. At this stage, the quantities and types of material that might conceivably enter the marine environment in this way are not known and so scale and magnitude of effects are unquantifiable at present. In the worst case scenario, the potential significance of an accidental spillage would be **major**. Accidents are by definition unknown and the uncertainty associated with this effect is, therefore, high.

Operation

Loss of Original Habitat

10.1.5.24 A reduction in the total area of current habitat will occur as a result of the placement of the foundations of the OSPs and converter stations and associated scour and cable protection material on the seabed. Based on the worst case design parameters summarised in Table 10.1-3 above, a total of 0.58 km^2 of habitat will be lost. In addition, any cutting of rock as part of the cable lay operation will result in the loss of an area of this habitat type proportional to the size of the cut. This effect is of potential interest as a reduction in the total area benthic habitat will occur relative to the baseline.

10.1.5.25 Loss of original habitat will occur at the offshore end of the transmission infrastructure due to the placement of the foundations of the OSPs and converter stations. Consequently, only those corresponding areas of the offshore mixed sand and gravel and fine sand habitats will be reduced in extent (including the SS.SSa.OSa.OfusAfil, SS.SSa.IMuSa.FfabMag and SS.SSa.CFiSa.EpusOborApri biotopes). Draft PMF habitat and Annex I features will not be affected by these platforms. Given the small footprint of the AC OSPs, AC / DC converter stations and associated protection material within the context of the wider availability of these biotopes (see Chapter 4.2: Benthic Ecology), **no significant effects** on biotope diversity and ecosystem functioning of the wider Moray Firth region are predicted. Consequently, effect magnitude is considered to be negligible to low.

10.1.5.26 Shallow water rock habitat closer inshore may be unsuitable for trenching methods and consequently may be subject to concrete mattressing / rock placement (or similar) to achieve successful cable installation resulting in a reduction in the total area of this habitat type. The mattressing / rock placement may replace potential Annex I stony and bedrock reef but is highly likely to be quickly colonised by fauna and flora that are representative of local populations. However, given that it will be a different (artificial) material possibly with reduced complexity, relative to the ambient rocky habitat, the colonising community is expected to be a simpler and less diverse variant of the surrounding communities. This would constitute a negative effect, although its spatial extent would be localised around the area of the mattressing / rock placement. Consequently, effect magnitude and receptor sensitivity are considered to be low.

10.1.5.27 Finally, further rock habitat may be lost on a permanent basis following any cutting of rock as a part of the cable lay process. At this stage the quantity of rock cutting required (if any) is not known. The cutting of rock will remove habitat and the species attached to it. However, it will present new rocky surfaces for colonisation by local species from surrounding unaffected areas once the installation process is complete. Recovery is likely to be very rapid, subject to the presence of nearby reproductive colonies, with establishment and growth of locally occurring foliose red algae, ascidians, bryozoans and the soft coral *A. digitatum* occurring within one year (Budd, 2008). Effect magnitude and receptor sensitivity are therefore considered to be low in this regard.

10.1.5.28 With reference to the assessment criteria presented in Chapter 4.2 (Benthic Ecology), the spatial extent of the effect will be negligible as it will relate only to the direct footprint of any rock placement. Duration will, however, be medium as the foundations for the OSPs, converter stations and the scour and cable protection material will be in place throughout the operational phase of the scheme. Any rock cutting will leave a permanent localised impact on the seabed but affected areas will be rapidly recolonised. Because of this, the severity of the effect is considered to be low as comparable rocky communities will develop rapidly on rock placement material. Effect frequency will be negligible as the effect will occur only once. Overall, effect magnitude is considered to be low. No sensitive receptors will be lost with the exception of Annex I stony and rocky reef habitats should any rocky cutting occur but this will be replaced by additional rock habitat as a result of rock placement or exposure of new natural rock. Receptor sensitivity is therefore judged to be low. Accordingly, the significance of the loss of original habitat is considered to be **minor**.

10.1.5.29 The footprint of potential habitat loss is quantifiable. Consequently, uncertainty associated with this assessment is considered to be low.

Habitat and Associated Community Change

10.1.5.30 The foundations of the AC OSPs and AC / DC converter stations together with the associated scour and cable protection material will introduce new hard substrate for colonisation by attaching and encrusting species and will change the ambient sedimentary habitats to a more heterogeneous coarse, hard substrate habitat. This effect is of potential interest as it will change benthic ecological conditions relative to the baseline. The introduction of hard substrata may increase the risk of enhancing the spread of non–indigenous species (NIS). The impact associated with this increased risk is dealt with in Chapter 4.2 (Benthic Ecology) and is not considered further here. Marine Scotland consultation response concerning the raising of the significance of the impact of NIS to moderate is acknowledged (see Chapter 4.2: Benthic Ecology).

10.1.5.31 An assessment of habitat and associated community change has already been made in relation to the wind farm (Chapter 4.2: Benthic Ecology). This concluded that only minor impacts will occur based on the localised nature of the effect and that any colonising species will be representative of those that already naturally occur in the locale. It is expected that there will be a succession of colonising species on the vertical and angled surfaces of the OSP foundations as previously described through historic investigations of installations associated with the adjacent Beatrice field (see Chapter 4.2: Benthic Ecology). The spatial scale of the effect will be localised and limited to the footprint of the impact and is therefore judged to be negligible to low. However, the effect will last throughout the operation and so duration will be medium. Overall effect magnitude is therefore judged to be low. Receptor sensitivity is considered to be low as coarse, heterogeneous seabed habitats and associated communities are already represented in the study area as assessed in Chapter 4.2 (Benthic Ecology). Therefore, the significance of habitat and associated community change is judged to be **minor.**

10.1.5.32 The footprint of potential habitat change is quantifiable and local colonising species have been well studies locally. Consequently, uncertainty associated with this assessment is considered to be low.

Effects on Physical Processes and Related Biological Changes

10.1.5.33 Effects on physical processes and associated benthic ecological impacts have been assessed in Chapter 4.2 (Benthic Ecology) in relation to the presence of 339 turbines (maximum number of turbines if the lowest rated turbines are installed). This showed that very small changes in physical process are forecast resulting in no effects on benthic ecology. The presence of an additional eight foundations as part of the offshore transmission infrastructure is highly unlikely to raise the significance of this effect or alter the conclusions already made. The cable along the majority of the length of the route will be buried to a target depth of one metre and so is unlikely to contribute to changes in physical processes. Consequently, effects of the offshore transmission infrastructure on physical processes and associated impacts on benthic ecology are assessed to be of **no significance.**

Effects of EMFs

10.1.5.34 This assessment covers the potential effects from both export cables and inter–array cables.

10.1.5.35 Studies on the effects of EMFs on marine animals have focused on fish species (particularly elasmobranchs) and little is currently known on possible influences on benthic invertebrates. BERR (2008) explains that sensitivity in benthic organisms, where present, is thought to be related to orientation and direction finding. Therefore, effects of EMFs are of potential interest as these may cause changes in a range of behaviours from local foraging to migration of benthic species depending upon the scale and magnitude of the influence. Effects of EMFs on larger, more mobile fish including elasmobranchs, and crustaceans are considered in Chapter 10.2 (Fish and Shellfish Ecology).

10.1.5.36 The survival and physiology of selected species of prawns, crabs, starfish, marine worms and blue mussels, have been studied in relation to EMF levels corresponding to the intensity on the surface of ordinary sub–marine DC cables in the Baltic Sea. Results showed no significant effects for any of the species under consideration after three months of exposure (Bochert and Zettler, 2004). In addition, a visual survey of benthic communities on wind power cables and the peripheral areas, showed no differences in assemblage structure (Wilhelmsson *et al.,* 2010).

10.1.5.37 Additionally, the occurrence of apparently healthy and diverse communities on existing offshore wind farm structures provides evidence that EMFs are unlikely to pose a significant threat to the colonising communities (Linley *et al.,* 2007). This suggests that receptor sensitivity is low or negligible.

10.1.5.38 As part of the current project design, the offshore export cables will be buried to a target depth of one metre (see Chapter 2.2: Project Description). This is likely to provide some mitigation for possible impacts associated with EMFs, as a result of the dampening effects of the substrate and the physical separation of the receptors from the EMF source, but as pointed out by Gill *et al.,* (2005) EMFs may still remain detectable to the most sensitive of species even if the cable was buried to several metres below the seabed. Some dampening of EMFs may also be achieved through the placement of concrete mattresses or rock protection over the cable, although the effectiveness of this in comparison to burial in sediment is not known.

10.1.5.39 The overall effect of EMFs from both export and inter–array cables is thought to be highly localised around the cable (BERR, 2008). Effects will be long term, lasting for the duration of the operational phase of the development but will be reversible upon decommissioning. Effect magnitude is therefore considered to be low. These factors coupled with current field observations described above (low or negligible receptor sensitivity) and the mitigation through burial suggests that EMF effects on benthic ecology will be **not significant**. This assessment carries medium uncertainty as the number of experimental field studies addressing invertebrate tolerance / sensitivity to EMF is currently rather limited.

Effects of Heat

10.1.5.40 This assessment covers the potential effects from both export cables and inter–array cables.

10.1.5.41 The passage of electricity through a cable will generate heat, which will then be dissipated within the overlying water or surrounding sediment substrate. The potential interest of this impact relates principally to buried cables and associated increases in seabed temperatures, which might cause changes in physicochemical conditions of sedimentary substrates. These, in turn, may affect the physiology, reproduction or even mortality of certain benthic species (OSPAR, 2009). Effects of heat from cables laid on the surface of the seabed are considered to be of less concern, as the heat will be rapidly dissipated within the overlying water column.

10.1.5.42 German Federal Agency for Nature Conservation (BfN) guidelines suggest that seabed temperature rises within the uppermost sediment layer above buried cables, within which the majority of benthic organisms reside, should not exceed

2°C to which species are expected to be tolerant. Based upon model outputs, this guideline will be achieved if the cable burial depth is one metre (Meißner and Sordyl, 2006), although temperature rises very close to the cable (within a few cms) may increase by 10°C.

10.1.5.43 The actual temperature increase of the upper layer of the seabed, therefore, strongly depends upon the burial depth of the cable, although sediment characteristics, power rating and specific cable parameters are also influencing factors (OSPAR 2009). However, field observations are lacking and data for assessment purposes derive from modelled scenarios employing assumed pre–conditions. For example: seabed temperature rise has been considered during a project to bury a submarine HVDC cable between New England and Long Island, New York. It was estimated that the rise in temperature at the seabed immediately above the buried cable would be just 0.19°C and thus well within the natural variation (BERR, 2008). A further study for a wind farm development in the German EEZ predicted a rise of 5.6°C at a point 0.5 m above a buried cable and assumed that the cable was connecting five consecutive 4.5 MW turbines with the transformer station (Meißner and Sordyl, 2006).

10.1.5.44 With respect to the Project, sediment dwelling animals along the offshore export cable are unlikely to be directly exposed to permanent significant increases in sediment temperature. Since the surrounding water column will rapidly dissipate any heat from the offshore export cable the only organisms likely to experience heating are those, which burrow deep into surrounding sediments. The deepest burrowing organisms recorded during the site specific surveys (see Technical Appendix 4.2 B), was *Nephrops norvegicus*. This species can burrow to around 0.5 m depth and so could come within approximately 0.5 m of the cable if it is buried to one metre (see Chapter 2.2: Project Description). Sensitivity assessment undertaken by MarLIN (Sabitini & Hill, 2008) indicate that maximum and minimum temperatures limiting *N. norvegicus* in its natural environment are not known, although temperature increases over long periods may increase egg development and halve incubation time. As a mobile species, it is expected to be able to avoid adverse areas should these be encountered.

10.1.5.45 Given the highly localised effect predicted (within a few centimetres of the cable) the magnitude of this potential effect is assessed as being negligible. The effect will be of long duration, lasting throughout the operational phase of the development but will be reversible upon decommissioning.

10.1.5.46 Accordingly, the impact significance of heating from the offshore export cables is assessed to be **not significant.** This assessment carries medium uncertainty due to the very limited amount of data from field studies.

Decommissioning

10.1.5.47 It is proposed that the export cable will be left *in situ* and so no effects on benthic ecology will occur during its decommissioning.

10.1.5.48 Removal of the AC OSP foundations and AC / DC converter stations will disturb seabed sediments for subsequent re–distribution over adjacent areas resulting in potential smothering effects. The dominant sediment habitats and communities will be tolerant to these effects (as assessed in Chapter 7.1: Bethic Ecology) and the significance of related effects is expected to remain **minor**.

10.1.5.49 Removal of the OSP foundations will result in the removal of the epifaunal communities attached to them. A reduction in epifaunal abundance to pre–construction conditions is, therefore, predicted. The protected cold water coral *Lophelia pertusa* is not expected to colonise OSP foundations during the operation of the wind farm, as the comparatively shallow water conditions locally are thought unsuitable. As such, adverse decommissioning effects on high value benthic ecological receptors are not forecast.

10.1.5.50 Removal of the foundations and scour material will expose the natural seabed previously lost under these structures. These areas are expected to be rapidly re–colonised from surrounding reproducing populations with full restitution of the habitats and biotopes expected within five years, subject to the condition of the seabed substrate and stability compared to the baseline situation.

10.1.6 Proposed Monitoring and Mitigation

Construction

10.1.6.1 Micro–siting of the offshore export cables around sensitive Annex I *S. spinulosa* reef habitats will avoid direct disturbance to these features. This option was discussed during the draft ES consultations with Marine Scotland and included presentation of acoustic and video ground truthing data (see Chapter 4.2: Benthic Ecology). The patchy nature of the reefs, their variable quality and the presence of large areas of "*Sabellaria* free" seabed was demonstrated where current characterisation data were available. This showed that micro–siting of offshore export cables within the wider area is a relevant mitigation measure. The final micro–siting protocol will be based on agreed pre–construction surveys in collaboration with the nature conservation agencies.

10.1.6.2 Advice from engineers suggests that it is possible to lay power cables around quite intricate shapes, with the use of suitable 'installation aids'. These might for example represent 1 tonne 'dumpy' bags filled with gravel & positioned onto the seabed prior to cable lay. The cable is then laid around the installation aids, which act to prevent subsequent cable movement on the seabed (for example: due to the tension in the cable), and allow cables and umbilicals to be laid in relatively tight radii, if required. The installation aids can then be removed following cable lay activities and subsequent burial / protection activities.

10.1.6.3 Development of and adherence to an Environmental Management Plan (EMP) compliant with ISO14001 or BSA 555, will limit the risk of accidental spillages or releases occurring or ensure that adequate contingency is in place (i.e. spill plan) to resolve any incidents quickly. Also, establishment of an Environmental Mitigation and Monitoring Plan (EMMP) will identify appropriate measures to avoid or minimise adverse effects on marine life.

10.1.6.4 As discussed in Chapter 7.1 (Benthic Ecology), the development and adherence to a protocol to minimise risk of introducing NIS via attachment to marine plant and / or specialised equipment is recommended by SEPA.

Operation

10.1.6.5 Development of and adherence to an EMP will limit the risk of accidental spillages or releases occurring or ensure that adequate contingency is in place to resolve any incidents quickly.

Decommissioning

10.1.6.6 Development of and adherence to an EMP will limit the risk of accidental spillages or releases occurring or ensure that adequate contingency is in place to resolve any incidents quickly.

10.1.7 Residual Impacts

10.1.7.1 The avoidance of direct disturbances to Annex I *S. spinulosa* reef through the micro–siting of offshore export cables will result in a residual impact of no significance, with respect to this feature.

10.1.7.2 The wide geographical extents of the burrowed mud PMF and the stony and bedrock reef habitats are highly unlikely to be circumvented by the offshore cable routing. No mitigation can be offered to avoid impacts on stony / bedrock reef and PMF "burrowed mud" features. Impacts on these particular features will occur over a very small spatial scale relative to the wider availability of these habitats. Recovery of both habitats is forecast as assessed above.

10.1.7.3 Control of the use and storage of fuels, oil and construction chemicals through the adoption and adherence of Construction and Project Environmental Management Plans will result in a residual minor effect.

10.1.7.4 A protocol will be developed and adopted to minimise the risk of introducing of NIS as required.

10.1.8 Habitats Regulations Appraisal

10.1.8.1 Impacts from the construction, operation and decommissioning of the generating station on benthic ecology do not give rise to Habitats Regulations Appraisal concerns.

10.1.9 References

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10.2 Fish and Shellfish Ecology

10.2.1 Summary of Impacts and Mitigation Summary of Effects

10.2.1.1 The likely effects considered for assessment on fish and shellfish resources are as follows:

- Temporary disturbance of the seabed (increased suspended sediment concentrations and sediment re-deposition);
- Underwater noise;
- Electromagnetic fields (EMFs); and
- Changes to fishing activity.

10.2.1.2 Given the small footprint of the OfTI, effects derived from loss of habitat and introduction of new habitat have been excluded for the assessment of effects on fish and shellfish species.

10.2.1.3 For the purposes of this assessment and in the absence of detailed information on decommissioning schedules and methodologies, it is assumed that any effects derived from the decommissioning phase will, at worst, be of no greater significance than those derived from the construction phase.

10.2.2 Proposed Mitigation and Residual Effects

10.2.2.1 Likely significant effects (above minor) have not been identified on fish and shellfish ecology as a result of the construction / decommissioning phase of the OfTI. However, as indicated in Chapter 7.2 (Fish and Shellfish Ecology), soft start piling will be used with the aim that mobile species are not exposed to the highest noise levels.

10.2.2.2 Similarly, likely significant effects (above minor) have not been identified on fish and shellfish receptors for the operational phase of the OfTI. As mentioned in the assessment of EMFs, cable burial will reduce exposure of electromagnetically sensitive species to the strongest EMFs that exist at the "skin" of the cable owing to the physical barrier of the substratum (OSPAR, 2008). Similarly, where burial is not feasible, cable protection will ensure that fish and shellfish receptors are not in direct contact with the cable and hence with the strongest EMFs.

10.2.2.3 In light of the above mitigation measures, no additional measures to those described above have been proposed.

10.2.2.4 A summary of the pre and post mitigation impact assessment on fish and shellfish ecology is given in Table 10,2-1 below.

Table 10.2-1 Impact Assessment Summary

Effect	Receptor	Pre–Mitigation Effect	Mitigation	Post–Mitigation Effect
Construction / Decommissioning				
Increased SSCs and Sediment Re-Deposition	**Adult and Juvenile Fish and Shellfish**	Negative Minor Unlikely	None	Negative Minor Unlikely
	Diadromous Species	Negative Minor Unlikely (general) Probable (salmon and sea trout)	None	Negative Minor Unlikely (general) Probable (salmon and sea trout)
	Fish and Shellfish which lay eggs on the seabed (herring, sandeels and squid)	Negative Minor Unlikely	None	Negative Minor Unlikely
Noise	**Plaice**	Negative Not significant Probable	Soft start piling	Negative Not significant Probable
	Salmon and Sea Trout	Negative Minor Probable	Soft start piling	Negative Minor Probable
	Cod	Negative Minor Probable	Soft start piling	Negative Minor Probable
	Whiting	Negative Minor Probable	Soft start piling	Negative Minor Probable
	Herring	Negative Minor Probable	Soft start piling	Negative Minor Probable
	Larvae and Glass Eels	Negative Minor Probable	None	Negative Minor Probable
	Shellfish	Negative Minor Unlikely	Soft start piling	Negative Minor Unlikely

Effect	Receptor	Pre–Mitigation Effect	Mitigation	Post–Mitigation Effect
Operation				
EMFs	**Elasmobranchs**	Negative Minor Probable	Cable burial / protection	Negative Minor Probable
	River and Sea Lamprey	Negative Minor Unlikely	Cable burial / protection	Negative Minor Unlikely
	European eel	Negative Minor Probable	Cable burial / protection	Negative Minor Probable
	Salmon and Sea trout	Negative Minor Probable	Cable burial / protection	Negative Minor Probable
	Other fish Species	Negative Minor Unlikely	Cable burial / protection	Negative Minor Unlikely
	Shellfish Species	Negative Minor Unlikely	Cable burial / protection	Negative Minor Unlikely
Changes to Fishing Activity	**General (All)**	Below moderate	None	Below moderate

10.2.3 Introduction

10.2.3.1 This chapter describes the assessment of likely significant effects of the construction, operation and decommissioning phases of the offshore transmission infrastructure (OfTI) on fish and shellfish resources. For the purposes of this assessment, the following OfTI elements have been considered:

- Up to six AC Offshore Substation Platforms;
- Two AC / DC Offshore Converter Substation Platforms;
- Inter-platform cabling; and
- Offshore export cables.

10.2.3.2 The precise location of the Offshore Substation Platforms (OSPs) has not yet been defined. It is however anticipated that all AC OSPs will be located within or at the boundaries of the three proposed wind farm sites. The two AC / DC converter OSPs will either be located within the wind farm site boundaries or within 2 km of the surveyed cable route boundary, as close as practicable to the wind farm boundary. The following chapters and appendixes support this chapter:

- Chapters 3.5 and Chapter 9.2 (Sedimentary and Coastal Processes);
- Chapter 3.6 (Underwater Noise);
- Chapter 4.3 and Technical Appendix 4.3 A (Fish and Shellfish Ecology);
- Chapters 5.1 and 11.1 (Commercial Fisheries);
- Chapter 10.1 (Benthic Ecology);
- Technical Appendix 4.3 B (Salmon and Sea Trout Ecology and Fisheries Technical Report);
- Technical Appendix 4.3 C (Sandeel Survey Results); and
- Technical Appendix 4.3 D (Electromagnetic Fields Modelling).

10.2.4 Rochdale Envelope Parameters Considered in the Assessment

10.2.4.1 The worst realistic case scenario for the effects of the OfTI on fish and shellfish ecology has identified the engineering design parameters which may result in the greatest effect upon fish and shellfish species.

10.2.4.2 In general terms, it is considered that the installation of the maximum number of cables, and OSPs constitutes the worst case scenario, as this would result in the greatest footprint, duration and frequency of OfTI installation operations.

10.2.4.3 A summary of the worst case scenarios defined for the assessment of effects on fish and shellfish ecology is given in Table 10.2-2 below.

Table 10.2-2 Potential Effects and Rochdale Scenarios Assessed

Potential Effect	Rochdale Scenario Assessed
Construction	
Temporary Disturbance to Seabed (increased suspended sediment concentrations and sediment re-deposition)	Seabed preparation for GBS installation: • Max. Number of OSPs: eight (six AC and two DC); • Max number of GBS per OSP: four; • Max. base diameter: 65 m; and • Dredger affected width: 190 m. Drilling to facilitate pin pile installation: • Max. Number of OSPs: eight (six AC and two DC); and • Pile diameter: 3 m. Cable installation by energetic means (i.e. jetting): • Inter-platform cable installation: - Trench affected width per trench: 6 m; and - Max. cabling length: 90 km. • Offshore Export Cables installation: - Max. number of cable trenches: two; - Trench affected width per trench: 6 m; and - Cable length from wind farm to shore: 105 km.

Potential Effect	Rochdale Scenario Assessed
Noise	Impact Piling for installation of OSPs: • Max. number of OSPs: eight (six AC and two DC); • Max. pile diameter: 3 m; and • Max. Number of piles: Up to 6-legged jacket for AC OSPs, up to 8-legged jacket for DC OSPs. Noise related to cable installation activities: • Suction dredging; • Cable laying; • Rock placing; and • Vessel noise.
Operation	
EMFs	Inter-platform cabling: • Type: 220 kV AC; • Max. number of OSPs: eight (six AC and two DC); • Max. number of cables in a trench: one; • Max. cabling length: 90 km; and • Target trench depth: 1 m. Offshore Export Cables: • Type: 320 kV DC; • Max. number of cable trenches: two; • Max. number of cables: four (two bundles of two cables in each trench); • Cable length from wind farm to shore: maximum 105 km; and • Target trench depth: 1 m.
Changes to Fishing Activity	• Max. Number of OSPs: Eight (Six AC and two DC); • Max. Inter-platform cable Length: 90 km; and • Max. Offshore Export cables Length: 105 km.

10.2.5 EIA Methodology

10.2.5.1 The impact assessment methodology used for the evaluation of effects on fish and shellfish species is described below. The significance criteria used are based on the magnitude of the effects and on the sensitivity of the receptors. Both magnitude of effect and receptor sensitivity have been assigned using professional judgement. The parameters used to define these take account of the IEEM (2010) impact assessment guidelines.

Magnitude of Effect

10.2.5.2 Magnitude values have been assigned based on the following considerations:

- **Extent of effect,** referring to the full area over which the effect occurs (e.g. noise impact range);
- **Duration of effect**, referring to the duration over which the effect is expected to last;
- **Frequency of the effect**; and
- **Reversibility**: Irreversible effects are those from which recovery is not possible within a reasonable timescale. Reversible (temporary) are effects from which spontaneous recovery is possible or, for which effective mitigation is both possible and an enforceable commitment has been made.

Sensitivity

10.2.5.3 The sensitivity of the receptor has been assigned taking account of its degree of adaptability, tolerance and recoverability to the effect. In addition the following parameters have been considered:

- **Timing of the effect**, referring to whether effects are caused during critical life-stages or seasons (e.g. spawning season and migration); and
- **Ecological value**, referring to conservation status of the receptor (i.e. protected to the European level and / or national level) and importance in the area (i.e. species of importance as prey to other marine organisms, species of commercial important).

Significance

10.2.5.4 The significance of an effect is defined using the following categories:

- **Not significant:** An effect that is predicted to be indistinguishable from natural background variation using conventional monitoring techniques. The effect is not significant in the context of the nature conservation objectives or legislative requirements;
- **Minor significance:** The effect will be measurable in the short term and / or over very local scales using standard monitoring techniques. The effect does not affect nature conservation objectives and falls within legislative requirements. Effects are typically reversible;
- **Moderate significance**: The effect will be measurable in the long term and over a broad to very broad spatial scale and is likely to have a measurable effect. It may affect nature conservation objectives and legislative requirements. Effects may be reversible; and
- **Major significance:** A permanent effect which has a measurable effect on wider ecosystems functioning and nature of conservation objectives and exceeds acceptable limits or standards.

10.2.5.5 The significance of an effect is determined taking account of the magnitude of the effect and the sensitivity of the receptor following the matrix below (Table 10.2-3 below), In addition to the significance ratings whether the predicted effect is considered *positive* or *negative* has also been described. Those effects assessed to be above minor (i.e. moderate or major) are considered to be significant.

Table 10.2-3 Impact Assessment Significance Criteria

Impact Assessment Significance Criteria		Sensitivity of Receptor		
		Low	**Medium**	**High**
Magnitude of Effect	**Negligible**	Not significant	Minor	Minor
	Small	Minor	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

10.2.5.6 The impact assessment below uses the best knowledge that is currently available on sensitivity of particular species / species groups. It should, however, be noted that some limitations exist. Where required, surrogates (similar species / species groups for which information is available) have been used to inform this assessment. In addition, as a result of uncertainties in relation to the distribution of some species and the use that they make of the area of the OfTI, (particularly in the case of migratory species) a number of conservative assumptions have been made. Where applied, these are detailed throughout this chapter.

10.2.5.7 For certain effects, the limited information available to date does not allow for the impact assessment to follow the standard methodology described above, as data gaps make defining magnitudes of effect and identification of receptors and their sensitivity difficult. In those instances, the impact assessment has been based on a literature review of current knowledge of the particular effect and the receptors under consideration and on indirect evidence from monitoring studies carried out in operational wind farms.

10.2.5.8 In light of the limitations of the impact assessment the probability for each effect to occur has been assessed as "certain / near certain", "probable", "unlikely" and "extremely unlikely". The definition of the probability categories used in the assessment is given below as provided in the IEEM (2010) guidelines:

- **Certain / near certain:** probability estimated at 95 % or higher;
- **Probable:** probability estimated above 50 % but below 95 %;
- **Unlikely:** Probability estimated above 5 % but less than 50 %; and
- **Extremely unlikely:** Probability estimated at less than 5 %.

10.2.5.9 Probabilities have been assigned taking into account the available evidence for an effect to occur, the degree of available baseline information on the ecology of the receptors and the use that they make of the area where the OfTI is located.

10.2.6 Impact Assessment

10.2.6.1 Fish and shellfish species are expected to be affected in different ways, depending on the use that they make of the area of the OfTI, their ecology and the life stage under consideration (i.e. migratory species and degree of mobility).

10.2.6.2 As described in Chapter 4.3 (Fish and Shellfish Ecology) and Technical Appendix 4.3 A (Fish and Shellfish Ecology Technical Report), a number of species are known to spawn and have nursery areas in the Moray Firth, including areas where the OfTI is located and their vicinity. Some of these (i.e. sandeels and herring) lay their eggs on the seabed and may therefore be particularly sensitive to the effects of seabed disturbance. In addition, sandeels and herring (together with sprat) are considered to be of importance as prey species in the area, not only for other fish but also for marine mammals and seabirds.

10.2.6.3 Migratory diadromous species of conservation importance, particularly salmon and sea trout, European eel and river and sea lamprey, may transit the area of the OfTI during migration and in some cases (particularly sea trout) as part of their foraging activity (Technical Appendix 4.3 A: Fish and Shellfish Ecology Technical Report and Technical Appendix 4.3 B: Salmon and Sea Trout Ecology and Fisheries Technical Report).

10.2.6.4 In addition, shellfish species of commercial importance (*Nephrops*, scallops, squid, edible crab, lobster and whelks) and elasmobranchs are also present at varying degrees in the area.

10.2.6.5 The likely effects derived from the construction / decommissioning and operational phases of the OfTI considered for assessment on fish and shellfish ecology are as follows:

- Temporary disturbance to the seabed;
- Underwater noise;
- Electromagnetic fields (EMFs); and
- Changes to fishing activity.

10.2.6.6 The footprint of the OSPs, scour and cable protection will result in a loss of seabed area and in the introduction of new habitat to fish and shellfish species. As indicated in Chapter 10.1 (Benthic Ecology), this will be very small (0.58 km^2 and 0.61 km^2 respectively). Effects derived from loss of habitat and introduction of new habitat have therefore been excluded for the assessment of effects on fish and shellfish species. These effects are, however, assessed for benthic communities in Chapter 10.1 (Benthic Ecology).

10.2.6.7 Effects have been separately assessed for the construction / decommissioning phases and the operational phase in terms of OfTI site specific effects. For the purposes of this assessment and in the absence of detailed information on decommissioning schedules and methodologies, it is assumed that any effects derived from the decommissioning phase will, at worst, be of no greater significance than those derived from the construction phase. Cumulative effects arising from other marine developments are discussed separately in Chapter 14.2 (Fish and Shellfish Ecology).

Construction

10.2.6.8 The following likely significant effects on fish and shellfish resources are assessed below for the construction phase of the OfTI below:

- Temporary disturbance to the seabed; and
- Underwater noise.

Temporary Disturbance to the Seabed

10.2.6.9 Cable installation activities will result in sediment being released into the water column, leading to an increase in suspended sediment concentrations (SSCs). Sediment will be advected with ambient tidal currents and will be subject to general processes of dispersion and deposition. Once deposited, the sediment will effectively rejoin the local sedimentary environment. These processes are described in detail in Chapter 9.2 (Sedimentary and Coastal Processes).

10.2.6.10 Cable installation by burial into the seabed along the cable route will have a relatively large magnitude impact on SSC (elevated to order 100 s to 10,000 s mg / l). However the effect will be short term (order of seconds to minutes, depending on the sediment grain size and degree of aggregation) and will be largely localised to the cable installation location (main effect within tens of metres). The thickness of sediment accumulation will be limited by the volume of sediment being disturbed and should not exceed a few tens of centimetres other than immediately adjacent to the cable. Once redeposited to the bed, the displaced material will join the natural sedimentary environment and ceases to present any further effect.

10.2.6.11 In addition to the above, an increase in SSCs will occur as a result of sediments being disturbed from the seabed whilst preparing the seabed from GBS foundations for the OSPs. The expected sediment plume associated with dredging as part of seabed preparation of GBS foundations for turbine foundations will be as described in Chapter 7.2 (Fish and Shellfish Ecology). This is summarised below:

- An increase in SSC of 30 to 35 mg / l above ambient levels depending on the tidal state and the local water depth at the time and location of the release. These maximum levels of effect are contained within 50 to 100 m of the dredger and only occurring during sediment release;
- A maximum increase in SSC of 20 mg / l or less above ambient levels within 500 to 1,000 m in a plume downstream and to 10 mg / l or less within 2,000 to 3,000 m downstream;
- Both of the above levels of effect are only present during dredging and no more than 1 hour after cessation of dredging; and
- A more widely dispersed residual increase in SSC of 1 to 4 mg / l above ambient levels.

10.2.6.12 It should be noted however that given the small number of OSPs, the magnitude of the effect will be smaller than that described for installation of turbine foundations in Chapter 7.2 (Fish and Shellfish Ecology).

10.2.6.13 Taking the localised and short term nature of the expected significant increases in SSCs and sediment redeposition, the magnitude of the effect is considered to be small.

10.2.6.14 The potential effects of increased SSCs and sediment re-deposition on fish and shellfish receptors are assessed below by species / species group. Some of the species potentially present in the area of the OfTI may be particularly sensitive to these effects due to certain aspects of their ecology and life cycles, including diadromous migratory species and fish and shellfish species which lay their eggs on the seabed (herring, sandeels and squid).

Diadromous Migratory Species

10.2.6.15 In the case of diadromous species, assuming fish are migrating through areas where cable and OSP installation activities are taking place, increased SSCs may result in localised avoidance and limited disturbance during migration. Given the proximity of the offshore export cable landfall to salmon and sea trout rivers, particularly those relevant to the Deveron and Ugie Salmon Fishery Districts (SFDs) it is considered that there is potential for salmon and sea trout to be disturbed prior to river entry and immediately after leaving the rivers (see Technical Appendix 4.3 B: Salmon and Sea Trout Ecology and Fisheries Technical Report).

10.2.6.16 Works in close proximity to shore will only be undertaken over a limited period of time for cable installation in each trench. In this context the seasonality of river entry and, particularly in the case of salmon, the diversity of runs should be noted. Diadromous migratory species are considered of medium sensitivity and the effect of increased SSCs is assessed to be negative, of **minor significance,** and probable for salmon and sea trout, and unlikely for other diadromous species potentially entering / exiting rivers in the vicinity of the offshore export cable landfall site.

Fish and Shellfish which lay their Eggs on the Seabed (Herring, Sandeels and Squid)

10.2.6.17 Herring and sandeels deposit their eggs on the seabed, there is therefore potential for these to be affected by increased SSCs and smothering as a result of sediment re-deposition. The significance of any effect will however depend on the degree of overlap between their spawning areas and the areas affected. In the case of herring, spawning is thought to take place off the Banffshire, Buchan and Aberdeenshire coast during August and September, as well as in the area between the Orkneys and the Shetlands and to a lesser extent off the Caithness coast. As shown in Chapter 4.3 (Fish and Shellfish Ecology), the southern section of the offshore export cable route passes through a herring spawning area off the Banffshire / Buchan coast. In the case of sandeels, they deposit their eggs on the sediment and also spend most of the time buried in it. Taking the wider area where both sandeels and spawning herring are distributed and the likely small degree of overlap with the areas affected by SSCs and sediment re-deposition, herring and sandeel are considered receptors of medium sensitivity. The effect is therefore assessed to be negative, of **minor significance** and unlikely.

10.2.6.18 Squid are thought to inhabit shallow, coastal waters when they move inshore to spawn (Viana *et al.,* 2009) and eggs have been reported off Burghead and Buckie in May and June in water depths of 5 to 6 m by fishermen (Young *et al.,* 2006). Spawning occurs over an extended period from December to June, with peak spawning reported from December to March (Lum-Kong *et al.,* 1992; Collins *et al.,* 1997; Boyle *et al.,* 1995). It is considered that spawning may occur in areas relevant to the OfTI, particularly in the southern section of the offshore export cable route and that there is potential for eggs to be subject to high SSCs and smothering through sediment re-deposition. Given the localised effects expected as a result of increased SSC and sediment re-deposition, the degree of overlap between areas affected and squid spawning grounds will however be comparatively small. Squid are considered receptors of medium sensitivity and the effect is assessed to be negative, of **minor significance** and unlikely**.**

Adult and Juvenile Fish

10.2.6.19 Adult and juvenile fish, being mobile, will be able to avoid localised areas disturbed by increased SSCs. If displaced, juveniles and adults would be able to move to adjacent undisturbed areas within their normal distribution range. Adult and juvenile fish are therefore considered receptors of low sensitivity and the effect of increased SSCs and sediment re-deposition is assessed to be negative, of **minor significance** and unlikely.

Shellfish Species

10.2.6.20 The principal shellfish species (i.e. scallops, crabs, lobster, nephrops and whelks) present in the area are, with the exception of squid, of limited mobility compared to most fish species. It is therefore likely that these will remain in areas disturbed by increased SSC during cables and OSPs foundations installation. In addition, some of them could be affected by smothering as a result of sediment re-deposition.

10.2.6.21 The distribution of these species is however comparatively large in the context of the areas where seabed disturbance related effects may occur. Examples of the degree of sensitivity to smothering, increased SSCs and displacement for several shellfish species found in the area of the OfTI and in the wider Moray Firth for which the Marine Life Information Network (MarLIN) provides species specific information are given in Table 10.2-4 below (MarLIN, 2011).

Table 10.2-4 Sensitivity of Shellfish Species to Smothering, Increased SSC and Displacement

Species	Smothering	Increased SSC	Displacement
Edible Crab	Very low	Low	Not sensitive
King Scallop	Low	Low	Not sensitive
Nephrops	Not sensitive	Not sensitive	Very low

10.2.6.22 Taking the information above, the distribution ranges of shellfish species in the OfTI and the wider area, and MarLIN's examples of sensitivity for species for which species specific information is available (Table 10.2-4 above), shellfish species are considered of low sensitivity and the effect is assessed to be negative, of **minor significance** and unlikely.

10.2.6.23 It is recognised that in addition to indirect effects through increased SSCs and sediment re-deposition, the disturbance of the seabed associated to construction works may result in a direct effect on species and life stages of limited mobility, such as shellfish species, demersal eggs, etc. (i.e. if unable to avoid construction machinery) and in a localised loss of habitat (i.e. seabed preparation works for installation of OSPs foundations). As indicated in Chapter 10.1 (Benthic Ecology), a maximum area of 1.99 km^2 of seabed habitat will be disturbed over the construction phase. It should be noted, however, that only discrete areas will be disturbed at a given time and that disturbance will be short term. The majority of fish and shellfish species present in the area are relatively mobile and their distribution ranges large in comparison to areas potentially being disturbed at a given time. Direct effects associated to seabed disturbance have therefore not been considered for assessment on fish and shellfish species. Likely significant effects on the benthic community derived from this are assessed in Chapter 10.1 (Benthic Ecology).

Noise

10.2.6.24 A number of activities associated to the construction phase of the OfTI generate underwater noise and vibration. These are as follows:

- Piling noise derived from the installation of OSPs;
- Suction dredging;
- Cable laying;
- Rock placement; and
- Vessel noise.

10.2.6.25 In order to assess the likely effect of construction noise on fish, modelling was undertaken using the dB_{ht} (*Species*) metric which allows for impact ranges be defined taking account of species specific sensitivities. The noise modelling methodology is described in detail in Chapter 3.6 (Underwater Noise). The criteria for assessment of effects on fish is summarised in Table 10.2-5 below.

Table 10.2-5 Noise Assessment Effect Criteria

Level dB_{ht} *(Species)*	Effect
≥ 75	Mild avoidance reaction by the majority of individuals. At this level individuals will react to the noise, although the effect will probably be transient and limited by habituation.
≥ 90	Strong avoidance reaction by virtually all individuals
> 110	Tolerance limit of sound; unbearably loud
> 130	Possibility of traumatic hearing damage from single event

10.2.6.26 Noise modelling was undertaken for cod, dab, herring and salmon, species representing different degrees of hearing ability and sensitivity to noise. The outputs of the noise modelling at the 90 dB_{ht} (*Species*) for different construction activities are given in Chapter 3.6 (Underwater Noise). Detailed information on the noise modelling methodology and hearing ability of fish species is provided in Chapters 3.6 (Underwater Noise) and Chapter 7.2 (Fish and Shellfish Ecology).

10.2.6.27 Impact piling is the activity resulting in the greatest effect on fish species with other construction activities having negligible impact ranges on fish. This activity has therefore been studied in more detail and forms the basis of the impact assessment. The assessment of noise on fish has been primarily focused on the outputs of the modelled 90 dB_{ht} (*Species*) impact ranges, at which greatest behavioural effects are to be expected.

10.2.6.28 Noise at the 130 and 110 dB_{ht} (*Species*) level, above which possibility of traumatic hearing damage and unbearably loud sounds may be expected respectively, would only occur in close proximity of where piling is taking place (order of 10's to 100's of metres at 130 dB_{ht} (Species) level and order 100s to few 1,000s of metres at the 110 dB_{ht} (Species) level, depending on species specific hearing abilities) (See Table 10.2-6 below).It should be noted that soft start piling will be used with the aim that mobile species are not exposed to the 110 and 130 dB_{ht} (*Species*) levels, as this will allow fish to leave the vicinity of the foundations before the highest noise levels are reached.

Table 10.2-6 130 dB$_{ht}$ and 110 dB$_{ht}$ (Species) Impact Ranges Associated to Piling of a 3 m Pile by Species

Species	130 dB$_{ht}$ (Species) Range (m)	110 dB$_{ht}$ (Species)Range (m)
Cod	220	4,000
Dab	30	460
Herring	370	5,400
Salmon	< 10	160

10.2.6.29 For the purposes of this assessment, one construction scenario (scenario1) was modelled (see Chapter 3.6: Underwater Noise). The construction programme of this scenario is summarised in Table 10.2-7 below.

Table 10.2-7 Modelled Scenarios

Scenario	Build Programme (years)	Max. no. Years with Piling Activities	Max. no. of Vessels (piling activities)
1	5	4	1

10.2.6.30 For the noise realistic worst case scenario, based on conservative assumptions, the following parameters are considered:

- Sixteen pin piles per OSP;
- Eight OSPs (two DC and six AC); and
- 260 minutes per pile (assuming 3 m diameter piles).

10.2.6.31 Assuming four years piling (one construction vessel), the average percentage of piling days will constitute 1 % of the total building programme (See Chapter 3.6: Underwater Noise).

Fish Species

10.2.6.32 Concerns were raised during consultation as part of the EIA process with regard to the sensitivity of juvenile fish and in particular salmon and sea trout smolts. To address this issue, a report on ontogenic development of auditory sensitivity in fish was commissioned (Technical Appendix 3.6 A: Underwater Noise). This concluded that the experimental evidence suggests that the juveniles of marine fish are no more sensitive to sound than the adults of the species. Furthermore, in some cases it appears that there is a degree of insensitivity to sound of juveniles when compared with adults, implying some protection from the adverse effects of noise. In light of this, juvenile fish have been assessed using the same criteria as that used for evaluation of the effect of impact piling on adults.

10.2.6.33 A comparative indication of the expected 90 dB$_{ht}$ (*Species*) noise effects for the four species modelled is given for a single piling operation (3 m pile) in Figure 10.2-1, Volume 6 a. Table 10.2-8 below shows the maximum, minimum and mean impact ranges modelled by species at the 90 dB$_{ht}$ and 75 dB$_{ht}$ (Species) levels for a 3 m pile.

Table 10.2-8 Maximum, Minimum and Mean Impact Ranges Modelled by Species at the 90 dB_{ht} and 75 dB_{ht} Levels for a 3 m Pile

Modelled Location	Species	90 dB_{ht} Impact Range (km)			75 dB_{ht} Impact Range (km)		
		Max.	Min.	Mean	Max.	Min.	Mean
2	Cod	34	25	30	82	41	64
	Dab	6.9	6.7	6.8	33	26	30
	Herring	39	29	34	94	41	69
	Salmon	2.5	2.5	2.5	14	13	14

10.2.6.34 As shown in both Figure 10.2-1, Volume 6 a and Table 10.2-8 above, dab and salmon are expected to exhibit strong avoidance reactions (90 dB_{ht} (Species) level) only in close proximity to the foundations, whilst cod and herring are expected to avoid wider areas. Similarly, milder behavioural reactions (75 dB_{ht} (Species)) level are expected in relatively small areas for dab and salmon, whilst for cod and herring wider areas are expected to be affected (Table 10.2-8 above).

10.2.6.35 In order to help the assessment and provide an indication of the ecological significance of the predicted noise impact ranges, the location and extent of spawning grounds is provided for plaice, cod and herring, and, in the case of salmon, the location of SAC rivers (Figure 10.2-.2 to Figure 10.2-5, Volume 6 a). Note that in the particular case of herring, given their dependence on the presence of a coarse substrate for spawning, the distribution of gravel and sandy gravel (based on BGS data) available to the Orkney / Shetland stock is also shown in Figure 10.2-5, Volume 6 a. As previously mentioned the impact assessment is primarily based on the 90 dB_{ht} (*Species*) effect contours. In the case of salmon, however, given its conservation status, the importance of their fisheries to the local, regional and national level in Scotland 75 dB_{ht} (*Species*) levels have also been used to form the basis for assessment.

10.2.6.36 It should be noted that given the small number of OSPs, the frequency and duration of piling noise will be considerable smaller / shorter than that described for installation of turbine foundations in Chapter 7.2 (Fish and Shellfish Ecology). Taking account of the above impact ranges and the short term nature and frequency of the effect, the magnitude of construction noise has been defined as follows:

- Based on the noise modelling outputs for dab (surrogate for plaice) the magnitude of the effect is considered to be negligible;
- Based on the noise modelling outputs for salmon (surrogate for sea trout), and taking into account the 75 dB_{ht} levels, the magnitude of the effect is considered to be negligible; and
- Based on the noise modelling outputs for cod (surrogate for whiting) and herring, the magnitude of the effect is considered to *be* small.

10.2.6.37 The sensitivity of the receptors modelled based on their ecological importance and the use that they make of the OfTI and the wider area and the significance of the predicted effects is given below:

- Plaice have defined spawning and nursery grounds in areas relevant to the proposed OfTI. These are however relatively large and considered of low intensity (Ellis *et al.,* 2010). Plaice is therefore considered a receptor of low sensitivity. The effect of noise on plaice is assessed to be negative, **not significant** and probable**;**
- In the absence of detailed information on the migratory routes of salmon and sea trout it is assumed that they transit the OfTI as part of their normal migration and / or as part of their foraging activity (particularly sea trout). It should be noted, however, that areas in the immediate vicinity of the rivers will not be affected and hence fish will not be disturbed immediately prior to river entry or immediately after leaving the rivers at the 90 dB_{ht} or 75 dB_{ht} levels. In addition, there is little potential for barrier effects to take place given the relatively small expected ranges for these species at the 90 dBht level (Figure 10.2-3, Volume 6 a). Taking the above into account and given the conservation status of salmon and sea trout and the importance of their fisheries to the local and national level in Scotland, they are considered of medium sensitivity. The effect on salmon and sea trout is assessed to be negative**,** of **minor significance** and probable;
- The cod population of the Moray Firth is genetically distinct from other North Sea populations and spawning activity has been low in recent years. In addition they are known to use the Moray Firth as a nursery ground (Technical Appendix 4.3 A: Fish and Shellfish Ecology Technical Report). Noise contours at the 90 dB_{ht} (Species) level could overlap with a significant area of their spawning and nursery grounds. The uncertainties in relation to the current extension and relative importance to these grounds should however be recognised. The sensitivity of cod is considered to be medium. The effect of piling noise on cod is therefore assessed as to be negative, of **minor significance** and probable;
- Whiting (for which cod has been used as a surrogate), have defined spawning and nursery grounds in the area relevant to the proposed sites. However, these are comparatively large. They are considered receptors of low sensitivity. The effect on whiting is therefore assessed as negative, of **minor significance** and probable; and
- Herring are known to spawn in the Moray Firth and use the area as a nursery ground. They are important as prey species for a number of other marine organisms. In addition, they are substrate specific spawners needing the presence of an adequate coarse substrate on which to lay their eggs. As shown in Figure 10.2-5 (Volume 6 a), the southern section of the OfTI passes through herring spawning grounds of the Buchan stock. It should be noted, however, that it is anticipated that OSPs will be located within the boundary of the three proposed wind farm sites or within the surveyed cable route boundary, as close as practicable to the wind farm boundary. The 90 dB_{ht} noise contours for herring are therefore unlikely to extend into the spawning grounds of the Buchan stock but may, as shown in Figure 10.2-5, Volume 6 a potentially affect spawning grounds of the Orkney-Shetland stock. The highest intensity of herring spawning tends to take place in the area between the Orkney and Shetlands in most years and gravelly substrate is available to the stock in various areas unaffected at 90 dB_{ht} (*Clupea harengus)* levels (see Figure 10.2-5, Volume 6 a). Based on the above, herring are considered receptors of medium sensitivity and the effect is assessed to be negative, of **minor significance** and probable.

Other Fish Species Present in the OfTI

10.2.6.38 The level of hearing specialisation in fish is assumed to be associated with possession of a swim bladder and whether this is connected to the ear. Fish with specialist structures are considered of highest sensitivity, non-specialists with swim bladder of medium sensitivity and non-specialists without swim bladder of lowest sensitivity (Nedwell *et al.*, 2004). Based on this classification, potential magnitudes of effect have been assigned to a number of species of importance in the Moray Firth area (i.e. species with conservation status, of commercial value, key prey species) for which noise modelling has not been undertaken and direct surrogates have not been defined as follows:

- For flatfish species and other species which lack a swim bladder, namely sandeels, elasmobranchs, anglerfish, river lamprey and sea lamprey, the magnitude of effect may be similar to that assigned to dab (negligible);
- For species with a swim bladder but not connected to the ear, namely mackerel, haddock and European eel, the magnitude of effect may be between that assigned to cod (small) and that assigned for dab (negligible); and
- For species which possess a connection between the swim bladder and the ear such as sprat, the potential magnitude of effect may be similar to that assigned to herring (small).

10.2.6.39 It should be noted that data on hearing ability exist for a limited number of species and extrapolation of hearing capabilities between different species, and especially those that are taxonomically distant, should be undertaken with caution (Hastings and Popper, 2005). The likely potential magnitude of effect and the sensitivity of the species above is summarised in Table 10.2-9 below. Given the limitations and qualitative nature of the assessment, significance ratings and probabilities have not been defined. The limitations and the qualitative nature of the noise assessment for the species which have not been modelled and for which direct surrogates have not been defined should be recognised and only be taken as an indication of potential effects.

Table 10.2-9 Qualitative Assessment for Species not Modelled and without Defined Surrogates Based on Potential Magnitude of Effects and Receptor Sensitivities

Species	Potential Magnitude of Effect	Sensitivity of Receptor	
Sandeels	Negligible	• Important prey species; • Export cable site specific distribution unknown. The results of the sandeel survey undertaken suggest that there are not extensive areas supporting important sandeel populations within the Moray Firth Round 3 Area; and • Substrate specific.	Medium
Elasmobranchs	Negligible	• Most species are of conservation importance; • Generally more prevalent in the north and west of Scotland than in the Moray Firth; and • Some with nursery grounds defined in the proposed sites (spurdog, spotted ray and thornback ray).	Low to Medium

Species	Potential Magnitude of Effect	Sensitivity of Receptor	
River and Sea Lamprey	Negligible	• Conservation importance; and • Potentially transiting the site during migration (lack of detailed information on migration).	Medium
Anglerfish	Negligible	• Commercially important; and • High intensity nursery area in the sites.	Medium
Haddock	Negligible to Small	• Commercially important; and • Nursery grounds in the area and spawning grounds in the proximity of the proposed sites, however comparatively large.	Low
European Eel	Negligible to Small	• Conservation importance; and • Potentially transiting the site during migration (lack of detailed information on migration).	Medium
Mackerel	Negligible to Small	• Seasonal commercial fishery in inshore areas along the Moray coast and in the vicinity of the export cable landfall (Chapter 10.1); and • No spawning or nursery grounds in the vicinity of the OfTI.	Low
Sprat	Small	• Important as prey species; and • Spawning and nursery grounds in the area, however these are comparatively large.	Low to Medium

Life Stages of Limited Mobility

10.2.6.40 Life stages of limited mobility such as larvae, and in the case of European eel, their juvenile form (glass eels), will not be able to avoid areas where the highest noise levels are reached during construction, assuming they drift through the OfTI. Although there is limited information on the effect of piling noise to date on early life stages of fish, research recently carried out by the Institute for Marine Resources and Ecosystem Studies (IMARES) (Bolle *et al.*, 2011) suggests that the assumption of 100 % of larvae mortality within a radius of 1,000 m around a piling site (used in the Appropriate Assessment of Dutch offshore wind farms) is too conservative. Bolle *et al.*, 2011 found no significant effects in the larval stages analysed at the highest exposure level (cumulative SEL = 206 dB re 1 $\mu Pa^2 s$) which represented 100 pulses at a distance of 100 m from piling. It is recognised that the results, based on sole (*Solea solea*) larvae, should not be extrapolated to fish larvae in general as inter-specific differences in vulnerability to sound exposure may exist. The findings, however suggest that larval mortality would only occur within a few hundred metres from where piling is taking place. On this basis the magnitude of the effect is considered negligible. The sensitivity of larvae and glass eels is considered medium and the effect is assessed to be negative, of **minor significance** and probable**.**

Shellfish Species

10.2.6.41 The majority of shellfish species present in areas relevant to the OfTI, with the exception of squid, have limited mobility in comparison to most fish species, hence they may not be able to avoid areas in close proximity to piling operations.

The hearing mechanism of invertebrate species is currently not well understood. They are generally assumed to be less sensitive to noise than fish due to the lack of a swim bladder. Recent studies, however, have found that species such as the shrimp (*Palaemus serratus*) and the longfin squid (*Loligo pealeii*) are sensitive to acoustic stimuli and it has been suggested that these species may be able to detect sound similarly to most fish, via their statocysts (Lovell *et al.,* 2005; Mooney *et al.,* 2010). No species specific information on the sensitivity of *Nephrops*, crabs and lobsters is currently available; however, they are expected to be present in areas relevant to the OfTI in relatively low numbers, being more prevalent in other areas within the region. Squid are seasonally present in the Moray Firth to spawn and, as previously mentioned, may potentially be affected by noise in a similar way as fish.

10.2.6.42 Scallops are the principal commercial shellfish species targeted in the proposed sites. Whilst detailed information on the hearing ability of scallops is currently lacking, they are not considered to be sensitive to noise (MarLIN, 2011).

10.2.6.43 Taking the above into account and the short term nature and frequency of piling associated with OSPs, the magnitude of the effect of noise on shellfish is considered negligible- small and the sensitivity of shellfish low. The effect on shellfish species is therefore assessed to be negative, of **minor significance** and unlikely.

Operation

Electromagnetic Fields (EMFs)

10.2.6.44 The export and inter-platform cables will generate EMFs during the operational phase of the OfTI. The inter-platform cables will be 220 kV AC cables and the export cables 320 kV DC cables. Both cable types will generate an electric field (E) and a magnetic field (B). The sheathing and armoured cores, prevent the propagation of electric fields (E) into the environment, however, these materials are permeable to magnetic fields (B), which therefore emanate into the surrounding environment.

10.2.6.45 The magnetic fields generated by AC cables are constantly changing. In turn, the motion of these B fields through the surrounding seawater induces varying electric (Ei) fields. Therefore, both B and induced E (Ei) fields will be generated by inter-platform cables during the operational phase of the OfTI.

10.2.6.46 Due to the static nature of the B field, Ei will not be produced directly by DC cables. It should be noted, however, that in the marine environment organisms and tidal streams will pass through the static B field and this will indirectly result in the production of an Ei field. As a result, both B and E fields will be produced during the operational life of the export cables. Furthermore, magnetic fields generated by DC cables interact with the geomagnetic field. The intensity, shape, and spatial extent of the resulting magnetic field (cable + geomagnetic) is therefore affected by the orientation of the cable system with respect to the earths' north-south magnetic dipole (Normandeau *et al.,* 2011). This makes evaluating resulting EMFs from DC cables complicated.

10.2.6.47 The strength of the magnetic field generated by both AC and DC cables decreases exponentially horizontally and vertically with distance from source (Normandeau *et al.,* 2011). Cables will be buried to a target depth of 1 m. As mentioned in Chapter 7.2 (Fish and Shellfish Ecology), cable burial does not completely mitigate B or Ei fields, although it reduces exposure of electromagnetically sensitive species to the strongest EMFs that exist at the 'skin' of the cable owing to the physical barrier of the substratum (OSPAR, 2008). In instances where adequate burial cannot be achieved, alternative protection such as mattresses or rock placement will be used. Benthic and demersal fish and shellfish species will therefore not be directly exposed to the strongest EMFs as a result of the physical barrier that burial and cable protection constitute

10.2.6.48 Since the strength of the magnetic field decreases with distance from the source, the likely effects of EMFs on fish and shellfish will be influenced by the position of particular species in the water column and water depth.

10.2.6.49 An estimate of the B fields expected to be produced by the cables proposed for the OfTI is given below in Plate 10.2-1 to Plate 10.2-3. B fields are expected to decrease very quickly with distance from the cable being within a few metres horizontally and within 5 metres from the seabed vertically (Plate 10.2-1, Plate 10.2-2 and Plate 10.2-3 below). The E fields induced by these B fields, will as a result, also similarly decrease with distance from the source.

10.2.6.50 The expected B fields generated by DC export cables and inter-platform AC cables are, taking cable burial to 1 m, well below the Earth's magnetic field (assumed to be 50 μT) (Plate 10.2-1 and Plate 10.2-2 below). Where DC cables cannot be buried and are instead protected (0.25 m under rock placement), B fields will be higher at the seabed, however, they are also expected to decrease to values below the Earth's magnetic field within 5 metres from the seabed (Plate 10.2-3 below).

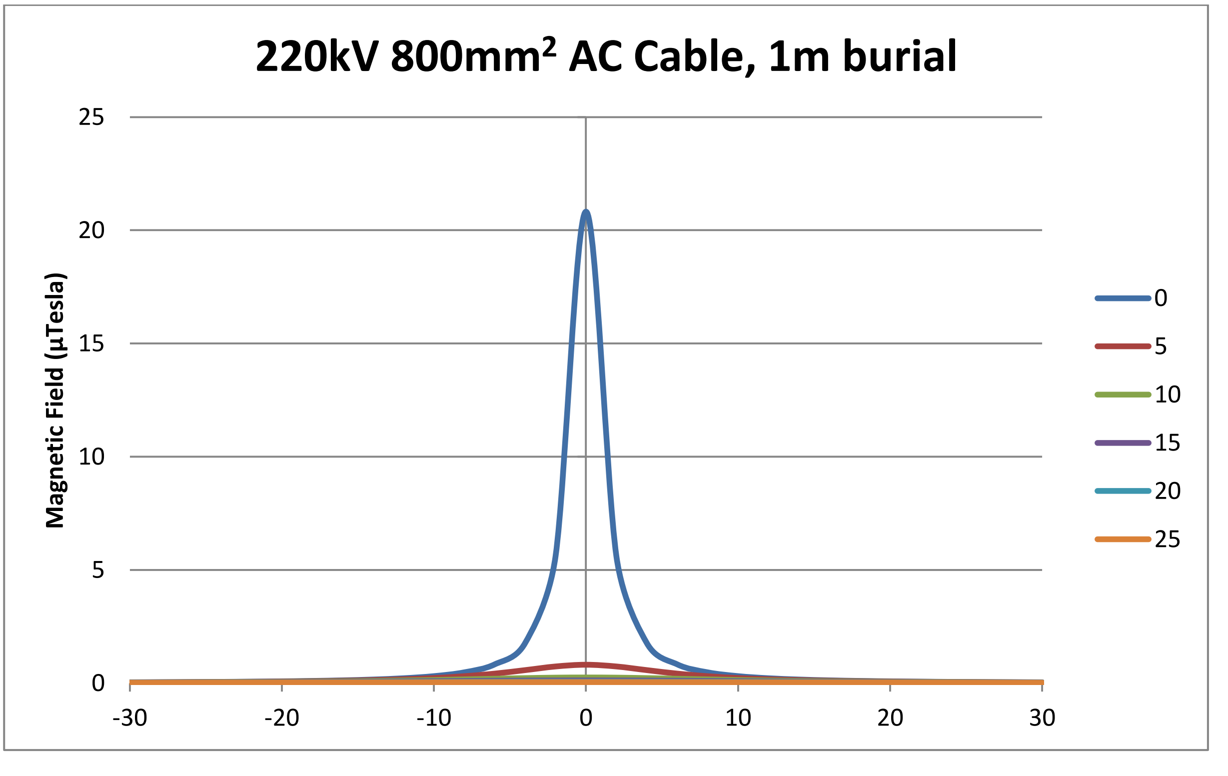

Plate 10.2-1 Magnetic Field Expected from 220 kV 800 mm² AC Inter-Platform Cables assuming 1 m Burial

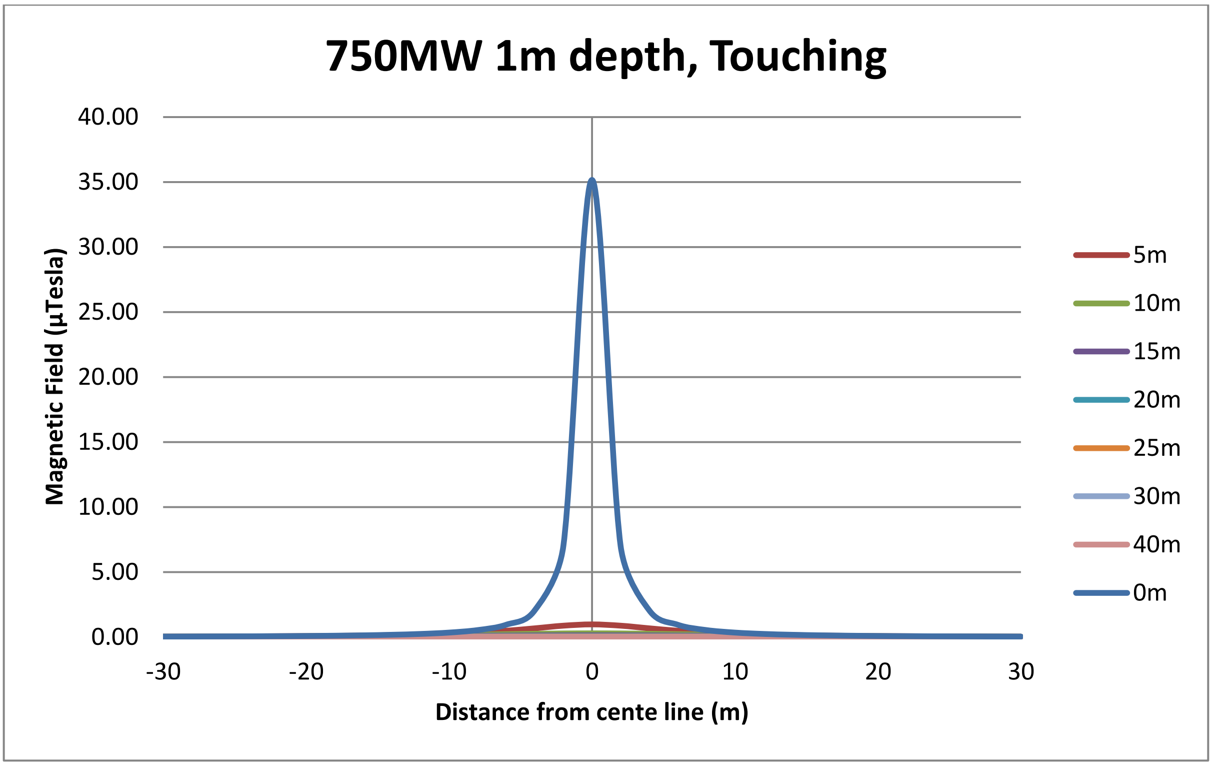

Plate 10.2-2 Magnetic Field Expected from 320 kV DC Export Cables Assuming 1 m Burial and Bundled Cables (touching)

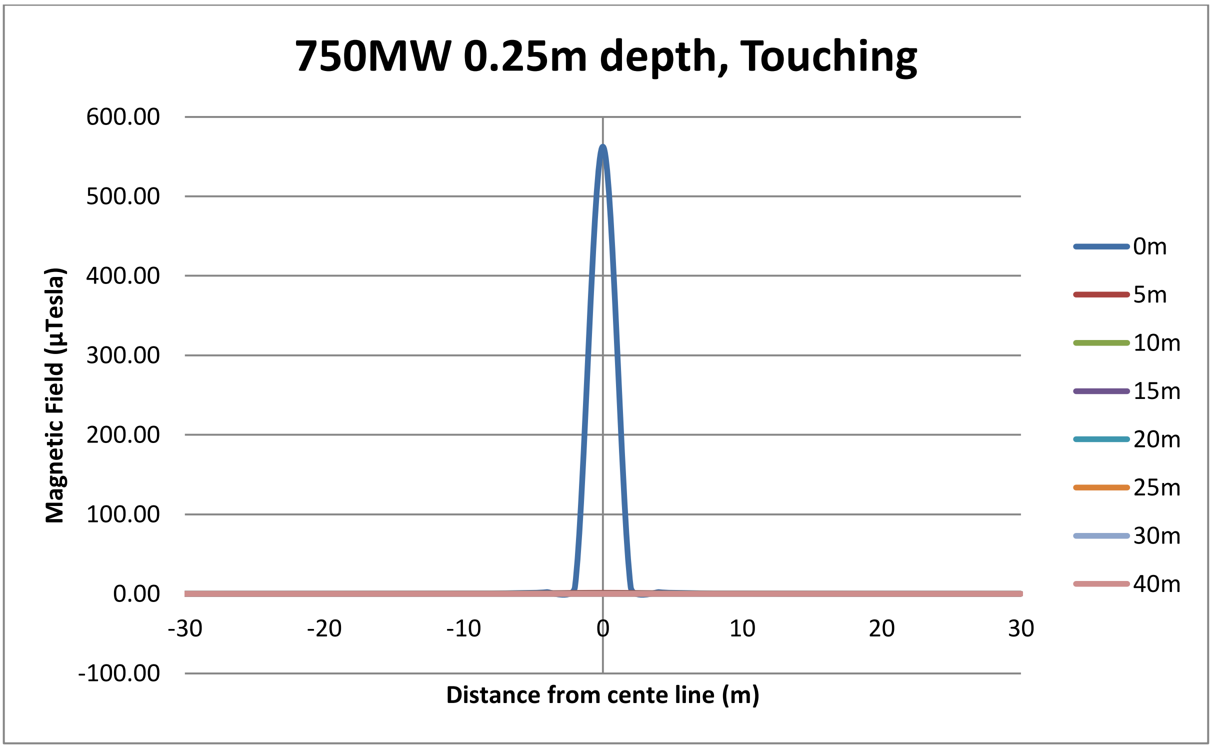

Plate 10.2-3 Magnetic Field Expected from 320 kV DC Export Cables Assuming Cable Protection (0.25 m under rock placement) and Bundled Cables (touching)

10.2.6.51 Taking the above into account it is considered that the area where effects due to EMF emissions may occur will be limited to the OfTI and its immediate vicinity. The magnitude of the effect is therefore considered to be small.

10.2.6.52 A summary of the species for which there is evidence of a response to electric (E) and magnetic (B) fields is given below in Table 10.2-10 and Table 10.2-11 respectively, as provided in Gill *et al.,* (2005). The likely effects of EMFs on these species are assessed separately in the following paragraphs.

Table 10.2-10 Species Found in UK Waters for which there is Evidence of a Response to E Fields

Species / Species Group	Latin Name
Elasmobranchs	
Lesser Spotted Dogfish	*Scyliorhinus canicula*
Blue Shark	*Prionace glauca*
Thornback Ray	*Raja clavata*
Round Ray	*Rajella fyllae*
Agnatha	
River Lamprey	*Lampetra fluviatilis*
Sea Lamprey	*Petromyzon marinus*
Teleosts	
European Eel	*Anguilla anguilla*
Cod	*Gadus morhua*
Plaice	*Pleuronectes platessa*
Atlantic Salmon	*Salmo salar*

Table 10.2-11 Species Found in UK Waters for which there is Evidence of Response to B Fields

Species / Species Group	Latin Name
Elasmobranchs	
All Elasmobranchs possess the ability to detect magnetic fields	
Agnatha	
River Lamprey	*Lampetra fluviatilis*
Sea Lamprey	*Petromyzon marinus*
Teleosts	
European Eel	*Anguilla anguilla*

CHAPTER 10.2

Species / Species Group	Latin Name
Plaice	*Pleuronectes platessa*
Atlantic Salmon	*Salmo salar*
Sea Trout	*Salmo trutta*
Yellowfin Tuna	*Thunnus albacores*
Crustaceans	
Lobster, Crabs, Shrimps and Prawns	*Specific cases non-UK* *Decapoda; Crangon crangon (ICES, 2003)* Isopoda: Idotea baltica (Ugolini and Pezzani,1995) *Amphipoda: Talorchestia martensii (Ugolini, 1993)* and *Talitrus saltator (Ugolini* and *Macchi, 1988)*
Molluscs	
Snails, Bivalves and Squid	*Specific case non-UK* *Nudibranch: Tritonia diomedea (Willows, 1999)*

10.2.6.53 An assessment of the likely effect of EMFs on sensitive receptors expected to be present in the area of OfTI is given below by species / species group. It is recognised that the information available to date in relation to the implications of EMF related effects, particularly in terms of behavioural effects, is limited. This is particularly evident in the case of diadromous migratory species for which limited research has been undertaken to date.

10.2.6.54 A study is currently being carried out by MSS into the potential behavioural effect of EMFs on European eel and Atlantic salmon (smolts). The results of this study will provide further detail in terms of the behavioural reactions that may be triggered by the EMFs associated to offshore wind farm cables, and if any, of their implications in ecological terms. The results of this study will be released towards the end of 2012. An outline of the methodology of MSS research is given in Technical Appendix 4.3 D.

Elasmobranchs

10.2.6.55 Elasmobranchs are the main group of organisms known to be electrosensitive, possessing specialised electroreceptors, Ampullae of Lorenzini. These species naturally detect bioelectric emissions from prey, conspecifics and potential predators / competitors (Gill *et al.*, 2005). In addition, they are known to either detect magnetic fields using electronsensory systems or through a yet-to-be described magnetite receptor system (Normendaeu *et al.*, 2011). Magnetic field detection is thought to be used as a means of orientation in elasmobranchs, however, evidence for magnetic orientation by sharks and rays is limited (Meyer *et al.*, 2005) and there is currently debate on the actual mechanisms used (Johnsen and Lohmann, 2005).

10.2.6.56 Both attraction and repulsion reactions associated with E fields in elasmobranch species have been observed. Gill & Taylor (2001) found limited laboratory based evidence that the lesser spotted dogfish avoids DC E fields at emission intensities similar to those predicted from offshore wind farm AC cables. The same fish were attracted to DC emissions at levels predicted to emanate from their prey. Marra (1989) found evidence of a communication cable being damaged by elasmobranchs (*Carcharhinid* species and *Pseudocarcharias Kamoharai*). Further research on EMFs and elasmobranchs (Gill *et al.,* 2009) found that two benthic species, lesser spotted dogfish and thornback ray, were able to respond to the EMFs of the type and intensity associated with sub-sea cables. The responses found were however not predictable and did not always occur; when there was a response this was species dependent and individual specific, suggesting that some species and their individuals are more likely to respond by moving more or less within the zone of EMF (Gill *et al.,* 2009).

10.2.6.57 Information gathered as part of the monitoring programme undertaken at Burbo Bank suggest that certain elasmobranch species (sharks, skates and rays) do feed inside the wind farm and demonstrated that they are not excluded during periods of low power generation (CEFAS, 2009). Monitoring at Kentish Flats found an increase in thornback rays, smooth hound and other elasmobranchs during post construction surveys in comparison to surveys undertaken prior to construction. It appeared, however, not to be any discernible difference between the data for the wind farm site and reference areas, including population structure changes, and it was concluded that the population increase observed was unlikely to be related to the operation of the wind farm (CEFAS, 2009).

10.2.6.58 As suggested by the information provided above, EMFs produced by the cables may result in behavioural effects on elasmobranchs, by either temporarily affect seasonal movements in migratory species over short distances or behaviourally affecting species inhabiting areas in the vicinity of offshore export cables, which could be attracted, repelled, unaffected by the presence of the cables or affected by means of interfering with feeding activity.

10.2.6.59 As described in Chapter 4.3 (Fish and Shellfish Ecology*)*, the majority of elasmobranch species potentially transiting the area of the offshore export cable route are in most cases more frequently found in the north and west coast of Scotland. The OfTI, however, falls within defined nursery grounds (Ellis *et al.,* 2011) for several of these, namely spurdog, thornback ray and spotted ray.

10.2.6.60 Given the conservation status of most elasmobranch species, the potential for the OfTI to be used as a nursery ground by some of them, and the evidence of their ability to detect EMFs fields, they are considered of medium sensitivity. The effect of EMFs on elasmobranchs is therefore assessed to be negative, of **minor significance** and probable.

River and Sea Lamprey (Agnatha)

10.2.6.61 Lamprey possess specialised ampullary electroreceptors that are sensitive to weak, low-frequency electric fields (Bodznick and Northcutt, 1981, Bodznick and Preston, 1983). Whilst responses to E fields have been reported for these species, information on the use that they make of the electric sense is limited. It is likely, however, that they use it in a similar way as elasmobranches to detect prey, predators or conspecifics and potentially for orientation or navigation (Normadeau *et al.,* 2011). Chung-Davidson *et al.,* (2008) found, based on experiments carried out on sea lamprey, that weak electric fields may play a role in their reproduction and it was suggested that electrical stimuli mediate different behaviours in feeding-stage and spawning-stage sea lampreys.

10.2.6.62 Both river and sea lamprey are species of conservation importance. In addition, sea lamprey is a primary reason for selection of the River Spey SAC. Whilst the behaviour and distribution of both river and sea lamprey in the marine environment is poorly understood, given the central location of the offshore transmission cable route in the Moray Firth context, it is considered that sea lamprey will transit the area where the OfTI is located. Similarly, river lamprey have been reported in rivers in the Moray Firth and, hence, are also likely to be present in the vicinity of the OfTI.

10.2.6.63 EMFs generated by the cables could therefore result in behavioural effects on these species in areas adjacent to the OfTI and potentially cause limited disturbance during migration. Lampreys are considered of medium sensitivity and the effect of EMFs assessed to be negative, of **minor significance** and unlikely.

European Eel

10.2.6.64 European eel are known to possess magnetic material of biogenic origin of a size suitable for magnetoreception (Hanson *et al.,* 1984; Hanson and Walker, 1987; Moore and Riley, 2009) and are thought to use the geomagnetic field for orientation (Karlsson, 1985). In addition, their lateral line has been found to be slightly sensitive to electric current (Vriens and Bretschneider, 1979; Berge, 1979).

10.2.6.65 A number of studies have been carried out in relation to the migration of eels and the potential effect of EMFs derived from offshore wind farm cables. Experiments undertaken at the operational wind farm of Nysted detected barrier effects, however correlation analysis between catch data and data on power production showed no indication that the observed effects were attributable to EMFs. Furthermore, mark and recapture experiments showed that eels did cross the offshore export cable (Hvidt *et al.,* 2005). Similarly research by Westerberg (1999) on HVDC cables and eel migration found some effects associated to the magnetic disturbance were likely to occur on eel although the consequences appeared to be small. In addition, no indication was found that the cable constituted a permanent obstacle to migration, neither for adult eels nor for elvers.

10.2.6.66 Further research where 60 migrating silver eels were tagged with ultrasonic tags and released north of the 130 kV AC cable found swimming speeds were significantly lower around the cable than in areas to the north and south (Westerberg and Lagenfelt, 2008). It was noted that no details on the behaviour during passage over the cable were recorded and possible physiological mechanisms explaining the phenomenon were unknown. Based on the results of Westerberg and Lagenfelt (2008) before publication, Öhman *et al.,* (2007) suggested that even if an effect on migration was demonstrated, the effect was small, and on average the delay caused by the passage was approximately 30 minutes.

10.2.6.67 Based on the above, European eel are considered of medium sensitivity and the effect of EMFs generated by the offshore transmission cables assessed to be negative, of **minor significance** and probable.

10.2.6.68 As previously mentioned, MSS is currently undertaking research into the behavioural effect of EMFs on European eel. It is anticipated that the results of MSSs study will contribute to increase the current knowledge in this field.

Salmon and Sea Trout

10.2.6.69 Research carried out on salmon and sea trout indicates that these species are able to respond to magnetic fields (Formicki *et al.,* 2004; Formicki and Winnicki, 2009; Tanski *et al.,* 2005, Sadowski *et al.,* 2007). Furthermore, Atlantic salmon possess magnetic material in their lateral line, of a size suitable for magnetoreception (Moore *et al.,* 1990), and are able to respond to electric fields (Rommel and McLeave, 1973). However, most of the limited research undertaken on the subject of these species has been focused on physiology based laboratory studies. Research under these conditions has found that EMFs can elicit localised physiological responses on the three species (McCleave and Richardson, 1976; Vriens & Bretshneider, 1979; Hanson *et al.,* 1984; Formicki *et al.,* 1997, 2004). It is, however, recognised that laboratory based responses to a stimulus do not necessarily imply that the same behavioural response will be triggered at sea. Öhman *et al.,* (2007) point out that detection of stimuli may not necessarily lead to behavioural responses in fish and that senses that detect magnetic fields are not the only means of spatial orientation, as vision, hearing and olfaction as well as hydrographic and geoelectric information could all be used for spatial orientation.

10.2.6.70 Since the strength of EMFs decreases exponentially with distance to source the magnitude and intensity of the potential movement and behavioural effects on salmonids as in other pelagic species, would be closely linked to the proximity of the fish to the source of EMF. Gill and Barlett (2010) suggest that if there is going to be any effect on the migration of salmon and sea trout, this will be most likely dependent on the depth of water and the proximity of the rivers to a development site. Given the central location of the offshore export cable route in the context of the Moray Firth area, the uncertainties in relation to migratory patterns not only for fish originating in the Moray Firth rivers but also in other areas of Scotland, and the proximity of the proposed offshore cable landfalls to salmon and sea trout rivers (particularly those relevant to the Deveron and Ugie SFDs) it is likely that salmon and sea trout will transit the area.

10.2.6.71 As suggested above, there is potential for EMFs generated by offshore export cables to result in a behavioural response on migrating salmon and sea trout (both adult and juveniles). It should be noted, however, that for the most they will not be exposed to the strongest EMFs as they normally swim in the upper metres of the water column during migration (Technical Appendix 4.3 B: Salmon and Sea Trout Ecology and Fisheries Technical Report). Furthermore, salmon and sea trout are able to use other cues for navigation in addition to the geomagnetic field and these would more likely be prevalent in shallow areas in the proximity of the rivers. In addition, as shown above in Plate 10.2-1 and Plate 10.2-2, the predicted B fields are expected to decrease significantly within 5 metres from the seabed. Assuming one metre burial the expected B fields produced by the proposed cables will in all cases be well below the Earth's magnetic field. In the particular case of DC cables, where cable burial is not feasible and cables are protected (Plate 10.2-3 above), B fields will be higher at the seabed. These will however rapidly decrease below the Earth's magnetic field within 5 m from the seabed.

10.2.6.72 Based on the above, salmon and sea trout are considered receptors of medium sensitivity and the effect is assessed to be negative, of **minor significance** and probable.

10.2.6.73 It is anticipated that the findings of MSSs current research into the behavioural responses of migratory fish to EMFs will contribute to increase the current knowledge in this field.

Other Fish Species

10.2.6.74 As indicated in Table 10.2-10 and Table 10.2-11 above, further to the species described above, there is some evidence of a response to EMFs for other teleost species such as cod and plaice. The results of monitoring programmes carried out in operational wind farms do not, however, suggest that EMFs have resulted in a detrimental effect on these species. Lindeboom *et al.,* (2011) suggest that the presence of the foundations and scour protection and potential changes in the fisheries related to offshore wind farm development, are expected to have the most effect upon fish species and that noise from the turbines, and EMFs from cabling do not seem to have a major effect on fish and other mobile organisms attracted to the hard bottom substrates for foraging, shelter and protection (Leonhard and Pedersen, 2006). In line with this, research carried out at the Nysted offshore wind farm (Denmark), focused on detecting and assessing possible effects of EMFs on fish during power transmission (Hvidt *et al.,* 2005), found no differences in the fish community composition after the wind farm was operational. Whilst effects on the distribution and migration of four species were observed (European eel, flounder, cod and Baltic herring), it was recognised that the results were likely to be valid on a very local scale and only on the individual level, and that an effect on a population or community level was likely to be very limited. In general terms it is considered that fish species / species groups other than those previously assessed are receptors of low sensitivity and the effect of EMFs is assessed to be negative, of **minor significance** and unlikely.

Shellfish Species

10.2.6.75 Limited research has been carried out to date on the ability of marine invertebrates to detect electromagnetic fields. Whilst there is to date no direct evidence of effects to invertebrates from undersea cable EMFs (Normandeau *et al.,* 2011), the ability to detect magnetic fields has been studied for some species and there is evidence in some of a response to magnetic fields, including molluscs and crustaceans (Table 10.2-11 above). It is, however, generally accepted that effects derived from EMFs on invertebrates are limited to behavioural reactions rather than direct effects.

10.2.6.76 The functional role of the magnetic sense in invertebrates has been hypothesised to be for orientation, navigation and homing using geomagnetic cues (Cain *et al.,* 2005; Lohmann *et al.,* 2007). Concern has therefore been raised on the potential for EMFs to affect some invertebrate species during migration in the Moray Firth particularly edible crab (*Cancer pagurus*) and lobster (*Homarus gammarus*), both species commercially important in the area. As suggested by fisheries data, these species are found along the Caithness coast, in coastal areas off Fraserburgh and, to a lesser extent, in the proximity of the southern section of the offshore cable route. Whilst there is no detailed information on the extent and preferred migration routes used by these species in the Moray Firth, given the location of the OfTI there is potential for these species to encounter the offshore export cables during migration. Research undertaken on the Caribbean spiny lobster (*Panulirus argus*) (Boles and Lohmann, 2003) suggest that this species derive positional information from the earth's magnetic field. Limited research undertaken with the European lobster (*Homarus gammarus*), however, found no neurological response to magnetic field strengths considerably higher than those expected directly over an average buried power cable (Normandeau *et al.,* 2011; Ueno *et al.,* 1986).

10.2.6.77 It should be noted that indirect evidence from monitoring programmes undertaken in operational wind farms do not suggest that the distribution of potentially magnetically sensitive species of crustaceans or molluscs have been affected by the presence of submarine power cables and associated magnetic fields. In this context, however, the lack of shellfish specific EMFs monitoring programmes should be recognised.

10.2.6.78 Based on the above, shellfish species are considered receptors of low sensitivity and the effect is assessed to be negative, of **minor significance** and unlikely.

Changes to Fishing Activity

10.2.6.79 As described in Chapter 7.2 (Fish and Shellfish Ecology) for the three proposed wind farm sites, changes to fishing activity during the operational phase of the OfTI could potentially have an effect on fish and shellfish receptors. Primarily this would be species commercially targeted and / or caught as by-catch, although a wider range of organisms may also be affected due to changes in seabed communities associated to seabed disturbance.

10.2.6.80 A reduction in fishing activity in the OfTI may have some benefits to seabed communities. This could in turn benefit fish and shellfish species, provided the productivity of the area increases. In addition, target and by-catch species would be positively affected through a direct decrease in fishing mortality on a site specific basis. The potential displacement of fishing into other sensitive areas should however be recognised.

10.2.6.81 The degree to which fishing may be reduced in the OfTI area during the operational phase and the areas where fishing effort may be potentially displaced are currently unknown. As noted above, fish and shellfish receptors may benefit as a result of a reduction in fishing activity, however, for a net benefit to occur fishing activity should not be displaced to equally or more productive / sensitive areas. Whilst the potential for changes to fishing activity to have an effect on fish and shellfish receptors is recognised, given the numerous uncertainties to this respect (i.e. actual degree of fishing reduction and areas where fishing effort may be displaced) it is not possible for a meaningful assessment to be made. In the commercial fisheries assessment, however, effects on commercial fisheries above minor were not identified during the operational phase of the OfTI. Taking this into account it is considered that changes to fishing activity have no potential to result in a significant effect (above minor) on fish and shellfish species.

Decommissioning

10.2.6.82 As previously mentioned, in the absence of detailed decommissioning schedules and methodologies it is assumed that the likely effects during this phase will at worst, be as those assessed for the construction phase. It should be noted, however, that piling is not envisaged to be required during decommissioning and hence, effects associated to noise during this phase will likely be significantly smaller than those assessed for the construction phase above.

10.2.7 Proposed Monitoring and Mitigation

Construction and Decommissioning

10.2.7.1 Likely significant effects (above minor) have not been identified on fish and shellfish ecology as a result of the construction / decommissioning phase of the OfTI. However, as indicated in Chapter 7.2 (Fish and Shellfish Ecology) for the three proposed wind farm sites, soft start piling will also be used for installation of OSP foundations with the aim that mobile species are not exposed to the highest noise levels.

Operation

10.2.7.2 Similarly, likely significant effects (above minor) have not been identified on fish and shellfish receptors for the operational phase of the OfTI. As mentioned in the assessment of EMFs, cable burial will reduce exposure of electromagnetically sensitive species to the strongest EMFs that exist at the "skin" of the cable owing to the physical barrier of the substratum (OSPAR, 2008). Similarly, where burial is not feasible, cable protection will ensure that fish and shellfish receptors are not in direct contact with the cable and hence with the strongest EMFs.

10.2.8 Residual Effects

10.2.8.1 The residual effects are as described in the impact assessment paragraphs above (paragraphs 10.2.6.8 and 10.2.6.82) for the construction / decommissioning and operational phases of the OfTI.

10.2.8.2 A summary of the impact assessment is given in Table 10.2-1 above by effect and receptor.

10.2.9 Habitats Regulations Appraisal

10.2.9.1 As indicated in Chapter 7.2 (Fish and Shellfish Ecology), for the three proposed wind farm sites, as part of the Habitat Regulations, it is required that the likely effect of the OfTI on Atlantic salmon and sea lamprey SAC populations be assessed. These species are qualifying features and primary reason for selection of a number of SACs in the Moray Firth. In addition to these species, freshwater pearl mussel is also a primary reason for selection of a number of SACs. Given the location of the OfTI relative to the habitat of the species (restricted to freshwater) it is not considered that freshwater pearl mussel SAC populations will be directly effected through construction / decommissioning or operation of the OfTI. It is however recognised that SAC populations of this species may be indirectly effected if significant effects on their host species (salmon and sea trout in particular) occur.

10.2.9.2 As specified in the JNCC and SNH scoping response (28/10/2010), the SACs needing assessment in relation to fish and shellfish resources are as follows:

- Berriedale & Langwell Waters SAC;
- River Evelix SAC;
- River Moriston SAC;
- River Oykel SAC;

- River Spey SAC; and
- River Thurso SAC.

10.2.9.3 The qualifying status of the SAC species and the conservation objectives of each relevant SAC are given in Table 10.2-12 below.

Table 10.2-12 Qualifying Status of SAC Species and SAC Conservation Objectives (SNH, 2012)

SAC	Qualifying Species	Conservation Objectives
Berriedale & Langwell Waters	**Atlantic salmon**: Primary reason for SAC selection	• To avoid deterioration of the habitats of Atlantic salmon or significant disturbance to Atlantic salmon, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and • To ensure for the qualifying species that the following are maintained in the long term: 1. Population of the species, including range of genetic types for salmon, as a viable component of the site; 2. Distribution of the species within the site; 3. Distribution and extent of habitats supporting the species; 4. Structure, function and supporting processes of habitats supporting the species; and 5. No significant disturbance of the species.
River Evelix	**Freshwater pearl mussel**: Primary reason for SAC selection	• To avoid deterioration of the habitats of freshwater pearl mussels or significant disturbance to freshwater pearl mussels, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and • To ensure for the qualifying species that the following are maintained in the long term: 1. Population of the species as a viable component of the site; 2. Distribution of the species within the site; 3. Distribution and extent of habitats supporting the species; 4. Structure, function and supporting processes of habitats supporting the species; 5. No significant disturbance of the species; 6. Distribution and viability of the species' host species; and 7. Structure, function and supporting processes of habitats supporting the species' host species.

SAC	Qualifying Species	Conservation Objectives
River Moriston	**Freshwater pearl mussel**: Primary reason for SAC selection **Atlantic salmon**: Qualifying feature for SAC selection	• To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and • To ensure for the qualifying species that the following are maintained in the long term: 1. Population of the species, including range of genetic types for salmon, as a viable component of the site; 2. Distribution of the species within the site; 3. Distribution and extent of habitats supporting the species; 4. Structure, function and supporting processes of habitats supporting the species; 5. No significant disturbance of the species; 6. Distribution and viability of freshwater pearl mussel host species; and 7. Structure, function and supporting processes of habitats supporting fresh water pearl mussel host species.
River Oykel	**Freshwater pearl mussel**: Primary reason for SAC selection **Atlantic salmon**: Qualifying feature for SAC selection	Idem as above
River Spey	**Freshwater pearl mussel**; Primary reason for SAC selection **Atlantic salmon**: Primary reason for SAC selection **Sea lamprey**: Primary reason for SAC selection **Otter**: Primary reason for SAC selection	Idem as above
River Thurso	**Atlantic salmon**: Primary reason for SAC selection	Idem as for the Berriedale & Langwell Waters SAC

10.2.9.4 For the SACs detailed above, the effects on the relevant fish and shellfish qualifying species have been assessed based on the following criteria:

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

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

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

10.2.9.6 It should be noted that, as indicated by the JNCC / SNH in their scoping response, in the case of salmon, it is not possible to conclusively identify from / to which SAC watercourses any particular individuals (post smolts or adults) are coming or going. The assumption that all individuals are SAC salmon should therefore be made. As a result the effects identified for salmon are considered to be applicable to any of the relevant SACs. In the case of freshwater pearl mussel, as any effect on the SAC populations could only be a result of their host species being adversely affected (salmon and sea trout) the same limitation applies. In order to assess likely effects on freshwater pearl mussel SAC populations it has therefore been assumed that the effects identified for Atlantic salmon apply to the freshwater pearl mussel's host species in the relevant SACs.

10.2.9.7 A summary assessment of the potential effect of the OfTI on the relevant Atlantic salmon, freshwater pearl mussel and sea lamprey SAC populations is given in Table 10.2-13 below. This takes account of the impact assessment for these species given above and summarised in Table 10.2-1 above.

Table 10.2-13 Assessment of Effects on Qualifying Species in the Relevant SACs per Criterion

Species	Criterion	Assessment
Atlantic Salmon	1	The salmon SACs are located at a considerable distance from the OfTI. The habitat of the SACs will not be subject to any direct deterioration as a result of the construction / decommissioning or operation of the OfTI. Deterioration of the marine habitats of Atlantic salmon could however occur: Chapter 10.1 predicts not significant to minor effects on benthic habitats associated with the OfTI. This chapter predicts no potential for effects above minor associated to changes to fishing activity to occur.
	2	This chapter predicts that disturbance through increased SSC, sediment re-deposition, noise during construction, and EMFs will result in minor effects.
	3	Changes to the distribution of the species are not expected in the site as no significant disturbance to the species or its habitat has been identified (See assessment against criteria 1 and 2 for Atlantic salmon above).
	4	As assessed for criteria 1 for Atlantic salmon above.
	5	As assessed in criteria 1, 2, 3 and 4 for salmon above.

Species	Criterion	Assessment
Freshwater Pearl Mussel	1	The freshwater pearl mussel SACs are located at a considerable distance from the OfTI. The habitat of the SACs will not be subject to direct deterioration as a result of the construction / decommissioning or operation of OfTI.
	2	Given the distribution of freshwater pearl mussel (restricted to the freshwater habitat) direct disturbance to the species has no potential to occur.
	3	Given the distribution of the species (restricted to the freshwater habitat) direct changes to the distribution of the species in any of the SACs associated to OfTI has not potential to occur.
	4	As assessed for criteria 1 for freshwater pearl mussel above.
	6	As assessed for criteria 1, 2, 3, 4 and 5 for Atlantic salmon above.
Sea Lamprey	1	The Spey SAC is located at a considerable distance from the OfTI. The habitat of the SAC will not be subject to any direct deterioration as a result of the construction / decommissioning or operational phase of the OfTI. Deterioration of the marine habitats of sea lamprey could however occur: Chapter 10.1 predicts not significant to minor effects on benthic habitats. This chapter predicts no potential for effects above minor associated to changes to fishing activity to occur.
	2	This chapter predicts that disturbance through increased SSC, sediment re-deposition, noise during construction, and EMFs will result in minor effects.
	3	Changes to the distribution of the species are not expected in the site as no significant disturbance to the species or its habitats has been identified (See assessment against criteria 1 and 2 for sea lamprey above).
	4	As assessed for criteria 1 for sea lamprey above.

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10.3 Marine Mammals

10.3.1 Summary of Effects and Mitigation

10.3.1.1 Effects on marine mammal receptors have been assessed during the construction, operation and decommissioning phases of the offshore transmission infrastructure (OfTI).

10.3.1.2 Significant medium term effects on marine mammal receptors are predicted from piling noise associated with Offshore Substation Platform (OSP) foundations, but no long term population level effects are assessed to be likely. No other significant effects are predicted.

10.3.1.3 The assessment process has used noise propagation and impact analysis to quantify the risks of physical injury and displacement due to piling noise and used population analysis to assess the potential effects at the population level for harbour seals. The assessment incorporates a series of conservative assumptions about the potential impacts of noise on marine mammals. If these assumptions are confirmed, the assessment represents likely significant effects.

Summary of Effects

10.3.1.4 The effects on marine mammals that were assessed include:

- Temporary displacement caused by increased noise levels during construction, in particular during piling activity;
- Permanent hearing damage resulting from increased noise levels, in particular during piling activity;
- Risk of collision with vessels and ducted propellers;
- Long term avoidance resulting from operation and maintenance activity;
- Secondary effects associated with changes to prey availability;
- Risk of stranding associated with electromagnetic field (EMF) emissions; and
- Impacts of non-toxic and toxic contamination.

Proposed Mitigation Measures and Residual Effects

10.3.1.5 Primary mitigation during construction will include adherence to the Joint Nature Conservation Committee (JNCC) protocol for minimising the risk of injury to marine mammals from piling noise. Currently, this protocol involves the use of marine mammal observers and 'soft start' piling procedures. All effects assessed within this assume these, or future, best practice guidelines are implemented. In addition, to minimise the risk of collision with vessels involved in the construction, operation and decommissioning of the OfTI infrastructure, all vessels will operate within designated routes, ensuring predictable vessel movement. This has also been assumed for the purposes of the assessments in this chapter.

10.3.1.6 MORL is working with The Crown Estate (TCE) and other offshore wind developers to investigate and develop further best practice measures to reduce either the level of piling noise at the source or noise propagation. Table 10.3-1 below summarises the predicted residual effects on marine mammal receptors.

Table 10.3-1 Primary Impact Assessment Summary

Effect	Receptor	Pre-Mitigation Effect	Mitigation	Post-Mitigation Effect
Construction				
Hearing Damage **Disturbance / Displacement** **Collision Risk** **Reduction in Prey Sources** **Reduction in Foraging Ability**	Harbour seal	*	None additional to JNCC protocol for minimising risks to marine mammals. Designated vessel routes	No significant long term impact
	Grey seal	*		No significant long term impact
	Harbour porpoise	*		No significant long term impact
	Bottlenose dolphin	*		No significant long term impact
	Minke whale	*		No significant long term impact
Operation				
Collision risk **Stranding due to Electromagnetic Fields** **Long Term Changes in Prey Availability** **Toxic Contamination**	Harbour seal	Not significant	Designated vessel routes	Not significant
	Grey seal	Not significant		Not significant
	Harbour porpoise	Not significant		Not significant
	Bottlenose dolphin	Not significant		Not significant
	Minke whale	Not significant		Not significant
Decommissioning				
Hearing Damage **Disturbance / Displacement** **Collision Risk** **Reduction in Prey Sources** **Reduction in Foraging Ability**	Harbour seal	*	None additional to The equivalent of the JNCC protocol for use during piling activities. Designated vessel routes	Not significant
	Grey seal	*		Not significant
	Harbour porpoise	*		Not significant
	Bottlenose dolphin	*		Not significant
	Minke whale	*		Not significant

* The modelling on which the assessment is based has been undertaken including mitigation measures (JNCC protocol and designated vessel routes) and therefore pre-mitigation effects are not separately identified.

10.3.2 Introduction

10.3.2.1 The aim of this assessment is to describe the potential significant effects that specific activities associated with the installation of transmission infrastructure may have on marine mammal populations within the Moray Firth. It concentrates on the connection between the proposed offshore wind farm sites and the proposed landfall site for the transmission cables at Fraserburgh beach, including the offshore OSPs.

10.3.2.2 A full review of potential significant effects on marine mammals and the methodologies used in this assessment can be found in the following technical appendices:

- Technical Appendix 7.3 A (Marine Mammals: Environmental Impact Assessment);
- Technical Appendix 7.3 B (Framework for assessing the impacts of pile-driving noise from offshore wind farm construction on Moray Firth harbour seal populations);
- Technical Appendix 7.3 C (SAFESIMM impact assessment for seals and cetaceans);
- Technical Appendix 7.3 D (A comparison of behavioural responses by harbour porpoise and bottlenose dolphins to noise);
- Technical Appendix 7.3 E (Identification of appropriate noise exposure criteria for assessing auditory injury for Pinnipeds using offshore wind farm sites);
- Technical Appendix 7.3 F (Noise propagation and SAFESIMM model outputs);
- Technical Appendix 7.3 G (Habitat Regulations Appraisal: Marine Mammals – Two SAC's listing marine mammals as qualifying features can be found within the Moray Firth. For the purpose of Appropriate Assessment, an appraisal under the Habitats Regulation is presented within this appendix); and
- Technical Appendix 7.3 H (EPS Assessment: Supplementary Information – All cetaceans present within the Moray Firth are European Protected Species (EPS). MORL recognises that an EPS license may be required during the construction phase of the developments. A preliminary assessment is presented, which will be revised once construction parameters have been finalised.

10.3.2.3 Additional supporting information on underwater noise modelling activities can be found in Chapter 3.6 and Technical Appendix 3.6 A (Underwater Noise).

10.3.2.4 The marine mammal assessment interacts with assessments for the following receptors and where relevant, linkages have been made:

- Chapters 4.3 and 10.2 (Fish and Shellfish Ecology);
- Chapters 4.2 and 10.1 (Benthic Ecology); and
- Chapters 5.2 and 11.2 (Shipping and Navigation).

10.3.2.5 The species assessed in this chapter are:

- Grey seal;
- Harbour seal;
- Harbour porpoise;
- Bottlenose dolphin; and
- Minke whale.

10.3.2.6 Key effects on marine mammals assessed are summarised in Table 10.3-2 below.

Table 10.3-2 Summary of the Key Risks for Marine Mammals Addressed in this Assessment, and their Associated Activities

Risk	Associated Activity	Effect
Permanent Hearing Damage	Increased noise levels, in particular from piling.	Reduction in ability to find prey, avoid predators and socially interact.
Temporary Disturbance / Displacement	Increased vessel movements; Elevated construction noise;	Restricted access to food sources, breeding grounds or migration routes leading to reduced fitness.
Collision	Vessel movements, including those with ducted propellers.	Physical injury and reduced viability.
Long term Avoidance	Foundation footprints, increased Operation and Maintenance related vessel movement.	Habitat disturbance leading to reduction in prey source; Restricted access to food sources, breeding grounds or migration routes leading to reduced fitness.
Reduction in Prey	Secondary effect resulting from increased noise and / or vibration (including electromagnetic fields), habitat disturbance or the physical presence of the turbines.	Reduction in fitness.
Stranding	Electromagnetic fields from operational cables.	Disruption of navigation mechanism, possibly resulting in stranding (and death).
Toxic / Non-Toxic Contamination	General construction activities leading to increased sediment; sacrificial anodes and antifouling paints.	Habitat disturbance leading to reduction in foraging ability and prey resources leading to reduced fitness. Contamination of food chain leading to reduced fitness.

10.3.3 Rochdale Envelope Parameters Considered in the Assessment

10.3.3.1 The parameters from the Rochdale Envelope used for this assessment are described in Table 10.3-3 below. A full review of potential significant effects on marine mammals and the methodologies used in this assessment can be found in Technical Appendix 7.3 A.

Table 10.3-3 Rochdale Envelope Parameters Relevant to the Marine Mammal Impact Assessment for the OfTI

Potential Effect	Rochdale Envelope Scenario Assessed
Construction & Decommissioning	
Permanent Threshold Shift (PTS – hearing damage)	Greatest potential cause of auditory damage will be from piling noise during construction. Worst case (as modelled) is 128 x 3 m piles from eight substations (16 piles per OSP for jack-up foundation type).
Disturbance / Displacement	Greatest potential cause of disturbance / displacement will be increased noise, in particular from piling, created during construction. Worst case (as modelled) is 128 x 3 m piles from eight substations (16 piles per OSP for jack-up foundation type).

Potential Effect	Rochdale Envelope Scenario Assessed
Collision Risk	An assessment will be undertaken with respect to anticipated increased vessel traffic and around the offshore transmission works, taking account of the presence standard vessel routes which will help to localise effects. A separate review of ducted propeller related injury from vessel movement near haul-out sites will be undertaken as part of the impact assessment as described below. Cognisance will be taken of consultation responses by Marine Scotland to the MORL met mast application. The Rochdale Envelope scenario assessed assumes the use of vessels with ducted propellers.
Reduction in Prey Sources	Secondary impacts as a result of changes in prey distribution or density. Worst case likely to be gravity based foundations (maximum eight, seabed take of 65 m x 65 m) and associated loss of habitat and impacts of piling on prey availability (128 x 3 m piles for eight substations). Refer to Chapters 10.1 and 10.2 for details.
Reduction in Foraging Ability	Secondary effect due to increased suspended sediment associated with construction activities i.e. piling or trenching. Refer to Chapter 9.2 for details.
Operation	
Collision Risk from Maintenance Vessels	Additional traffic movements within the Moray Firth addressed with regards to increased background noise. Use of DP vessels assessed against potential effects on seals. The Rochdale Envelope scenario assessed assumes the use of vessels with ducted propellers.
Electromagnetic Fields	90 km of 220 kV HVAC cable for inter-platform cables; and 105 km of HCDV 320 kV export cable.
Long term Changes in Prey Availability	Secondary impacts due to changes in prey distribution or density as a result of loss or gains in habitat (refer to Chapter 10.1: Benthic Ecology and 10.2: Fish & Shellfish for details) or responses to operational noise.
Toxic Contamination	Sacrificial anodes & anti-fouling coatings

10.3.4 EIA Methodology

10.3.4.1 The assessment process used for marine mammals is based on methodologies recommended by the Institute of Ecology and Environmental Management (IEEM, 2010). Some additional definitions are provided by Wihelmsson *et al.*, (2010) in a review of potential effects of offshore wind developments. For full details of methodology used in this assessment, including details of modelling undertaken to assess the impacts of piling and the conservatism in the assessment, refer to Chapter 7.3 (Marine Mammals).

10.3.4.2 Key components of the Project design relevant for this impact assessment on marine mammals are:

- Duration and timing of construction activities;
- Associated vessels;
- Number of OSPs and type of foundation structures; and
- Extent of export cable route to Fraserburgh beach.

10.3.4.3 A magnitude scale (see Table 10.3-4 below) was determined through consultation with scientific experts, and guided by comparison of predicted changes in population size against likely baseline trends. This also considered whether predicted change could be detected in these marine systems. A high magnitude change in distribution or population size should be measureable within the Moray Firth given the robust baseline information for this area. Medium or low magnitude change may remain undetected due to high levels of background variation and sampling variability. The duration of effect described has been agreed through consultation with Marine Scotland, SNH and JNCC. Details of the conservatism and certainty in predictions can be found in Table 7.3-11 of Chapter 7.3 (Marine Mammals).

10.3.4.4 Given the level of legal protection afforded all of the marine mammals likely to be encountered within the Moray Firth, all species of marine mammal are considered to be of high sensitivity in this assessment.

Table 10.3-4 Criteria Used for Predicting Significance from Magnitude of Effect and Duration

	Duration		
Magnitude	**Short Term (days)**	**Medium Term (construction years)**	**Long Term (25 yrs)**
High (> 20 %) of Population	Major significance	Major significance	Major significance
Medium (10 % to 20 %)	Minor significance	Medium significance	Medium significance
Low (< 10 %)	Negligible significance	Low significance	Low significance

10.3.5 Habitats Regulations Appraisal Methods

10.3.5.1 As part of the Habitat Regulations, the likely significant effects of the Project on SACs will be assessed by the competent authority through consideration of each SACs conservation objective (see Technical Appendix 7.3 A). Conclusions from this assessment are presented in this chapter. Full details of this appraisal can be found in Technical Appendix 7.3 G (HRA).

10.3.6 Impact Assessment

10.3.6.1 All marine mammal species that may be encountered in the vicinity of the proposed works are considered target species due to the fact that all cetaceans are listed on Annex IV of the Habitats Directive and the bottlenose dolphin, harbour porpoise, harbour seal and grey seal are listed on Annex II. This assessment will concentrate on the key species highlighted in Chapter 4.4 (Marine Mammals) (and associated Technical Appendix 4.4 A) and assume that conclusions can be applied to all marine mammal species. The behaviour and sensitivity to noise of harbour porpoise has been used as a proxy for the marine mammals listed below, and this proxy could be extended to other, more infrequent visitors to the Moray Firth. The key species to be discussed are:

- Grey seal;
- Harbour seal;

- Harbour porpoise;
- Bottlenose dolphin; and
- Minke whale.

Construction

10.3.6.2 The primary effects during the construction phase of the OfTI are likely to be:

- Hearing damage and temporary avoidance or displacement due to increased anthropogenic noise, in particular piling; and
- Collision risk from installation vessels.

10.3.6.3 There is also the potential for a secondary impact effect of:

- Reduction in prey due to noise from construction activities;
- Reduced foraging capability and prey availability due to increased suspended sediment.

Increased Anthropogenic Noise (Non-Piling Activities)

10.3.6.4 The greatest effect on marine mammals during installation of the OSPs and export cable are considered to be from increased levels of anthropogenic noise (see Chapter 7.3: Marine Mammals and Section 4.1.2 of associated Technical Appendix 7.3 A for more details). Potential sources of anthropogenic noise involved in the installation of the OfTI are:

- Piling of OSP foundations;
- Vessel noise;
- Suction dredging;
- Cable laying;
- Rock placing; and
- Trenching.

10.3.6.5 Simple Propagation Estimator and Ranking (SPEAR) modelling was conducted by Subacoustech Environmental Ltd to demonstrate the level of noise produced by different construction activities. The SPEAR model was run using a value of 90 dB_{ht}, a level which is predicted to cause strong avoidance in virtually all individuals, and 75 dB_{ht}, a level predicted to cause reactions by a lower proportion of individuals (Nedwell *et al*., 2007) for four species; harbour porpoises, bottlenose dolphins, harbour seals and minke whales. Background noise levels experienced by marine mammals within the Moray Firth are in the range of 30-55 dB_{ht}, depending on species and sea state. Underwater measurements of background noise taken within the Moray Firth suggest that levels of background noise within the Moray Firth are typical for UK waters (see Section 7 of Technical Appendix 3.6: Underwater Noise Technical Report for details).

10.3.6.6 The results showed that the primary source of noise during construction (and therefore the greatest effect on marine mammals) will be from piling for the OSPs. This is illustrated below in Plate 10.3-1, and explored in detail in Technical Appendix 7.3 A. Plate 10.3-1 below illustrates the range at which noise from different OfTI construction related activities reaches 90 dB_{ht} for harbour porpoises from the noise source. It should be noted that the Y-axis of these graphs are plotted using a log scale, illustrating that the impact range of piling associated noise is several orders of magnitude larger than other construction related activities.

10.3.6.7 As shown in Table 10.3-5 below, SPEAR modelling for other marine mammal species shows very similar impact ranges from the modelled construction activities to those of harbour porpoises (see Section 4.1.2 of Technical Appendix 7.3 A full details of SPEAR modelling undertaken).

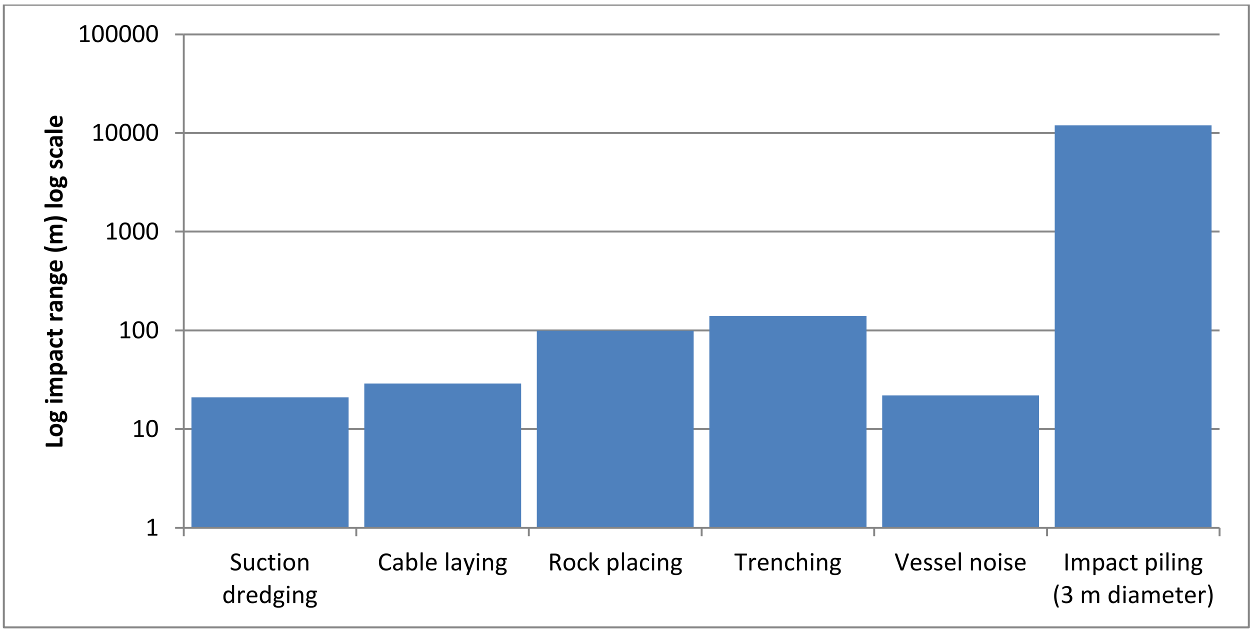

Plate 10.3-1 Extent of Effect of Various Construction Activities (90 dB_{ht}) on Harbour Porpoise

Table 10.3-5 Numerical Output from SPEAR Model Predicting and Comparing the Modelled Noise Effects of Different Construction Activities on Marine Mammals

Construction Activity	Impact Range (m)							
	Minke Whale		Bottlenose Dolphin		Harbour Porpoise		Harbour Seal	
	90 dB_{ht}	75 dB_{ht}	90 dB_{ht}	75 dB_{ht}	90 dB_{ht}	75 dB_{ht}	90 dB_{ht}	75 dB_{ht}
Suction Dredging	16	180	21	72	21	200	2	26
Cable Laying	18	180	9	75	29	220	2	29
Rock Placing	70	390	31	170	99	550	17	99
Trenching	59	390	81	350	140	640	12	87
Vessel Noise	6	130	12	110	22	200	< 1	11
Impact Piling (3 m diameter)	12,000	24,000	7,700	15,000	12,000	21,000	5,400	14,000

10.3.6.8 The results of this study showed that the primary source of noise during construction (and therefore exerting the greatest potential effect on marine mammals) will be from piling. Piling noise is discussed in greater detail below, and while occurring, it is considered that the effects of piling are of more significance than those effects related to other construction activities.

10.3.6.9 When piling is not occurring, marine mammals may become sensitive to other sources of anthropogenic noise. Such noise sources include:

- Vessel noise;
- Suction dredging;
- Cable laying;
- Rock placing; and
- Trenching.

10.3.6.10 Based on the SPEAR model outputs above, it was concluded that the effects of these additional construction activities would be minimal due to their local influence and the fact that more distant effects would be masked by the noise produced from piling (of both the OSP and generating station foundations). During periods when no piling is occurring, strong reactions to the activities modelled are unlikely to occur at distances of greater than 140 m (Table 10.3-5 above) from the source and so any impacts effects would be of low magnitude, of medium duration, temporary in nature and of **minor significance**.

Piling Noise Related Effects

10.3.6.11 For the offshore connection, the proposed infrastructure will include up to six AC collector OSPs and two direct current AC / DC convertor OSPs. A number of foundation types are currently under consideration including jackets and jack ups (platform with jack-up legs) secured with pin piles, which would require piling (see Chapter 2.2: Project Description for more details). The maximum number of piling events envisaged for these OSPs are provided in Table 10.3-3 above.

10.3.6.12 In order to assess the effect of piling these foundations will have upon the marine mammals of the Moray Firth, the assessment framework detailed in 7.3.6 of Chapter 7.3 (Marine Mammals) and Section 4.2.2.1 of Technical Appendix 7.3 A was repeated assuming the proposed maximum pile diameter of 3 m occurring at Location 2 (see Figure 01 in Technical Appendix 7.3 F). This location represents the closest location to the cable route corridor, and thus the most representative for any direct current convertor OSPs. While it is recognised that OSPs have the potential to be located further to the west, and so closer to the seal haul outs, this piling will be undertaken within the same periods as that of the wind turbine foundations and so should be viewed in this context. Location 2 represents a worst case scenario with regards to proximity to the bottlenose dolphin commuting corridor along the southern Moray Firth coast.

10.3.6.13 As discussed above, piling for OSP foundations will be in the same timescales as the generating stations. The population assessments presented for the OfTI assumes that the OSP construction activity would commence in 2015, before the offshore generating station construction is scheduled to begin, and be spread over the remaining construction period of the wind farms until 2020. This is worst case, as piling activity within 2015 would not coincide with that of construction activity for the wind farm infrastructure and would therefore represent an extension to the duration of construction related disturbance to marine mammals. Depending upon vessel availability, the piling for the OSPs may occur solely within the 2016 to 2020 construction phase and so not extend this duration of construction related disturbance.

10.3.6.14 As the number of piles associated to the OSP construction in each year would be significantly less than for the offshore generating station, the population modelling has assumed that piling would be undertaken for one month each year for six years and that the consequences of displacement are modelled as a 10 % reduction in reproduction. It is recognised that MORL may not build out the OSPs evenly throughout the build programme, but this scenario represents worst case in terms of the duration of the piling activity associated to foundation installation. The piling associated to the installation of each OSP is envisaged to require a number of days (up to a week), thus modelling the disturbance for one month allows for the construction of more than one OSP per year. Increase in piling activity in one year will be balanced by a reduction in piling activity in a preceding or following year. Outputs from the noise modelling can be found in Technical Appendix 7.3 F and the predicted number of individuals affected in Table 10.3-6 below. Results from the harbour seal population modelling can be found in Plate 10.3-2 below. Due to the low level of effect predicted upon the bottlenose dolphins, no population modelling was undertaken for this species for the piling of the OfTI foundations (see below for more detailed rationale).

Table 10.3-6 Predicted Number of Individuals and Proportion of the Population Affected by Piling Noise Associated with OSPs in Year One of Construction (2015). It has been Assumed that these Figures Equate to the Additional Yearly Impacts from Subsequent Piling Years.

	Number	%
Harbour Seal		
PTS: 186 dB	125	10.6
Behavioural Displacement: High	650	54.9
Behavioural Displacement: Best Fit	459	38.8
Behavioural Displacement: Low	36	3
Grey Seal		
PTS: 186 dB	203	6.2
Behavioural Displacement: High	1,250	34.7
Behavioural Displacement: Best Fit	823	22.9
Behavioural Displacement: Low	50	1.4
Harbour Porpoise		
PTS: 198 dB	6.2	0.1
Behavioural Displacement: High	4,040	66.1
Behavioural Displacement: Best Fit	2,930	47.9
Behavioural Displacement: Low	241	3.9

	Number	%
Bottlenose Dolphin		
PTS: 198 dB	0.05	< 0.1
Behavioural Displacement: High	28	14.3
Behavioural Displacement: Best Fit	16	8.1
Behavioural Displacement: Low	0	0.2
Minke Whale		
PTS: 198 dB	0	0.2
Behavioural Displacement: High	28.1	1.9
Behavioural Displacement: Best Fit	208	14.2
Behavioural Displacement: Low	173	11.83

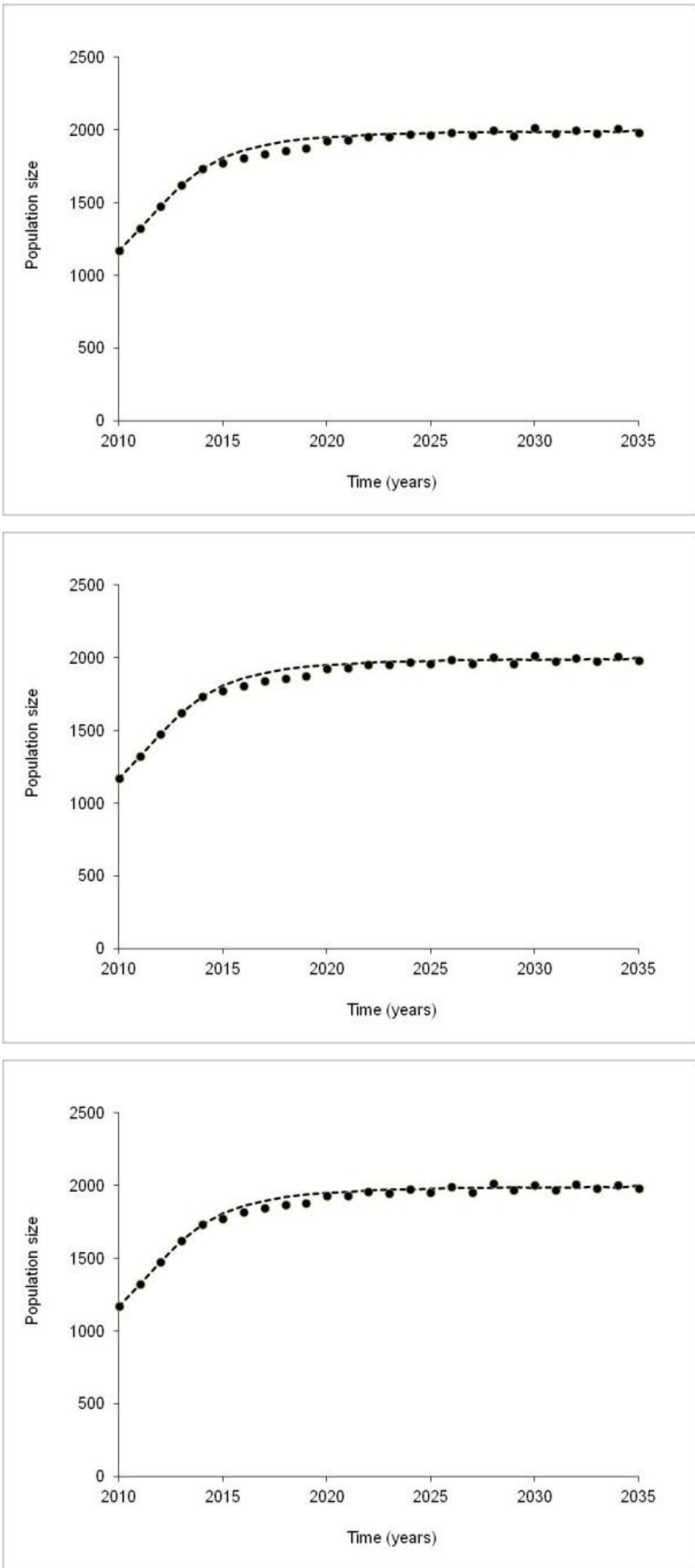

Plate 10.3-2 Population Modelling for the Harbour Seal Population in the Moray Firth. Data Based on 186 dB SAFESIMM Model Outputs. The Dashed Line Presents Predicted Baseline Population Growth. From Top to Bottom: Upper, Best Fit and Lower Prediction for Displacement as a Consequence of Piling Noise.

10.3.6.15 The modelling above indicates that while there will clearly be significant displacement effects to the harbour seal during the piling for the OSPs (high magnitude, low to medium duration each year), these effects at a population scale do not extend to long term effects of on population size. The model predicts that the population will recover to projected baseline size once piling has ceased. Thus the overall effect is considered to be of low magnitude (predicted population size within 10 % of that predicted as a baseline if population parameters to not change within the Moray Firth) and so **minor significance**.

10.3.6.16 Following review of the harbour seal population modelling outputs for the OfTI and both the bottlenose dolphin and harbour seal population, modelling for the generating station (see Chapter 7.3: Marine Mammals), population modelling was not undertaken for bottlenose dolphin for this assessment. Predicted population effects on the harbour seal are lower from piling the OSP foundations than the generating station, and populations of both harbour seal and bottlenose dolphin were predicted to recover quickly from larger effects than predicted from OSP related piling. Given the short time period that would be required to install the pin piles for these foundations (i.e. up to a week per platform, and a month per year if multiple platforms are installed during one year) during which other piling on site is likely to be occurring, it was considered these activities would not affect the long term viability of the bottlenose dolphin population. Effects on bottlenose dolphins are predicted to be of medium magnitude, for short to medium durations and thus of **minor significance** in the long term.

10.3.6.17 Many of the grey seals observed within the Moray Firth are believed to have originated from haul-out sites outside of the area (see Technical Appendix 4.4 A: Baseline Marine Mammals). While the predicted effects of behavioural displacement on grey seals within the Moray Firth during OSP related piling are considered to be of high magnitude, the effect is of short to medium duration. Given that grey seals are not tied to specific breeding or feeding grounds within the Moray Firth it is predicted that the long term effect on this species at the population level will be of **minor significance**.

10.3.6.18 Both harbour porpoise and minke whales exhibit generalised distributions and do not appear to be tied to specific feeding or breeding grounds. The effects from piling OSP foundations on individuals within the Moray Firth are considered to be of high (harbour porpoise) and medium (minke whale) magnitude. However, given the short to medium duration of this displacement and the generalised distribution and relative abundance of both species, the long effects at the population level will be of **minor significance**.

10.3.6.19 Table 10.3-7 below provides a summary of the predicted potential effects on marine mammal species within the Moray Firth from the piling activities associated with the OSPs of the OfTI works.

Table 10.3-7 Summary of Potential Effects from Piling Noise During OSP Construction on Relevant Marine Mammal Receptors

Species	Predicted Effect
Harbour Seal	Major significance over short to medium duration (piling phase each year) with low significance for long term effects.
Grey Seal	Major significance over short to medium duration (piling phase each year) with low significance for long term effects.

Species	Predicted Effect
Harbour Porpoise	Major significance over short to medium duration (piling phase each year) with low significance for long term effects.
Bottlenose Dolphin	Medium significance over short to medium duration (piling phase each year) with low significance for long term effects.
Minke Whale	Medium significance over short to medium duration (piling phase) with low significance for long term effects.

10.3.6.20 The above predictions are based on the assumption that substation OSP foundation installation will occur at a separate time to turbine installation. In reality, the majority of the substations are likely to be installed within the same time frame to the wind turbines and it is suggested that any effects from the installation of these piles will be incorporated into the effects of piling turbine foundations, without increasing the predicted effects of either event. The Whole Project Assessment (three proposed wind farms and OfTI) is included in Chapter 12.1.

Reduction in Prey Due to Noise from Construction Activities

10.3.6.21 Noise modelling was conducted to predict impact ranges from piling noise produced by the Project on key fish species (see Chapters 7.2: Fish and Shellfish Ecology and 3.6: Underwater Noise). Impact ranges were found to be similar to those derived from the worst case scenarios for the three proposed wind farm sites.

10.3.6.22 The effects from noise during construction on potential marine mammal prey species are therefore considered to be of low magnitude for a medium duration and therefore of **minor significance.**

Collision Risk and the Use of Ducted Propellers

10.3.6.23 The precise number and type of vessels to be used is yet to be confirmed but based on the Navigational Impact Assessment (Chapter 11.2: Shipping and Navigation), it was concluded that any vessel traffic would be slow moving in a predictable manner (along a predefined corridor). As a result, the effects of increased vessel traffic on marine mammals (of all species) were considered probable in the immediate vicinity of the vessel but, overall, effects would be of low magnitude, medium duration and **minor significance.**

10.3.6.24 The use of ducted propellers is discussed in Chapter 7.3 (Marine Mammals) and Section 4.3 of associated Technical Appendix 7.3 A. Taking into account the facts that the harbour seal population has been relatively stable in recent years and the OSP construction activities will occur at a distance of greater than 55 km (30 nm) from the Dornoch Firth and Morrich Moor SAC, the potential effects of the use of ducted propellers on harbour seal populations in the Moray Firth for the OSP works are considered low magnitude, of low to medium duration and **minor significance.**

10.3.6.25 The Dornoch Firth and Morrich More SAC is also greater than 30 nm away from the proposed land-fall site at Fraserburgh, and therefore seals associated with these haul-out sites are considered to be at low risk from ducted propellers on vessels associated with installing the offshore transmission cables. A smaller number of harbour seals are known to haul-out in the vicinity of Peterhead (SCOS, 2011; Duck *et al.,* 2011), approximately 16 nm away from the proposed landfall site, suggesting these individuals may be at a medium risk from activities relating to the offshore transmission cables. While these individuals may be at greater risk than those in the inner Moray Firth, the low number of animals involved combined with the uncertainty over the reason for corkscrew deaths occurring lead to an overall predicted effect of **minor significance** at the population level.

10.3.6.26 A number of grey seal haul-out sites have been identified around the Fraserburgh area (and south towards Cruden Bay, approximately 23 nm south; SCOS, 2011; Duck, 2012). Taking into consideration the low number of individuals present at these sites, the uncertainty over the mechanisms behind corkscrew deaths and the fact that very few grey seal carcasses have been found exhibiting these wounds, the risk to grey seals from vessels equipped with ducted propellers associated with the installation of the offshore transmission cables is considered to be of **minor significance**.

Reduction in Foraging Ability (Increased Suspended Sediment)

10.3.6.27 Increases in turbidity (suspended sediment) as a result of construction activities could affect foraging or social interactions of marine mammals. Chapter 9.2 (Sedimentary and Coastal Processes) discusses the effects construction activities will have on local sedimentary processes. Increased suspended sediment concentration is predicted to be of minor significance to mobile fish species (see Chapter 10.2: Fish and Shellfish Ecology) and therefore the secondary effects to marine mammals (in the context of effects on prey species) is also considered to be unlikely, of low magnitude, low duration and **negligible significance**.

Operation

10.3.6.28 The primary effects during the operational phase will be:

- Changes in prey availability (habitat loss);
- Collision risk with maintenance vessels;
- Disturbance from electromagnetic fields produced by transmission cables; and
- Toxic contamination of prey from sacrificial anodes and antifouling paint.

10.3.6.29 A summary of the consideration of these effects on marine mammals are provided below. For more details on the predicted effects during operation, see Technical Appendix 7.3 A: Impact Assessment. Publicly available information was reviewed with respect to the potential impacts to marine mammals.

Changes in Prey Availability (Habitat Loss)

10.3.6.30 The effects of habitat loss due to the OfTI are considered very low in the context of fish habitat (eight x 65 m diameter GBS in the worst case scenario – see Table 10.3-3 above) and therefore not considered in detail in Chapter 10.2 (Fish and Shellfish Ecology). As a result, the indirect effects of habitat loss (leading to a reduction in available prey species) upon marine mammals are considered of low magnitude, of long term duration and therefore of **low magnitude**

Collision Risk

10.3.6.31 Vessel movement associated with the maintenance programme of the OSPs could also potentially affect marine mammals during the operational phase of the proposed developments. The vessel program is yet to be decided, but after consideration of the navigational impact assessment, it was considered that maintenance traffic of the generation station would be unlikely to represent a significant increase above existing vessel traffic within the Firth. It is likely that the maintenance of the OSPs would constitute only a small part of the increase in vessel traffic. Therefore, effects on marine mammals are predicted to be of low magnitude, low duration (for the OSPs) and of **minor significance**.

Electromagnetic Fields

10.3.6.32 The primary effect relating to the export cable during the operational phase of the developments will be disturbance from Electromagnetic Fields (EMF) produced by transmission cables.

10.3.6.33 Information on the influence of EMF on marine mammals is very limited, with much of the available evidence concentrating on fish. There is no evidence to date suggesting a change (positive or negative) in cetacean activity related to magnetic fields from cables used for transmitting power from offshore wind farms. Harbour porpoises continue to migrate in and out of the Baltic Sea over sub-sea HVDC cables, although this is a different type of cable than could be present at the proposed developments. It is thought magnetic fields from cables are likely to be detected by cetaceans as a new localised addition to heterogeneous pattern of geomagnetic anomalies in the surrounding area (Basslink 2001). There are no indications in the literature that seals are sensitive to magnetic fields.

10.3.6.34 Where possible, export cables will be buried to a minimum target depth of 1 m. In areas where this is not possible, cables will be protected by a layer of rock or concrete. Therefore, cetaceans will not be directly exposed to any electro-magnetic fields produced. Although unproven, it is thought unlikely that magnetic fields will affect cetaceans.

10.3.6.35 In conclusion, the effects of electromagnetic fields on marine mammals are uncertain, but are considered to be unlikely and of low magnitude and is therefore considered **not significant.**

Toxic Contamination

10.3.6.36 Leaching of compounds (in particular heavy metals) from sacrificial anodes or antifouling paints on OSPs has the potential to contaminate marine mammals and their food supply. Given that such systems are likely to be present on most (if not all) shipping vessels already present within the Moray Firth and taking into account the tidal regime around the proposed sites (see Chapter 3.4: Hydrodynamics – Wave Climate and Tidal Regime), it is not felt there will be any detectable increase in metal concentrations within the Moray Firth should these systems be applied. As a result, effects on marine mammals are considered to be unlikely and **not significant**.

Decommissioning

10.3.6.37 The decommissioning programme has not yet been finalised, therefore a detailed assessment is not possible at this stage. The decommissioning of the OSPs and export cable may involve the use of cutting tools and / or other methods if appropriate.

10.3.6.38 Current cutting techniques include mechanical and abrasive cutting. No data is available at this time on noise levels produced by cutting mechanisms underwater but it would be expected to be lower or equivalent to the noise levels created during the installation of the OSP foundations and the export cables. There may also be disturbance from vessels associated with the decommissioning but, as with the construction phase, the associated effects are considered to be of low magnitude and therefore considered **not significant.**

10.3.7 Proposed Monitoring, Management and Mitigation

10.3.7.1 The information below summarises mitigation measures proposed to be applied during the different stages of the OfTI.

Construction

10.3.7.2 The primary effect on marine mammals during the construction phase of the OfTI is predicted to be from piling noise from the installation of the OSP foundations. MORL is working with The Crown Estate and other developers with regards to investigating and developing best practice for mitigation measures that may be implemented to reduce either the level of noise at the source or noise propagation. These investigations have shown that while such mitigation measures (such as bubble curtains and piling sleeves) have been relatively successful in low-tidal regimes such as German waters in depths of 8.5 m, they are either unviable in the deeper, tidal conditions of the Moray Firth (bubble curtains) or at the concept design or early prototype testing stage for deeper water (piling sleeves and other designs), and thus not commercially viable for large scale deployment at present.

10.3.7.3 Existing Joint Nature Conservation Committee (JNCC) guidelines require the presence of a marine mammal observer prior to piling commencing and the instigation of a “soft start” procedure once piling starts. Typically this involves a 30 minute visual watch being conducted prior to all piling operations along with a 30 minute acoustic survey. If a marine mammal is observed (visually or acoustically) within 500 m of the piling vessel during this period, piling is delayed until the animal has moved away from the area (outside of the 500 m buffer) or has not been sighted for 20 minutes.

10.3.7.4 Recent developments in passive acoustic monitoring technology promises to improve the potential to detect cetaceans in low light or poor weather conditions. Similarly, more effective acoustic deterrents are being developed to exclude seals from potential impact areas. It is anticipated that these developments may lead to more effective mitigation procedures within the life-time of this Project. The use of alternative approaches will be investigated prior to construction commencing and their use decided upon after consultation with regulatory bodies.

10.3.7.5 Typical response distances from pile driving activity range from 10 m for lethal injury (240 dB) and 60 m for non-auditory physical injury (220 dB) for marine mammal species (see Chapter 3.6: Underwater Noise). Given the small radii predicted to cause physical injury to marine mammals, mitigation will focus on ensuring that marine mammals are outside a 500 m buffer zone to reduce such impacts. Once piling begins, the power will be ramped up in stages thus giving the majority of marine mammals outside of this area the opportunity to move away from the area prior to the piling hammer reaching full power (and maximum noise generation).

10.3.7.6 The soft start procedure will involve the ramping up of power over a 20 minute period until the hammer reached optimal force. This procedure has already been factored into the noise propagation models discussed in Chapter 3.6 (Underwater Noise) and utilised within the assessment presented here. Therefore residual effects after the consideration of these mitigation measures have already been included in the impact assessment.

10.3.7.7 The risk to marine mammals of collision with construction vessels is predicted to be negligible and of low significance. Although mitigation is not considered a necessity, the designation of a navigational route for construction vessel traffic will aid marine mammals to predict vessel movement and reduce potential impacts.

10.3.7.8 As described in Table 10.3-1 above, the modelling on which the construction and decommissioning assessment is based has been undertaken including the mitigation measures described above.

Pre-Construction

10.3.7.9 MORL intend to install a met mast on a 4.5 m monopile foundation within the Stevenson site over a two week period in 2012, and will take the opportunity to participate in surveys designed to refine some of the conservatism within the assumptions made within the assessment methodologies. The conservative assumptions are detailed within Table 7.3-11 of Chapter 7.3 (Marine Mammals). Details of these surveys can also be found in Chapter 7.3 (Marine Mammals).

10.3.7.10 Through these studies, MORL would seek to inform the population parameters made within the existing framework used for modelling the construction impacts upon marine mammals within the Moray Firth (Technical Appendix 7.3 B) and refine the assignation of magnitude leading to prediction of significance detailed in Table 10.3-6 above.

10.3.7.11 The pre, during and post-construction monitoring described in Chapter 7.3 (Marine Mammals) will also provide valued information the correlation of predicted to actual effects of the construction of the OfTI infrastructure.

Operation

10.3.7.12 The risk to marine mammals of collision with operational and maintenance vessels is predicted to be negligible and of low significance. Although mitigation is not considered a necessity, the designation of a navigational route for construction vessel traffic will aid marine mammals to predict vessel movement and reduce potential effects.

Decommissioning

10.3.7.13 The decommissioning programme has not yet been finalised and will be dependent on the choice of foundation structure, therefore detailed mitigation is not possible at this stage. The most likely scenario would involve the use of cutting equipment and is predicted to be of low to medium magnitude of effect to marine mammals. Once the decommission program has been decided upon, a review of mitigation requirements will be undertaken and instigated as required based on the best available procedures at the time.

10.3.8 Residual Effects

10.3.8.1 Much of the mitigation and management measures described above are standard procedure for such developments. For example, the use of a soft start procedure has already been incorporated into the noise modelling. The marine mammal observer / PAM survey (and subsequent soft start) is designed to ensure that no marine mammals are within a certain radius of the piling event thus reducing the potential for physical injury. This has already been incorporated into the impact assessments and so residual effects are the same.

10.3.8.2 The use of designated navigational routes, although primarily a management tool, will also help reduce risks to marine mammals from collision and is therefore an indirect form of mitigation. This has already been incorporated into the impact assessments present here and therefore included residual effects are the same. The assessment of effects of piling incorporates a series of conservative assumptions about the potential impacts of this noise on marine mammals. If all the assumptions detailed in Table 7.3-11 of Chapter 7.3 (Marine Mammals), are confirmed, the assessments presented above are assessed as likely significant effects.

10.3.9 Habitats Regulations Appraisal

10.3.9.1 As part of the Habitat Regulations, the potential significant effects of the proposed Project on SACs will be assessed by the competent authority through consideration of each SACs conservation objective (see Technical Appendix 7.3 G). The two SACs under consideration in this assessment are the Moray Firth SAC (qualifying feature: bottlenose dolphin) and the Dornoch Firth and Morrich More SAC (qualifying feature: harbour seal).

10.3.9.2 The assessment is based on whether the following will occur due to the development of the OfTI:

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

10.3.9.3 Terminology used is based on that suggested by the Intergovernmental Panel on Climate Change (IPCC). Definitions provided by the IPCC for levels of confidence in an assessment can be found in Technical Appendix 7.3 G. As part of the EIA for designated sites, and to provide information to the competent authority, the following tables summarise the impacts the OfTI is predicted to have on Moray Firth (Table 10.3-8 below) and Dornoch Firth SACs (Table 10.3-9 below) in respect each of the five criteria listed above.

10.3.9.4 As detailed in the impact assessment above, the risk to designated species through construction activities, such as risk of:

- Collision with vessels and ducted propellers;
- Long term avoidance resulting from operation and maintenance activity;
- Secondary effects associated with changes to prey availability;
- Risk of stranding associated with electromagnetic field (EMF) emissions; and
- Impacts of non-toxic and toxic contamination:

10.3.9.5 These are predicted to be of minor or negligible significance to harbour seal and bottlenose dolphin. These effects are therefore not considered further within this HRA, and the HRA concentrates upon potential impacts from piling activities

10.3.9.6 Due to the number of conservative assumptions that have been made during the impact assessment for marine mammals from piling noise, consultation with scientific experts has resulted in an assignation of a likely degree of certainty (66-100 % probability) to the predictions. The scientific experts involved in the development of the assessment methodology feel the conservative nature of all the assumptions taken result in a substantial cumulative over-prediction of impact. Table 7.3-11 presented in Chapter 7.3 (Marine Mammals) provides details on the assumptions that have been made during this impact assessment, and why it is felt that they represent the most conservative approach possible in each case.

Table 10.3-8 Assessment of the Moray Firth SAC per Conservation Objectives. Confidence Levels Based on Conservative Assumptions Proposed in Seal Framework Assessment (Technical Appendix 7.3 B) and detailed in Table 7.3-11 of Chapter 7.3 (Marine Mammals), in Addition to a Desk Top Comparison of Behavioural Responses by Harbour Porpoise and Bottlenose Dolphins to Noise (Technical Appendix 7.3 D).

Criterion	Assessment
1. Change in Habitat Distribution	The OfTI for the proposed wind farms involves the installation of up to eight OSPs, the foundations of which may require piling. The exact locations of the OSPs have yet to be decided but they will be in the general areas of the proposed wind farm sites and therefore will not overlap with the Moray Firth SAC. Bottlenose dolphins are primarily encountered within the coastal regions and thus not expected to occur within the wind farm area. Chapter 10.1 predicts negligible to minor effects on benthic habitats within the footprints of the OfTI. Taking into account predictions made in this ES and the fact that the SAC does not fall within the boundaries of the proposed development, changes to habitat distribution as a result of construction activities are considered to be exceptionally unlikely and **not significant** on the Moray Firth SAC. **Confidence level: very high.**

Criterion	Assessment
2. Change in Habitat Structure	Chapter 10.2 predicts minor effects for the impacts of piling noise on fish species from the OfTI associated with proposed MORL developments. Taking into account predictions made in this ES and the fact that the SAC does not fall within the boundaries of the proposed developments, changes to habitat structure are considered to be exceptionally unlikely and **not significant** on the Moray Firth SAC. **Confidence level: very high**.
3. Significant Disturbance to Species	The primary disturbance to bottlenose dolphins from the proposed development is considered to be increased noise from piling during the construction phase. This disturbance has the potential to cause displacement from habitats currently frequented by bottlenose dolphins within the Moray Firth. The locations of OSPs will not overlap with the Moray Firth SAC and bottlenose dolphins are primarily encountered within coastal regions and thus not expected to occur within the vicinity of the OSPs. Levels of displacement predicted by the most precautionary models presented in Technical Appendix 7.3 A and presented above suggest that less than 9 % of the population will be displaced (based on the model of best fit) for the month of piling activity related to the OSP foundation installation each year. This proportion rises to 14 % if the most precautionary model is used for behavioural response to piling noise. Noise propagation models (see Technical Appendix 7.3 F) suggest that sound levels at the southern Moray Firth (which is commonly used by bottlenose dolphins) will be approximately 70 dB_{ht}. Using the noise dose response curve described above and detailed within Technical Appendix 7.3 A, 70 dB_{ht} equates to between 20 % (best fit) and 40 % (conservative fit) displacement. Noise levels in the inner Moray Firth will be even lower. As described in Technical Appendix 7.3 D, analysis of available data indicates higher level responses by harbour porpoises than bottlenose dolphins to similar noise levels. Thus, using harbour porpoise as a proxy for bottlenose dolphin is likely to produce an overestimation of associated effect upon the bottlenose dolphin population. The modelling presented in Technical Appendix 7.3 A and summarised in Chapter 7.3 assumes piling will occur consistently across the construction period. In practice there will be gaps in piling operations, either from operational constraints (i.e. when re-positioning vessels) or during periods of bad weather, thus providing periods without the risk of disturbance. Taking all of this into account, it is considered that any disturbance from piling noise on the bottlenose dolphin population will be likely but temporary in nature (i.e. only for the duration of the piling activities) and of **minor significance** in the long term. **Confidence level: high**
4. Change in Species Distribution	Many of the foraging areas preferred by the bottlenose dolphin population occur outside of the boundaries of the SAC and research has confirmed that individuals regularly leave the Moray Firth and spend time in other areas along the eastern coast (see Technical Appendix 4.4 A: Baseline Marine Mammals). Noise propagation and impact modelling presented in Technical Appendix 7.3 A and summarised above suggests that while noise levels in coastal waters from piling activities within the proposed development are predicted to elicit a response, and may lead to low levels of displacement, they will not prevent movement by bottlenose dolphins along the southern coast of the Moray Firth. It is therefore considered that changes in species distribution are unlikely and if they were to occur, would be temporary in nature (i.e. only for the duration of piling activities). The overall impact of piling noise on species distribution is considered to be of **minor significance** in the long term. **Confidence level: high**

Criterion	Assessment
5. Species Maintained as Viable Component	The population modelling described in Technical Appendix 7.3 A and summarised in Chapter 7.3 (Marine Mammals) predicts the abundance of bottlenose dolphins within the Moray Firth over a 25 year period, including years of presumed disturbance from the wind farm construction. Although population modelling for the consequences of disturbance relating to the OSP construction activity has not been undertaken, analysis of the outputs described above suggests that, based on the most precautionary model for OSPs, population levels will be similar to baseline scenarios over the 25 year period, even with a period of disturbance relating to OSP installation. Therefore it is predicted that the long term viability of the bottlenose dolphin population is robust, and the potential effects from piling noise from OSP installation on the population as a viable component of the SAC are unlikely and of **minor significance**. **Confidence level: high**

Table 10.3-9 Assessment of the Dornoch Firth and Morrich More SAC per Conservation Objectives. Confidence Levels Based on Conservative Assumptions Proposed in Seal Framework Assessment (Technical Appendix 7.3 B) and Detailed in Table 7.3-11 in Chapter 7.3 (Marine Mammals).

Criterion	Assessment
1. Change in Habitat Distribution	The OfTI for the proposed wind farms involves the installation of eight OSPs, the foundations of which may require piling. The exact locations of the OSPs have yet to be decided but they will be in the general area of the proposed wind farm sites and therefore will not overlap with the Dornoch Firth and Morrich More SAC. Chapter 10.1 predicts negligible to minor impacts on benthic habitats within the footprints of the proposed Telford, Stevenson, MacColl wind farms and their associated transmission structure. Although the footprint of the proposed OSPs and transmission cables do not overlap with the SAC, they do represent part of the harbour seal foraging range. Taking into account predictions made in this ES, changes to habitat distribution (either within the SAC or in preferred foraging areas within the Moray Firth) as a result of piling activities and cable burial are considered to be unlikely and **not significant** for the Dornoch Firth and Morrich More SAC. **Confidence level: high**.
2. Change in Habitat Structure	Chapter 10.2 predicts minor effects for the cumulative impacts of piling noise on fish species from the OfTI associate with the proposed MORL developments. The footprint of the proposed OSPs and transmission cables do not overlap with the SAC but do represent part of the harbour seal foraging range. Taking into account predictions made in this ES, changes to habitat structure as a result of piling noise (either within the SAC or in preferred foraging areas within the Moray Firth) are considered to be unlikely and **not significant** for the Dornoch Forth and Morrich More SAC. **Confidence level: high**.
3. Significant Disturbance to Species	The primary disturbance to harbour seals from the proposed OSP installation is considered to be increased noise from piling during the construction phase. This disturbance has the potential to cause displacement from habitats currently frequented by harbour seals within the Moray Firth and the Dornoch Firth and Morrich More SAC. Noise propagation modelling suggests that noise levels from piling will be relatively low in the inner Moray Firth. Given the distance between the proposed developments and haul-out sites within the SAC (> 50 km), disturbance to seals hauled-out are considered to be unlikely. As shown in Chapter 4.4 –(Marine Mammals), the footprint of the proposed wind farms (in which the OSPs are likely to be located) represents part of the harbour seal foraging range and it is here that the greatest level of disturbance has the potential to occur.

Criterion	Assessment
3. Significant Disturbance to Species (continued)	Modelling presented in Technical Appendix 7.3 A and presented above predict that between 39 % of the population may be displaced as a result of piling noise based on the model of best fit (55 % most precautionary fit). The modelling presented in Technical Appendix 7.3 A assumes piling will occur periodically across the construction period. While it is expected that the OSPs will require larger pin piles to secure the foundations than the wind turbines (which will potentially create more noise), the small number of platforms required means that in practice their installation will not cause a significant addition to the construction noise from the wind farm site. In addition, it is expected there will be gaps in piling operations, either from operational constraints (i.e. when re-positioning vessels) or during periods of bad weather, thus providing periods in which seals can forage within the wind farm footprint. It is considered that some harbour seals are likely to experience major significant disturbance while foraging during the piling operations. This impact is not expected to extend for prolonged periods once piling temporarily ceases. The effects of this disturbance are considered to be temporary (i.e. the duration of piling activities) and of **minor significance** to the population long term. **Confidence level: high.**
4. Change in Species Distribution	Annual haul-out surveys over the last 25 years have demonstrated that there have been natural changes in the distribution of harbour seals at different haul-out sites across the Moray Firth (Thompson *et al.,* 1996), including changes in the relative importance of sites within the SAC (Cordes *et al.,* 2011). Tagging studies have also shown that foraging areas for harbour seals from Moray Firth haul-out sites are not within the boundaries of the SAC (Cordes *et al.,* 2011). The footprint of the proposed wind farms covers part of the harbour seals' potential foraging area (Smith Bank), and the most precautionary models presented in above predict that 55 % of the population may be displaced as a result of piling noise. The duration of this displacement is unknown, but it is expected to be temporary by scientific experts, and forthcoming data from DECC funded studies in the Wash can be used to test these hypotheses. Displaced seals are likely to use alternative foraging areas within the Moray Firth where there are lower levels of disturbance. This would represent a potential temporary change in their distribution within the waters of the Moray Firth. As seen during periods of natural changes in prey availability, these changes may also lead to temporary changes in the use of different Moray Firth haul-out sites (Thompson *et al.,* 1996). Given the distance between the proposed OSPs and haul-out sites within the SAC (> 50 km), it is considered unlikely that haul-out sites will be directly disturbed from piling noise from the OSPs and therefore changes in haul-out distribution as a direct result of piling noise are considered unlikely, although indirect changes linked with changes in foraging patterns may occur. Population modelling suggests while population levels may show a minor decrease during the OSP construction period, they are predicted to recover once construction is completed. Taking all of this into account, it is suggested that changes in distribution of harbour seals associated with OSP piling noise within the Moray Firth are likely but temporary in nature (i.e. for the duration of piling activities) and of **minor significance**. **Confidence level: high**
5. Species Maintained as Viable Component of SAC	The population modelling described in Technical Appendix 7.3 A and summarised above predicts the abundance of harbour seals within the Moray Firth for each year over a 25 year period, including those years in which disturbance is predicted to occur. Analysis of these outputs suggests that population levels will decrease by less than 5 % based on the most precautionary model for OSPs, with the population recovering quickly over subsequent years. It is predicted that the long term viability of the harbour seal population is robust and the potential effects from piling noise on the population as a viable component of the SAC are unlikely and of **minor significance** in the long term. **Confidence level: high**

10.3.10 References

Basslink. (2001). Draft Integrated Impact Assessment, June 2001

Cordes, L.S., Duck, C.D., Mackey, B.L., Hall, A.J., & Thompson, P.M. (2011) Long term patterns in harbour seal site-use and the consequences for managing protected areas. *Animal Conservation* 14, 430-438.

Duck, C., & Morris, C., NERC Sea Mammal Research Unit (2012) Surveys of harbour (common) and grey seals in the Outer Hebrides and the Moray Firth in August 2011. *Scottish Natural Heritage Commissioned Report No. 518*

Tougaard, J., Tougaard, S., Jensen, R.C., Jensen, T., Teilman, J., Adelung, D., Liebsch, N. & Müller, G. (2006) Harbour seals at Horns Reef before, during and after construction of Horns Rev Offshore Wind Farm. Final report to Vattenfall A / S.

Wilhelmsson, D., Malm, T., Thompson, R., Tchou, J., Sarantakos, G., McCormick, N., Luitjens, S., Gullström, M., Patterson Edwards, J.K., Amir, O. & Dubi, A. (eds.) (2010) Greening Blue Energy: Identifying and managing the biodiversity risks and opportunities of off shore renewable energy. Gland, Switzerland: IUCN. 102pp.

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10.4 Ornithology

10.4.1 Summary of Effects and Mitigation

10.4.1.1 This chapter addresses the likely significant effects associated with the offshore transmission infrastructure (OfTI) on ornithological receptors. Baseline conditions are presented for the following species: fulmar, gannet, eider, long-tailed duck, common scoter, velvet scoter, red-throated diver, great northern diver, kittiwake, herring gull, great black-backed gull, guillemot, razorbill, and puffin. Short-listing was undertaken based on numbers of species recorded on the site plus those present in nearer shore areas of the OfTI (see Technical Appendix 4.5 A). The likely significant effects on ornithological receptors associated with the onshore transmission infrastructure (OnTI) are assessed separately in Chapter 10.6 (Terrestrial Ecology).

10.4.1.2 Information supporting this assessment has been collected through desk-based review of the data for the area as explained in Chapter 4.5 (Ornithology).

Summary of Effects

10.4.1.3 The effects on ornithology receptors that were assessed for the OfTI include:

- Disturbance caused by increased vessel traffic, especially during construction and decommissioning; and
- Displacement caused by the presence of the OSPs, including indirect effects on prey species.

Proposed Mitigation Measures and Residual Effects

10.4.1.4 No significant effects on ornithological receptors are predicted to arise due to construction, operation and decommissioning of the OfTI.

10.4.1.5 Vessel traffic will be along set routes where possible; thus increasing the likelihood of habituation to disturbance and therefore no mitigation measures are proposed.

10.4.1.6 A summary of the effects is provided in Table 10.4-1 below.

Table 10.4-1 Impact Assessment Summary

Effect	Receptor	Pre-Mitigation effect	Mitigation	Post-Mitigation Effect
Construction / Decommissioning				
Disturbance	Fulmar Gannet Eider Long tailed duck Common scoter Velvet scoter Red-throated diver Great northern diver Kittiwake Herring gull Great black-backed gull Guillemot Razorbill Puffin	Disturbance (direct and indirect) - minor risk (probable; short term, temporary). No significant effect predicted.	Wind farm vessel corridors	Not significant
Operation				
Disturbance	Fulmar Gannet Eider Long tailed duck Common scoter Velvet scoter Red-throated diver Great northern diver Kittiwake Herring gull Great black-backed gull Guillemot Razorbill Puffin	Disturbance (direct and indirect) – minor risk (certain; medium term, temporary). No significant effect predicted.	Wind farm vessel corridors	Not significant

10.4.2 Introduction

10.4.2.1 The following technical reports support this chapter:

- Technical Appendix 4.5 A (Ornithology Technical Report);
- Technical Appendix 4.5 B (APEM Aerial Survey Technical Report); and
- Technical Appendix 4.5 C (University of Plymouth Technical Report).

10.4.2.2 The ornithology assessment interacts with assessments for the following receptors and, where relevant, linkages have been made within the assessment:

- Chapters 4.2 and 10.1 (Benthic Ecology);
- Chapters 4.3 and 10.2 (Fish and Shellfish Ecology); and
- Chapters 5.2 and 11.2 (Shipping and Navigation).

10.4.2.3 Full details of the Rochdale Envelope for the OfTI are provided in Chapter 2.2 (Project Description). The key components of the Project design for this ornithological impact assessment are the:

- Length and location of the export cable route;
- The location and number of offshore substation platforms (OSPs); and
- Duration, timing and intensity of construction / decommissioning activity.

10.4.3 Rochdale Envelope Parameters Considered in the Assessment

10.4.3.1 The Rochdale Envelope parameters that will be considered in this assessment vary with the effect being assessed; these are summarised in Table 10.4-2 below.

Table 10.4-2 Rochdale Envelope Parameters Relevant to the Ornithological Impact Assessment

Potential Effect	Rochdale Envelope Scenario Assessed
Construction & Decommissioning	
Disturbance	The export cable route corridor and location of OSPs are shown in Figure 1.4-4, Volume 6 a. The number and type of vessels to be utilised in OSPs and export cable installation and decommissioning is yet to be confirmed, but it is expected to be low in comparison to those normally using the Firth (see Chapter 11.2: Shipping and Navigation). Installation vessels will travel at slow speeds along predefined corridors.
Habitat Disturbance	The worst case scenario estimate for direct habitat disturbance arising from the OSPs and export cable installation is 1.99 km^2.
Operation	
Habitat Loss	The worst case scenario estimate for habitat loss arising from the OSPs is 0.58 km^2.
Disturbance	The number and type of vessels to be utilised in the OSPs operation and maintenance is yet to be decided but is unlikely to represent a significant increase in existing vessel activity within the Firth (see Chapter 11.2: Shipping and Navigation).

10.4.4 EIA Methodology

10.4.4.1 The impact assessment methodology used for ornithology is that recommended by IEEM (Institute of Ecology and Environmental Management) for marine and coastal developments (IEEM 2010) as set out in paragraph 7.4.4 of Chapter 7.4 (Ornithology).

10.4.5 Description of Key Risks to Ornithological Receptors

Disturbance

10.4.5.1 Disturbance effects could operate by denying ornithological receptors the use of suitable or preferred habitat. During construction, disturbance has the potential to arise as a result of the presence of vessels, equipment, noise and vibration. There is also the potential for disturbance effects to continue into the operation phase due to operation / maintenance activities.

10.4.5.2 Different species show differing sensitivities to disturbance. Short-listing species of birds sensitive to disturbance was based upon: the number of each species on the sites, their estimated sensitivities to vessel presence (Garthe & Huppop 2004), whether their distribution over the wider area was highly localised or widespread, their reliance on specific habitat types, and any known rates of habituation. For details, please see Section 2.5 of Technical Appendix 4.5 A.

Indirect Effects

10.4.5.3 There may also be effects upon prey species, which then go on to have effects on the populations that depredate them. Full details of prey species are provided in Technical Appendix 4.5 A. Activities such as piling during the construction phase and electro-magnetic fields (EMF) during operation have the potential to affect fish stocks locally, thus affecting those species of birds that prey on them (the assessment of likely significant effects of the OfTI on fish and shellfish are presented in Chapter 10.2: Fish and Shellfish Ecology, and cross references have been made to this chapter where relevant).

Displacement

10.4.5.4 There is the potential for displacement to arise during the operation phase from the presence of the eight substations. Given the relatively small footprint of the infrastructure, (0.58 km^2 as detailed in Table 10.4-1 above) effects on all ornithological receptors are predicted to be negligible and are not considered further in this impact assessment.

10.4.6 Impact Assessment

10.4.6.1 A list of the relevant ornithological receptors for consideration in the impact assessment, along with their legislative and conservation statuses, is provided in Table 10.4-3 below. The short-list was determined by inclusion of species shortlisted for the offshore generating station (Chapter 7.4: Ornithology) plus species considered as being regularly present in near-shore waters (Kober, 2010). A summary of each of these receptors, based on the ornithology baseline described in Chapter 4.5 (Ornithology) (and associated Technical Appendices 4.5 A, 4.5 B and 4.5 C), is provided in Table 10.4-4 below.

10.4.6.2 Density calculations for each species are estimates of the mean densities within the three proposed wind farm sites, obtained from density surface modelling (Table 25, Technical Appendix 4.5 A). These estimates are not expected to be higher for the offshore export cable route and OSPs. A list of the designated sites that will be assessed within this chapter is provided in Table 4.1-1, Chapter 4.1 (Designated Sites).

Table 10.4-3 Summary of Legislative / Conservation Statuses for Relevant Ornithological Receptors

Species	Legislative status	Distribution	Importance
Fulmar	SPA feature	Common and widespread UK breeder, except around the south east coast	International
Gannet	SPA feature	Breeds in large colonies around UK, most numerous in Scotland	International
Eider	SPA feature	Locally common breeder around Scotland. Large wintering concentrations around all Scottish coasts	International
Long-Tailed Duck	SPA feature	Winter visitor, largest concentrations on northern and eastern coasts	International
Common Scoter	SPA feature	Very rare breeding species. Winter and summer moult aggregations on eastern coasts	International
Velvet Scoter	SPA feature	Non-breeding visitor. Winter and summer moult aggregations on eastern coasts	International
Red-Throated Diver	SPA feature	Very rare breeding species. Winter and passage aggregations on eastern coasts	International
Great Northern Diver	Birds Directive Annex 1	Winter visitor. Largest aggregations on northern and western coasts	International
Kittiwake	SPA feature	Common and widespread UK breeder, particularly around north eastern areas	International
Herring Gull	SPA feature	Common and widespread breeder around UK, though less abundant around the south east coast	International
Great Black-Backed Gull	SPA feature	Common breeder around north and west Scotland, less common elsewhere and largely absent from south east coast	International
Guillemot	SPA feature	Common and widespread UK breeder, except around south east coast	International
Razorbill	SPA feature	Locally common, widespread UK breeder, except around south east coast	International
Puffin	SPA feature	Locally common breeder around Scotland, less common elsewhere and not breeding around south east coast	International

Table 10.4-4 Summary of Baseline Conditions of Relevant Ornithological Receptors

Species	Summary
Fulmar	**Seasonality**: present all months; highest numbers in spring. **Distribution**: Evenly distributed throughout the Moray Firth. **Mean monthly density estimates (birds km^{-2})**: 2.77 in breeding season and 0.25 in non-breeding season within three proposed wind farm sites; 5 to 16 in breeding season and 3 to 7 in non-breeding season in wider Moray Firth (Kober, 2010).

CHAPTER 10.4

Species	Summary
Gannet	**Seasonality**: present all months; highest numbers in spring. **Distribution**: Evenly distributed throughout the Moray Firth. **Mean monthly density estimate (birds km^{-2})**: 0.66 in breeding season; 0.04 in non-breeding season; 0.9 to 2.9 in breeding season and 0.4 to 1.0 in non-breeding season in wider Moray Firth (Kober, 2010).
Eider	**Seasonality**: Present in all months. **Distribution**: Restricted to coastal areas, mainly to west of OfTI. **Mean monthly density estimates (birds km^{-2})**: too low for estimates to be made.
Long-Tailed Duck	**Seasonality**: Present in winter and early spring. **Distribution**: Restricted to coastal areas, mainly to west of OfTI. **Mean monthly density estimates (birds km^{-2})**: too low for estimates to be made.
Common Scoter	**Seasonality**: Present in all months, peaking in summer. **Distribution**: Restricted to coastal areas, mainly to west of OfTI. **Mean monthly density estimates (birds km^{-2})**: too low for estimates to be made.
Velvet Scoter	**Seasonality**: Present in all months, peaking in summer and autumn. **Distribution**: Restricted to coastal areas, mainly to west of OfTI. **Mean monthly density estimates (birds km^{-2})**: too low for estimates to be made.
Red-Throated Diver	**Seasonality**: Present during the winter months, peaking in late spring. **Distribution**: Restricted to coastal areas, mainly to west of OfTI. **Mean monthly density estimates (birds km^{-2})**: too low for estimates to be made.
Great Northern Diver	**Seasonality**: Present during the winter months. **Distribution**: Restricted to coastal areas, mainly to west of OfTI. **Mean monthly density estimates (birds km^{-2})**: too low for estimates to be made.
Kittiwake	**Seasonality**: small peak in winter; present in small numbers at other times. **Distribution**: Distributed throughout the Moray Firth, with highest densities in western parts. **Mean monthly density estimates (birds km^{-2})**: 7.90 in breeding season; 0.79 in non-breeding season; 0.1 to 85 (highest densities at colonies) in breeding season and 0.1 to 20.5 in non-breeding season in wider Moray Firth (Kober 2010).
Herring Gull	**Seasonality**: present in all months; small peak in winter. **Distribution**: Distributed throughout the Moray Firth, with highest densities in inshore areas and western parts. **Mean monthly density estimates (birds km^{-2})**: 0.02 in breeding season; 0.14 in non-breeding season; 0.1 to 44.8 in breeding season and 0.1 to 9.2 in non-breeding season in wider Moray Firth (Kober 2010).
Great Black-Backed Gull	**Seasonality**: present in all months. **Distribution**: Distributed throughout the Moray Firth, with highest densities in inshore areas and western parts. **Mean monthly density estimates (birds km^{2})**: 0.91 in breeding season; 0.36 in non-breeding season; 0.01 to 0.81 in breeding season and 0.01 to 1.21 in non-breeding season in wider Moray Firth (Kober, 2010).

Species	Summary
Guillemot	**Seasonality**: present in all months with peaks in early summer. **Distribution**: Distributed throughout the Moray Firth, with highest densities in inshore areas and western parts. In winter, highest densities of birds tend to be coastal. **Mean monthly density estimates (birds km^{-2})**: 25.57 in breeding season; 2.84 in non-breeding season; 0.1 to 713.4 (highest densities at colonies) in breeding season and 0.1 to 15.8 in non-breeding season in wider Moray Firth (Kober, 2010).
Razorbill	**Seasonality**: present in all months with peaks in late spring / early summer **Distribution**: Distributed throughout the Moray Firth, with highest densities in inshore areas and western parts. In winter, highest densities of birds tend to be coastal. **Mean monthly density estimates (birds km^{-2})**: 6.03 in breeding season; 2.64 in non-breeding season; 0.1 to 22.0 (highest densities at colonies) in breeding season and 0.1 to 15.8 in non-breeding season in wider Moray Firth (Kober, 2010).
Puffin	**Seasonality**: present in all months, with peaks in spring and summer. **Distribution**: Distributed throughout the Moray Firth, with highest winter densities in eastern areas. **Mean monthly density estimates (birds km^{-2})**: 6.55 in breeding season; 0.75 in non-breeding season; 0.1 to 14.8 (highest densities at colonies) in breeding season and 0.1 ro 3.8 in non-breeding season in wider Moray Firth (Kober, 2010).

Construction

Disturbance

10.4.6.3 Likely significant effects are predicted to be limited to disturbance. These will depend on the intensity of vessel traffic and construction strategy (see Chapter 11.2: Shipping and Navigation), and are expected to be of short term duration and reversible.

Indirect Effects

10.4.6.4 Indirect effects on benthic and fish populations resulting from piling have been assessed in Chapter 10.1 (Benthic Ecology) and 10.2 (Fish and Shellfish Ecology) and effects have been judged to be of minor significance (probable) for all prey species considered.

10.4.6.5 Given the small scale and duration of the likely effects during the construction period, they are predicted to be minor risk (probable) for all bird species, with these considered to be **not significant**.

Operation

Disturbance

10.4.6.6 Likely effects are predicted to be limited to disturbance caused by maintenance vessels, and displacement caused by the presence of up to eight OSPs (see Chapter 11.2: Shipping and Navigation). These are expected to be of short term duration and reversible.

Indirect Effects

10.4.6.7 Indirect effects resulting from EMF effects on benthic and fish populations have been assessed in Chapters 10.1 (Benthic Ecology) and 10.2 (Fish and Shellfish Ecology) and effects have been judged to be of minor significance for all prey species considered.

10.4.6.8 Given the small scale and duration of the likely significant effects during the operation period, they are predicted to be minor risk (certain) for all species, with these considered to be **not significant**.

Decommissioning

Disturbance

10.4.6.9 Likely effects are predicted to be limited to disturbance. These are expected to be of short term duration and reversible. The timing of the decommissioning will dictate the magnitude of the effect due to seasonal variation in bird numbers.

10.4.6.10 Given the small scale and duration of the likely significant effects during the decommissioning period, they are predicted to be minor risk (probable) for all species, with these considered to be **not significant**.

10.4.7 Proposed Monitoring and Mitigation

Construction, Operation & Decommissioning

10.4.7.1 During all phases, vessel traffic will be along set routes where possible; thus increasing the likelihood of habituation to disturbance. Since all potential effects were assessed as being of minor risk, this is still the case post-mitigation.

10.4.8 Habitats Regulations Appraisal

10.4.8.1 No detailed HRA appraisal was undertaken given the minor risk and non-significant effects from the construction, operation and decommissioning of the OfTI for all bird species assessed.

10.4.9 References

Garthe, S. & Huppop, O. (2004) Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. J. Appl. Ecol. 41: 724–734.

IEEM. (2010) Guidelines for ecological impact assessment in Britain and Ireland: marine and coastal. Published by the Institute of Ecology and Environmental Management.

Kober, K., Webb, A., Win, I., Lewis, M., O'Brien, S, Wilson, L.J, & Reid, J.B. (2010) An analysis of the numbers and distribution of seabirds within the British Fishery Limit aimed at identifying areas that qualify as possible marine SPAs. JNCC Report 431.

10.5 Intertidal Ecology

10.5.1 Summary of Effects and Mitigation

10.5.1.1 This chapter assesses the likely significant effects of the installation, operation and decommissioning of the offshore export cable on intertidal ecology at the landfall location at Fraserburgh Beach.

10.5.1.2 Information supporting this assessment has been collected from a site specific survey and data review as explained in Chapter 4.6 (Intertidal Ecology).

10.5.1.3 The following effects were assessed as being of **no significance** to benthic ecological receptors including habitats and species (collectively termed biotopes):

- Temporary direct intertidal habitat disturbance;
- Temporary indirect (sediment) disturbance; and
- Heating and EMF effects.

10.5.1.4 A summary of effects is shown in Table 10.5-1 below.

Table 10.5-1 Impact Assessment Summary

Effect	Receptor	Pre-Mitigation Effect	Mitigation	Post-Mitigation Effect
Construction & Decommissioning				
Temporary Direct Intertidal Habitat Disturbances	Sand and rock biotopes	Not significant	N / A	Not significant
Temporary Indirect (sediment) disturbances		Not significant	N / A	Not significant
Operation				
Heating and EMF Effects	Sensitive and deep-burrowing species	Not significant	N / A	Not significant

10.5.2 Introduction

10.5.2.1 The installation of the export cable has the potential to affect intertidal habitats through direct habitat disturbance and localised disturbed sediment re-suspension during the tidal cycle. However, it should be noted that BERR (2008) identify that "*Intertidal habitats that are more sensitive to the impacts of cable burial are generally those that have established in more sheltered conditions, where natural perturbations are lower and less frequent*", whereas at Fraserburgh, physical and biological indications are that the site is a high energy habitat prone to frequent natural perturbation.

10.5.3 Rochdale Envelope Parameters Considered in the Assessment

10.5.3.1 Table 10.5-2 below presents the Project parameters that define the realistic worst case scenario with respect to likely significant effects on intertidal ecology. It is considered that open cut cable trenching will result in the greatest disturbance to intertidal habitat and species (biotope) receptors.

Table 10.5-2 Rochdale Envelope Parameters Considered in the Assessment

Effect	Rochdale Scenario Assessed
Construction & Decommissioning	
Temporary Direct Intertidal Habitat Disturbance	**Total footprint = 3,240 m² based on the following factors, equating to < 0.1 % of total beach area at Fraserburgh Beach:** • Beach width / cable length of 120 m; • Affected width per trench: 6 m; • Two trenches constructed at a minimum of 1 year apart; and • Two jointing pits of several to a few tens of metres in length and breadth constructed at a minimum of 1 year apart (note that jointing pits may be located either below or above Mean High Water Springs).
Temporary Indirect (sediment) Disturbances	Sandy sediments arising from installation of export cable via trenching during incoming tides.
Operation	
Heating and EMF Effects	Offshore export cable: • Type: 320 kV DC; • Maximum number of cable trenches: two; • Maximum number cables: four; and • Target trench depth: 1 m.
Cumulative	
No cumulative effects identified (Chapter 14.5).	

10.5.4 EIA Methodology

10.5.4.1 The methodology for the determination of impact significance is presented in Chapter 7.1 (Benthic Ecology). The approach considers operations over the lifetime of the Project within the intertidal environment and relates these to the known habitats and species, considering any related effects and their associated significance, if any.

10.5.5 Impact Assessment

10.5.5.1 Receptors considered within the assessment of the export cable proposals on intertidal ecology include the intertidal biotopes as classified and mapped during the site specific survey and described in Chapter 4.6 (Intertidal Ecology). Consideration of intertidal species is implicit within the assessment at biotope level. The biotopes considered include:

- LS.LSa.MoSa (Barren or amphipod-dominated mobile sand shores);
- LR.HLR.MusB.Sem.LitX (*Semibalanus balanoides* and *Littorina* spp. on exposed to moderately exposed eulittoral boulders and cobbles); and
- LR.FLR.Lic.YG (Yellow and grey lichens on supralittoral rock).

Construction

Temporary Direct Intertidal Habitat Disturbance

10.5.5.2 The uppermost layers of beach material are highly unstable; consequently few animals can survive in this environment, especially when it is coupled with being exposed to the air when the tide is out. Consequently, such shores are often devoid of visible life (Connor *et al.,* 2004). The few animals that do live in this habitat are robust and highly mobile species that are specially adapted to a high degree of physical disturbance. Receptor sensitivity is therefore negligible.

10.5.5.3 Direct disturbances to intertidal habitats will occur as a result of the construction of the trenches and the jointing pits as well as the movement of construction plant and machinery over adjacent areas. The total area of disturbance is considered to be very small representing < 0.1 % of the total beach area. Following cessation of the activity any disturbed sediments will be rapidly dispersed by successive in-coming tides with full recovery of the beach expected within a few tidal cycles and after consolidation of the beach sediments to pre-construction conditions. The two trenches and their associated jointing pits will be constructed separately and at an interval of at least a year between the two construction events (worst case scenario). As such, full recovery of intertidal habitats following the initial construction activity is forecast to occur well before the onset of the second construction event. The direct effects of the construction will be highly localised and will be restricted to the footprint of the construction activity whilst the activity will only occur once for each installation so that the frequency of the impact is low. Consequently, the magnitude and duration of direct disturbances are therefore assessed to be negligible and this is likely to be similar regardless of the final installation technique. The overall impact of habitat disturbance is therefore assessed to be **not significant** and this assessment carries low uncertainty.

10.5.5.4 The total area of direct disturbance of intertidal habitat will be less than that assessed here if the jointing pits are constructed in the terrestrial environment above the high tide mark. Additionally, if directional drilling method is employed (if found to be technically feasible) there will be no direct impact on the intertidal area as the cable will pass under it.

Temporary Indirect (Sediment) Disturbances

10.5.5.5 The biotopes recorded at Fraserburgh are considered to be not sensitive to the effects of sediment re-suspension and smothering by 5 cm of sand (MarLIN benchmark), owing to the continual turbulence naturally occurring within these habitats due to storms and / or hydrodynamic exposure (e.g. tides and wave action) (Budd, 2008).

10.5.5.6 Cable installation within the intertidal area is likely to be undertaken during periods of low tide, therefore, the potential for re-suspension of material due to construction activities and subsequent settlement is limited. The degree of sediment re-suspension likely to occur with the flooding tide is expected to be low due to the relatively coarse nature of the sediment (sand), which will settle back to the sea floor very rapidly and close to the site of initial disturbance. The spatial extent of any sediment settlement is therefore expected to be very localised and will occur over the short term so that the overall magnitude of the effect will be negligible. The sensitivity of the biotopes to the effect of temporary sediment disturbances and re-settlement is also considered negligible as a result of the naturally perturbed environment at Fraserburgh Beach. Accordingly, the overall impact is assessed to be **not significant** with low uncertainty.

Operation

10.5.5.7 Generic effects of the export cable associated with the operation activities are considered to be minimal and include heating and electromagnetic fields as well as physical disturbance associated with any maintenance.

Heating Effects

10.5.5.8 As explained in Chapter 10.1(Benthic Ecology), the passage of electricity through a cable will generate heat. This heat will then be dissipated within the overlying water or surrounding sediment subject to installation method and physical environmental conditions.

10.5.5.9 Theoretical effects of a permanent increase of the seabed temperature relate to changes of physicochemical conditions of sedimentary substrates (Meißner and Sordyl, 2006). These in turn may affect the physiology, reproduction or even mortality of certain benthic species (OSPAR, 2009). This may result in de-oxygenation of the seabed leading to possible loss of fauna (Meißner and Sordyl, 2006). The temperature increase of the upper layer of the seabed depends on the burial depth of the cable, but also factors such as sediment characteristics, and cable parameters (OSPAR, 2009).

10.5.5.10 With respect to the export cable, the cable target burial depth is 1 m. The small numbers of animals living within the sediment at Fraserburgh Beach typically occupy only the uppermost few cms and so are unlikely to be directly exposed to permanent increase in sediment temperature. Furthermore, these upper sediment layers at Fraserburgh are subject to mobility as a result of the naturally energetic marine environment and so will remain well oxygenated. Although empirical data are generally lacking (OSPAR, 2009), the issue of seabed temperature rise as a result of buried cables has been considered during a project to bury a submarine HVDC cable between New England and Long Island, New York. The project estimated that the rise in temperature at the seabed immediately above the buried cable to be just 0.190C (BERR, 2008) and therefore well within the natural variation.

10.5.5.11 The effect of heat from operational cables is expected to be highly localised to the area immediately around the cable and thus is of negligible magnitude. In addition the cable target burial depth in the intertidal zone is 1 m so that animals occupying the uppermost few cms of seabed are unlikely to be significantly exposed to increased heat effects. Furthermore, regular tidal inundation will maintain oxygenation of surface beach sediments significant physicochemical change and associated mortality of benthic fauna of neglible sensitivity are not expected. Accordingly, the significance of impacts from heating effects from export cables within the intertidal area is assessed to be **not significant.** This assessment carries medium uncertainty due to the paucity of data from field studies.

Electromagnetic Fields (EMFs)

10.5.5.12 The effects of EMFs on benthic ecology have been described in Chapter 10.1(Benthic Ecology). Studies on the effects of EMFs on benthic invertebrate fauna are limited but those that do exist indicate that geomagnetic orientation occurs in molluscs. For example: nudibranchs (Cain *et al*., 2005), chitons (Bochert and Zettler, 2006) and crustaceans (sandhoppers: Bochert and Zettler, 2006).

10.5.5.13 The survival and physiology of selected species of prawns, crabs, starfish, marine worms and blue mussels, have been studied in relation to EMF levels corresponding to the intensity on the surface of ordinary sub-marine DC cables in the Baltic Sea. Results showed no significant effects for any of the species under consideration after three months of exposure (Bochert and Zettler, 2006). In addition, a visual survey of benthic communities on wind power cables and the peripheral areas, showed no differences in assemblage structure (Wilhelmsson *et al.,* 2010).

10.5.5.14 In general, the occurrence of apparently healthy and diverse communities on existing offshore wind farm structures provides evidence that EMFs are unlikely to pose a significant threat to the colonising communities (Linley *et al*., 2007) which are therefore deemed to be of negligible sensitivity. However, in the absence of more comprehensive evidence, uncertainty remains when predicting potential impacts of EMFs on benthic invertebrate communities.

10.5.5.15 The cable bundles will also be buried to a target depth of 1 m. Burial at this depth is likely to provide a degree of shielding reducing the potential for EMF to the effects. Effect magnitude is therefore considered to be low.

10.5.5.16 The overall effect of EMFs from export cables on marine benthic invertebrates is assessed to be **not significant** based on the small magnitude of the impact and perceived insensitivity of the benthic invertebrates as discussed above. However, this assessment carries medium uncertainty as the number of experimental field studies addressing invertebrate tolerance / sensitivity to EMF is currently rather limited. However, the cable will be buried so that potential EMF effects will be reduced.

Decommissioning

10.5.5.17 It is likely that the cables will be left in situ during decommissioning. However, the effects of removal of intertidal cables and jointing pits will be comparable to those that occur during construction and are therefore considered to be **not significant**.

10.5.6 Proposed Monitoring and Mitigation

Construction

10.5.6.1 No mitigation required.

Operation

10.5.6.2 No mitigation required.

Decommissioning

10.5.6.3 No mitigation required

10.5.7 References

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10.6 Terrestrial Ecology

10.6.1 Summary of Effects and Mitigation

10.6.1.1 This assessment details the evaluation of likely significant effects on terrestrial ecology as a result of the proposed development and provides mitigation measures to address these effects. The assessment covers birds, habitats and protected species (mammals and freshwater species). Assessments of likely significant effects on ornithological, fish and mammal interests associated with offshore development are provided separately in the following chapters:

- Chapters 7.4, 10.4 and 14.4 (Ornithology);
- Chapters 7.2, 10.2 and 14.2 (Fish and Shellfish); and
- Chapters 7.3, 10.3 and 14.3 (Marine Mammals).

Summary of Effects

10.6.1.2 The impact assessment was carried out on all valued ecological receptors (VERs), standard mitigation was proposed and residual impacts were found to be of only **negligible-minor** significance.

10.6.1.3 Residual impacts of only negligible significance were predicted for all ornithological impacts. All habitat VERs were found to have residual impacts of only negligible-minor significance. Otter and badger VERs were found to have residual impacts of only minor significance. Likewise, the bat roost and habitat suitability VER was found to have residual impacts of only negligible-minor significance. All residual impacts were therefore predicted to be only **minor** at worst.

Proposed Mitigation Measures and Residual Effects

10.6.1.4 The following standard mitigation was proposed:

- For Loch of Strathbeg SPA and SSSI VERs, avoid works early autumn and spring, and dawn and dusk, within 500 m of Goose Management Scheme (GMS) refuge and feeding areas and the Loch of Strathbeg roost site;
- For terrestrial breeding bird VERs, avoid works during mid-March to July and carry out preconstruction surveys;
- For habitat VERs, micro-site onshore cable route design to avoid sensitive habitats and employ CEMP (Construction Environmental Management Plan) and construction method statements;
- For otter and badger VERs, cover all excavations when not in use (or provide a means of escape), avoid night works (or minimise light spill), cease works within 100 m of otter holts and badger setts 1 hr before dusk and commence 1 hr after dawn, micro-site onshore cable route design to avoid badger setts (if setts cannot be avoided then a licence will be required from SNH), set up a protection zone 30 m around setts and carry out preconstruction surveys; and
- For the bat roost and habitat suitability VER, micro-site cable route design to avoid sensitive bat habitat features, carry out targeted baseline field surveys prior to construction once onshore cable route design has been confirmed to inform detailed mitigation, avoid dawn, dusk and overnight works near areas with bat roost potential and carry out preconstruction surveys.

10.6.1.5 A Summary of the impact assessment is shown in Table 10.6-1 below.

Table 10.6-1 Impact Assessment Summary

<table>
<tr><th>Receptor</th><th>Pre-Mitigation Impact</th><th>Mitigation</th><th>Post-Mitigation Impact</th></tr>
<tr><td colspan="4">Construction</td></tr>
<tr><td>Loch of Strathbeg SPA and SSSI (habitat loss)</td><td>Minor</td><td>Avoid early autumn and early spring and dawn and dusk, within 500 m of GMS refuge and feeding areas and Loch of Strathbeg roost site.
Minimise construction activity.
Habitat restoration.
ECoW present during works.</td><td>Negligible</td></tr>
<tr><td>Loch of Strathbeg SPA and SSSI (disturbance / displacement)</td><td>Moderate</td><td>As above</td><td>Negligible</td></tr>
<tr><td>Terrestrial Breeding Birds</td><td>Minor</td><td>Avoid mid-March to July inclusive.
Habitat restoration.
Carry out preconstruction surveys.
ECoW present during works.</td><td>Negligible</td></tr>
<tr><td>Coastal Wintering Birds</td><td>Minor</td><td>Avoid winter months.</td><td>Negligible</td></tr>
<tr><td>Buchan Ness to Collieston SAC and Buchan Ness to Colliestion Coast SPA</td><td>Minor</td><td rowspan="12">Micro-site cable route to avoid sensitive habitats.
Adhere to SEPAs Pollution Prevention Guidelines (PPGs).
Maintain vehicles and plant to avoid leaks.
Avoid heavy rainfall.
Delimit working areas to minimise zone of impact.
Employ best practice.
Enforce CEMP and construction method statements.
Sediment control near burns.
Avoid trenching alongside the River Ugie.
Habitat restoration.
ECoW present during works.</td><td>Negligible</td></tr>
<tr><td>Loch of Strathbeg SPA, Ramsar and SSSI</td><td>Minor-moderate</td><td>Negligible</td></tr>
<tr><td>Rora Moss SSSI</td><td>Negligible</td><td>Negligible</td></tr>
<tr><td>Waters of Philorth</td><td>Minor</td><td>Negligible</td></tr>
<tr><td>Blanket Bog</td><td>Minor</td><td>Minor</td></tr>
<tr><td>Acid / Neutral Flush</td><td>Minor</td><td>Minor</td></tr>
<tr><td>Dry Modified Bog</td><td>Minor</td><td>Negligible</td></tr>
<tr><td>Dune Grassland Coastland</td><td>Minor</td><td>Negligible</td></tr>
<tr><td>Semi-improved and Unimproved Neutral Grassland</td><td>Minor</td><td>Negligible</td></tr>
<tr><td>Running and Standing Water</td><td>Minor</td><td>Minor</td></tr>
<tr><td>Swamp, Marginal and Inundation Vegetation</td><td>Minor</td><td>Negligible</td></tr>
<tr><td>Marshy Grassland</td><td>Negligible</td><td>Negligible</td></tr>
</table>

Receptor	Pre-Mitigation Impact	Mitigation	Post-Mitigation Impact
Waterbodies	Minor		Negligible
Plantation and Semi-Natural Woodlands	Minor		Negligible
Arable Land	Minor		Negligible
Improved Grassland	Negligible		Negligible
Tall Ruderal Herb and Fern	Negligible		Negligible
Amenity Grassland	Negligible		Negligible
Dense / Scattered Scrub	Negligible		Negligible
Ephemeral / Short Perennial	Negligible		Negligible
Otter	Moderate	Cover all excavations when not in use. Where excavations cannot be covered, provide means of escape. Avoid night working. When night working cannot be avoided, direct light onto work area only and minimise light spill. Works within 100 m of holts should cease 1 hr before dusk and commence 1 hr after dawn. Adhere to SEPAs PPGs. Enforce vehicle speed limits. ECoW present during works.	Minor
Badger	Moderate	Micro-site cable route to avoid sett(s). If sett(s) cannot be avoided then obtain license from SNH to destroy sett(s). Impose protection zones 30 m from sett(s) and mark with brightly coloured tape. Cover all excavations > 5 m deep when not in use. Pipes of diameter > 20 cm should be capped nightly. Avoid night working. When night working cannot be avoided, direct light onto work area only and minimise light spill. Works within 100 m of sett(s) should cease 1 hr before dusk and commence 1 hr after dawn. Adhere to SEPAs PPGs. Enforce vehicle speed limits. ECoW present during works. Carry out preconstruction survey. Employ best practice.	Minor

Receptor	Pre-Mitigation Impact	Mitigation	Post-Mitigation Impact
Bat roost and Habitat Suitability	Minor-moderate	Micro-site cable route to avoid sensitive habitat features. Targeted baseline field surveys to be carried out prior to construction, once cable route confirmed, to inform detailed mitigation actions; surveys to include roost searches, Anabat surveys, commuting surveys and control surveys, all May-September. Carry out preconstruction survey. ECoW present during works. Habitat restoration. Avoid dawn, dusk and overnight works near areas with bat roost potential.	Negligible-minor
Operation			
Loch of Strathbeg SPA and SSSI	Minor	Avoid early autumn and early spring, and dawn and dusk, within 500 m of GMS refuge and feeding areas and Loch of Strathbeg roost site. Minimise construction activity in this area.	Negligible
Terrestrial Breeding Birds	Minor	Avoid mid-March to July inclusive. Habitat restoration.	Negligible
Coastal Wintering Birds	Negligible	Avoid winter months.	Negligible
Buchan Ness to Collieston SAC and Buchan Ness to Collieston Coast SPA	Negligible	Adhere to SEPAs PPGs. Maintain vehicles and plant to avoid leaks. Avoid heavy rainfall. Delimit working areas to minimise zone of impact. Employ best practice. Enforce CEMP and construction method statements. Sediment control near burns. Avoid trenching alongside the River Ugie. Habitat restoration where onshore export cable has impacts.	Negligible
Loch of Strathbeg Ramsar, SPA and SSSI	Negligible		Negligible
Rora Moss SSSI	Negligible		Negligible
Waters of Philorth	Minor		Negligible
Blanket Bog	Minor		Minor
Acid / Neutral Flush	Negligible-minor		Negligible
Dry Modified Bog	Minor		Negligible
Dune Grassland / Open Dune Coastline	Minor		Negligible
Semi-Improved and Unimproved Neutral Grasslands	Minor		Negligible

Receptor	Pre-Mitigation Impact	Mitigation	Post-Mitigation Impact
Watercourses and Standing Water	Negligible-minor		Negligible
Swamp, Marginal and Inundation Vegetation	Negligible-minor		Negligible
Marshy Grassland	Minor		Negligible
Waterbodies	Negligible-minor		Negligible
Plantation and Semi-Natural Woodlands	Minor		Negligible
Arable Land	Minor		Negligible
Improved Grassland	Minor		Negligible
Tall Ruderal Herb and Fern	Minor		Negligible
Amenity Grassland	Minor		Negligible
Dense / Scattered Scrub	Minor		Negligible
Ephemeral / Short Perennial	Minor		Negligible
Mud / Sand Coastland and Boulders / Rock Coastland	Minor		Negligible
Otter	Moderate	Cover all excavations when not in use. Where excavations cannot be covered, provide means of escape. Avoid night working. When night working cannot be avoided, direct light onto work area only and minimise light spill. Works within 100 m of holts should cease 1 hr before dusk and commence 1 hr after dawn. Adhere to SEPAs PPGs. Enforce vehicle speed limits.	Minor
Badger	Moderate	If sett(s) cannot be avoided then obtain license from SNH to destroy sett(s). Impose protection zones 30 m from sett(s) and mark with brightly coloured tape. Cover all excavations > 5 m deep when not in use. Pipes of diameter > 20 cm should be capped nightly. Avoid night working. When night working cannot be avoided, direct light onto work area only and minimise light spill. Works within 100 m of sett(s) should cease 1 hr before dusk and commence 1 hr after dawn. Adhere to SEPAs PPGs. Enforce vehicle speed limits. Employ best practice.	Minor

Receptor	Pre-Mitigation Impact	Mitigation	Post-Mitigation Impact
Bat Roost and Habitat Suitability	Minor	Habitat restoration to provide like-for-like compensation for any roosts, commuting or foraging habitat impacted. Avoid dawn, dusk and overnight works near areas with bat roost potential.	Negligible-minor
Decommissioning – comprises the same impact assessment as construction			

10.6.2 Introduction

10.6.2.1 The onshore cable route in north east Aberdeenshire comprises a managed, open landscape of arable land and improved grassland, inhabited by the protected species otter, badger and bats, and supporting a typical assemblage of farmland and coastal birds. The coast holds internationally important numbers of wintering geese at the Loch of Strathbeg.

10.6.2.2 This chapter assesses likely significant effects on terrestrial ecology baseline conditions derived from desk study and contemporary field surveys (2011) as a result of the proposed development. Terrestrial ecology baseline conditions are provided in:

- Chapter 4.7 (Terrestrial Ecology);
- Technical Appendix 4.7 A (Terrestrial Ecology Technical Report); and
- Technical Appendix 4.7 B (Terrestrial Ecology Confidential Report).

10.6.2.3 This impact assessment is used to inform the terrestrial ecology cumulative impacts provided in:

- Chapter 14.6 (Cumulative Impact Assessment).

10.6.2.4 Within the vicinity of north east Aberdeenshire several sites are designated for ornithological or ecological interests: SPAs, Ramsar sites, SACs and SSSIs. Information on the designated sites shortlisted for inclusion in the impact assessment is provided in Chapter 4.1 (Designated Sites).

10.6.2.5 This chapter contains relevant information on the onshore transmission infrastructure (OnTI) to allow Scottish Ministers and Marine Scotland to make decisions on the applications for Section 36 consents and Marine Licences for the three proposed wind farm sites and the OfTI. Discussions are ongoing with landowners to determine the exact location and layout of the substation(s) on their land within the preferred onshore substation area. This will be finalised following production of a masterplan by the owner / operator of the Peterhead Power Station compound which forms part of the preferred area. Once the precise location and layout for the onshore substation(s) and export cable location has been confirmed, an application for planning permission for the OnTI will be submitted to Aberdeenshire Council and will be supported by this ES and such further information as is required to support the planning application.

10.6.3 Rochdale Envelope Parameters Considered in the Assessment

10.6.3.1 The Rochdale Envelope, outlining the 'worst realistic case' impacts for the impact assessment is summarised in Table 10.6-2 below and based on details in Chapter 2.2 (Project Description).

Table 10.6-2 Rochdale Envelope Parameter Relevant to the Terrestrial Ecology Impact Assessment

Potential impact	Rochdale Envelope Scenario Assessed
Construction & Decommissioning	
Impacts on Loch of Strathbeg SPA and SSSI Qualifying Species from Habitat Loss and Disturbance / Displacement **Impacts on Breeding and Wintering Coastal and Terrestrial Birds from Habitat Loss and Disturbance / Displacement** **Impacts on Habitats and Conservation Designated Sites from Pollution, Damage and Disturbance** **Impacts on Otter and Badger from Habitat Loss and Disturbance / Displacement** **Impacts from Damage to Bat Habitat**	Onshore DC cable: • Maximum number of cable trenches = two, in two separate burial activities in separate years; • Number of cables = four, preference is for two bundles of two cables, but could potentially be either four single cables or two bipole cables (but still in two trenches of the same width); • Cable installation method = cable plough at an estimated rate of 1 km / day, directional drilling at landfall and water crossings at an estimated rate of < 1 km / day, and open trenching at rate of 300 m / day; • Cable trench width = 5 m assuming one trench for both bundles of two cables, these may be installed at different times. Two 3 m trenches would be required if bundles are buried separately, this event is only anticipated at the landfall site at Fraserburgh beach up to the jointing pit. For some very short sections it may be necessary to unbundle cable and install as single cables; • Cable trench depth = 1 m, although slightly deeper burial of 1.2 to 1.5 m may be required in some areas; • Cable trench working width = 20 m; • Cable route length = 30 km from landfall site at Fraserburgh beach to substation at Peterhead. This is an approximate value, final length will be determined by final route design and micro-siting; and • Two jointing pits of several to a few tens of meters in length and breadth constructed at a minimum of 1 year apart (note that jointing pits may be located either below or above Mean High Water Springs). AC + DC substation (converter building and control buildings): • Length, 200 m (plus temporary working area); • Width, 170 m (plus temporary working area); and • Height, 25 m (plus temporary working area).
Operation	
Impacts on Loch of Strathbeg SPA and SSSI Qualifying Species from Habitat Loss and Disturbance / Displacement **Impacts on Breeding and Wintering Coastal and Terrestrial Birds from Habitat Loss and Disturbance / Displacement** **Impacts on Habitats and Conservation Designated Sites from Pollution, Damage and Disturbance** **Impacts on Otter and Badger from Habitat Loss and Disturbance / Displacement** **Impacts from Damage to Bat Habitat**	AC + DC substation (converter building and control buildings): • Length = 200 m (plus temporary working area); • Width = 170 m (plus temporary working area); and • Height = 25 m (plus temporary working area).

10.6.4 EIA Methodology

10.6.4.1 Assessment of significance of impacts on VERs was broadly based on the staged process in IEEMs (2006) guidelines. As such, impacts were predicted and characterised and their significance in terms of EIA Regulations were determined. However unlike IEEMs (2006) guidelines, here a matrix approach was used to determine levels of significance based on conservation value of VERs and magnitude of impacts. This matrix is the standard approach adopted in ornithological impact assessment and is used for consistency and clarity. Results are subject to expert judgement using IEEMs (2006) guidelines to ensure accuracy in predictions and avoid over-reliance on matrix output.

10.6.4.2 The stages in the assessment are as follows:

- Determination of the conservation value of VERs within the onshore cable route based on geographical scale;
- Identification of potential impacts based on the nature of the proposed development;
- Determination of the scale and magnitude of those impacts;
- Determination of the significance of those impacts based on the magnitude and duration of impacts on the vulnerability of the VERs affected;
- Identification and assessment of mitigation measures required to address significant adverse impacts; and
- Determination of the significance of any residual impacts once the benefits of the prescribed mitigation measures have been assessed.

10.6.4.3 The significance of impacts is also determined by understanding how each species or habitat will be affected by construction, operation and decommissioning of the export cable and onshore substation. This takes into consideration the following:

- Habitat extent / population estimates within the onshore cable route and surrounding area;
- Population / habitat extent trends of each species / habitat at a national or regional level;
- Distribution of populations / habitats of each VER within the study area and at a wider scale;
- Vulnerability of each VER to particular impacts; and
- Ecology and behaviour of each species (e.g. flight and feeding characteristics).

Conservation Value of VERs

10.6.4.4 VERs were identified from baseline results, for detail refer to Chapter 4.7 (Terrestrial Ecology). VER sensitivity was first assessed in relation to the conservation value of the species over the full range of geographical scales listed in Table 10.6-3 below. VER sensitivity was also informed by JNCCs Guidelines for the selection of biological SSSIs (under review) (SNH, 2006) and the description of UK protected sites on JNCC's website.

Table 10.6-3 Defining the Conservation Value of VERs

Conservation Value	Examples
International	Habitats or species that form part of the cited interest within an internationally protected site, such as those designated under the Habitats Directive (SACs, SPAs) or other international convention (e.g. Ramsar site). This also includes species listed in the EU Birds Directive when outside of areas designated for their protection, i.e. within the wider countryside, that may interact with the study area.
National	Habitats or species that form part of the cited interest within a nationally designated site, such as a SSSI, or a National Nature Reserve (NNR). A feature (e.g. habitat or population) which is either unique or sufficiently unusual to be considered as being one of the highest quality examples in a national / regional context for which the site could potentially be designated as a SSSI. Presence of UK BAP habitats or species, where the action plan states that all areas of representative habitat, or individuals of the species, should be protected. A species for which a significant proportion (>1 %) of the national population is found within the site. An ecologically-sensitive species (< 300 breeding pairs in the UK).
Regional	Habitats or species that form part of the cited interest of a Local Nature Reserve (LNR), or some local-level designated sites depending on specific site conditions. A feature (e.g. habitat or population), which is either unique or sufficiently unusual to be considered as being of nature conservation value up to a district or county context. A species for which a significant proportion (>1 %) of the regional population is found within the site. Presence of LBAP habitats or species, where the action plan states that all areas of representative habitat, or individuals of the species, should be protected.
Local	Habitats or species that form part of the cited interest of a local-level designated site and may be designated as a non-statutory Site of Importance for Nature Conservation (SINC) or the equivalent (e.g. Local Wildlife Site, Ancient Woodland designation). A feature (e.g. habitat or population) that is of nature conservation value in a local context only, with insufficient value to merit a formal nature conservation designation.
Negligible	Common place feature of little or no habitat / historical significance. Loss of such a feature would not be seen as detrimental to the ecology of the area.

Impact Magnitude of Development

10.6.4.5 The magnitude of a potential impact is determined by understanding how a VER will be impacted by the onshore transmission infrastructure. The scale of potential impacts is defined by the following:

- Potential duration, whether short term (< 5 yrs), medium term (5 to 15 yrs) or long term (15 to 25 yrs or longer);
- Reversibility, whether impacts will be reversible in the short to medium term; and
- Whether there are any direct or indirect cumulative impacts.

10.6.4.6 The magnitude of change on each VER is defined in Table 10.6-4 below.

Table 10.6-4 Defining the Impact Magnitude of a Development

Magnitude	Examples
Total / Near Total	Would cause the loss of a major proportion or whole feature / population, or cause sufficient damage to a feature to immediately affect its viability. Irreversible.
High	Major impacts on the feature / population which would have a sufficient impact to alter the nature of the feature in the short to long term and affect its long term viability. For example: more than 20 % habitat loss or long term damage, or more than 20 % loss of a species' population.
Medium	Impacts that are detectable in short and medium term, but which should not alter the long term viability of the feature / population. For example: between 10 to 20 % habitat loss or 10 to 20 % reduction of a species' population.
Low	Minor impacts, either of sufficiently small-scale or of short duration to cause no long term harm to the habitat / population. For example: less than 10 % loss or damage.
Negligible	A potential impact that is not expected to affect the habitat / population

Significance of Impacts

10.6.4.7 The significance of an impact on a VER is therefore determined by combining the conservation value of the VER with the impact magnitude of the onshore transmission infrastructure, as shown in Table 10.6-5 below.

Table 10.6-5 The Significance of an Impact on a VER, as Defined by the Relationship between Conservation Value and Impact Magnitude

Impact Magnitude	Conservation Value			
	International	**National**	**Regional**	**Local**
Total / Near Total	Major	Major	Major	Moderate
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

10.6.4.8 The significance of an impact generated from this matrix can be assessed against the likelihood of such predictions occurring, and the confidence level of the impact on a population, based on expert judgement and literature evidence. A scale of confidence, as recommended by the IPCC (Intergovernmental Panel on Climate Change) (2005) was used:

- Virtually certain, > 99 % probability of occurrence;
- Very likely, > 90 % probability;
- Likely, > 66 % probability;
- About as likely as not, 33 to 66 % probability;
- Unlikely, < 33 % probability;
- Very unlikely, < 10 % probability; and
- Exceptionally unlikely, < 1 % probability.

10.6.4.9 Using these criteria, and with rationales to explain the reasoning, the predicted level of significance was altered either downwards (e.g. from major to moderate) or upwards (e.g. from minor to moderate) based on expert judgement and scientific evidence.

10.6.4.10 The level of significance of the onshore transmission infrastructure on VERs was defined by the following:

- Negligible significance, an impact that is found not to be significant in the context of the stakeholder / regulator objectives or EIA legislative requirements;
- Minor significance, an impact considered sufficiently small (with or without mitigation) to be well within accepted standards. No action is required if it can be controlled by adopting normal good working practices;
- Moderate significance, an impact within accepted limits and standards. Moderate impacts may cover a broad range, although the emphasis is on demonstrating that the impact has been reduced to a level that is as low as reasonably practical, such impacts should be recognised and addressed in consultation with particular stakeholders; and
- Major significance, an impact where an acceptable limit or standard may be exceeded.

10.6.4.11 Impacts / residual impacts determined as negligible or minor are therefore not considered to be significant effects with regard to the EIA Regulations.

10.6.5 Impact Assessment: Onshore Transmission Infrastructure

10.6.5.1 The following paragraphs describe the likely significant effects on terrestrial ecology which could arise in the absence of mitigation during the following phases of the proposed development:

- Construction;
- Operation; and
- Decommissioning.

10.6.5.2 Due to the nature of the site and the work to be undertaken, a number of impacts may be similar for each phase of development. In particular, construction and decommissioning impacts are likely to be similar in type, extent and duration. As such, decommissioning impacts are not considered separately unless there is a requirement to differentiate likely impacts.

10.6.5.3 The following VERs were derived from baseline desk study and field survey results, for detail refer to Chapter 4.7 (Terrestrial Ecology), and considered for impact assessment:

- Loch of Strathbeg SPA and SSSI;
- Terrestrial breeding birds;
- Coastal wintering birds;
- Habitats;
- Otter and badger; and
- Bat roost and habitat suitability.

10.6.5.4 Although impacts of the onshore export cable have been fully assessed, impacts of the substation have not yet been fully assessed. This is because final locations of the converter and control buildings, dimensions of the temporary working area, and noise impacts, are still under consideration. Assessment has been made of impacts concerning the size and number of buildings comprising the substation. Impacts surrounding noise, lighting, level of human presence and installation have not been assessed as these details are not yet known.

Ornithological VERs

Receptor Sensitivity

10.6.5.5 Each VERs conservation value and sensitivity are described below.

Loch of Strathbeg SPA and SSSI

10.6.5.6 The Loch of Strathbeg SPA and SSSI, approximately 2.5 km from the onshore cable route at its nearest point, qualifies under Article 4.1 of the EU Birds Directive (2009 / 147 / EC) by supporting populations of European importance, and under the Wildlife and Countryside Act 1981 by supporting populations of UK importance:

- Breeding:
    - Sandwich tern: 530 pairs representing < 3.8 % of the breeding population in Great Britain (Five year peak mean, 1993 to 1997).
- Wintering:
    - Whooper swan, 183 individuals representing < 3.3 % of the wintering population in Great Britain (Five year peak mean 1991 to 1992 and 1995 to 1996).

10.6.5.7 The SPA also qualifies under Article 4.2 of the EU Birds Directive (2009 / 147 / EC) by supporting migratory populations of European importance, and under the Wildlife and Countryside Act 1981 by supporting populations of UK importance:

- Wintering:
    - Greylag goose, 3,325 individuals representing < 3.3 % of the wintering Iceland / UK / Ireland population (winter peak means);
    - Teal, 1,898 individuals representing <1.4 % of the population in Great Britain (Five year peak mean 1991 to1992 and 1995 to 1996);
    - Pink-footed goose, 39,924 individuals representing < 17.7 % of the wintering Eastern Greenland / Iceland / UK population (Five year peak mean 1991 to 1992 and 1995 to 1996); and
    - Goldeneye, 109 individuals representing < 0.6 % of the population in Great Britain (Five year peak mean 1991 to 1992 and 1995 to 1996).

10.6.5.8 The SPA also has an assemblage qualification, and qualifies under Article 4.2 and the Wildlife and Countryside Act 1981 by supporting 49,456 waterfowl (5 yr peak mean 01 / 04 / 1998).

10.6.5.9 Since the bulk of cable installation will occur inland, the potential for a significant impact will be minimal for those qualifying species that spend their time within the SPA / SSSI foraging predominantly in the loch itself, or nearby coastal waters. No significant impacts are therefore predicted for Sandwich tern, whooper swan, teal or goldeneye.

10.6.5.10 The largest overlap of site utilisation is likely to occur for wintering pink-footed goose and greylag goose, where birds may use agricultural fields along the onshore cable route for feeding.

10.6.5.11 Although numbers of pink-footed goose within the UK are high (a peak total of 297,798 individuals in October 2010, Mitchell, 2011), the Loch of Strathbeg SPA and SSSI forms one of the major sites in the UK, with a 5 yr peak mean (2005 to 09) of 44,740 individuals (Mitchell, 2011). Due to the potential connectivity of any birds found on site with the SPA, the species is considered to be a VER of international conservation value.

10.6.5.12 Greylag goose is found in smaller numbers within the SPA, with a 5 yr peak mean of 247 birds between 2005 to 2006 and 2009 to 2010 in the overlapping Wetland Bird Survey (WeBS) count sector (Holt *et al*., 2011). The species has suffered a decline within the SPA due to a general redistribution of numbers to more northerly wintering locations such as Orkney over recent years. Nevertheless, as an SPA qualifier the species is of international conservation value.

Terrestrial Breeding Birds

10.6.5.13 A total of 80 species were recorded during breeding bird surveys and of these, 29 were considered for territory analysis. For results tables and detailed figures, refer to Technical Appendix 4.7 A. The aim of the evaluation of impacts on VERs was to report on 'likely' significant impacts, based on EIA Regulations and IEEM guidance. As such, a number of species were discounted from assessment as baseline field survey results indicated that significant impacts were not likely to occur at a regional scale or above (for example: if no breeding was recorded and site usage was rare). Consequently, such impacts did not require assessment under the terms of the EIA Regulations.

10.6.5.14 During the process of identifying VERs, only species of conservation value were considered. Amber-listed species not forming part of a UK BAP action plan were discounted as their conservation status generally reflects a decline in numbers rather than rareness; they are still relatively common and widespread in the UK. Even though these species were identified as breeding or at least present within the study area, they occurred in very low numbers (absolutely and / or relative to national and regional populations) in an area of limited habitat suitability. Any species recorded flying in low numbers, not using the site for breeding, feeding or roosting, was omitted from the assessment.

10.6.5.15 Estimated populations of remaining species among terrestrial breeding bird VERs were then assessed in context of larger, regional and national breeding populations, as shown in Table 10.6-6 below. For site population, each territory is assumed to be a pair unless surveyors provided a colony count.

Table 10.6-6 Conservation Value of Terrestrial Breeding Bird VERs

Bird Species	UK Population (pairs) (Baker *et al.*, 2006)	Regional Population (Forrester *et al.*, 2007)	Site Population (number of territories)	Site Population % of Regional Population	Conservation Value
Corn Bunting	8,500 to 12,200	550 to 600	30	5.0 to 5.5	Regional
Curlew	107,000	1,067	6	0.6	Regional
Grasshopper Warbler	11,750	500 + (est.)	3	0.6	Regional

Bird Species	UK Population (pairs) (Baker *et al.*, 2006)	Regional Population (Forrester *et al.*, 2007)	Site Population (number of territories)	Site Population % of Regional Population	Conservation Value
Grey Partridge	70,000 to 75,000	500 to 1,000 (est.)	1	0.1 to 0.2	Regional
Herring Gull	139,309	15,272*	63* (colony)	0.4	Regional
House Sparrow	2.1 to 3.6 m	30,000	65 (colonies)	0.2	Regional
Lapwing	156,000	7,314	16	0.2	Regional
Lesser Redpoll	26,900	2,238	1	0.04	Regional
Linnet	556,000	5,500	38	0.7	Regional
Quail	4 to 315	86	2	2.3	Regional
Reed Bunting	192,000 to 211,000	2,600	16	0.6	Regional
Skylark	1,785,000	50,000 (est.)	370	0.7	Regional
Song Thrush	1,144,000	18,000	18	0.1	Regional
Starling	804,000	13,000	56 (colonies)	0.4	Regional
Tree Sparrow	68,000	1,800	11 (colonies)	0.6	Regional
Yellowhammer	792,000	14,500	228	1.6	Regional

**Seabird 2000 count of nearest colonies – all are outside the onshore cable route*

Coastal Wintering Birds

10.6.5.16 Relevant wetland bird count data were received from WeBS for two count sites: Fraserburgh Bay (at the proposed landfall site at Fraserburgh beach) and Loch of Strathbeg (approximately 2.5 km from the onshore cable route at its nearest point). For results tables, refer to Technical Appendix 4.7 A.

10.6.5.17 Due to the largely inshore siting of the export cable, it can be reasonably assumed that only coastal wintering bird species inhabiting the shoreline may be affected. Thus, species inhabiting coastal waters (e.g. divers, eider) were excluded from assessment on the grounds that they occur beyond the reasonable zone of influence from cable installation. The remaining shorebird assemblage comprises waders (particularly golden plover and lapwing), ducks (e.g. wigeon and teal) and gulls (common gull, black-headed gull, great black-backed gull and herring gull), with higher peak counts found within the larger Loch of Strathbeg site. The Loch of Strathbeg site likely holds much larger numbers of birds than the proposed landfall site at Fraserbrugh beach, however it does provide an indicator of the bird assemblage likely to be present at the landfall site. As wintering shorebird presence within the onshore cable route is unknown, it is unrealistic to attempt to assess each species separately, and since species are likely to respond to impacts in similar ways, it is reasonable to consider coastal wintering birds as a single VER. This VER is considered to be of regional conservation value, based on the peak counts of birds affected likely being of regional importance at the most, and the relative mobility of species concerned during the winter period.

10.6.5.18 Buchan Ness to Collieston Coast SPA and Troup, Pennan and Lion's Heads SPA were also considered as VERs, but were scoped out of impact assessment. A herring gull colony of 4,292 pairs (2.7 % of the GB population) near Boddam was highlighted as concern for being a qualifying feature of the Buchan Ness to Collieston Coast SPA. However as the town of Boddam lies between the SPA and the onshore cable route, the colony is likely to be habituated to human activity and buffered from the cable route construction, operation and decommissioning processes.

Impact Assessment (Ornithology)

Construction (Ornithology)

10.6.5.19 Likely significant construction effects of the onshore export cable and substation on the Loch of Strathbeg SPA and SSSI, terrestrial breeding birds and coastal wintering bird VERs are:

- Habitat loss (both short and long term); and
- Temporary, short term disturbance and displacement due to increased noise and presence of humans and machinery.

Habitat Loss

10.6.5.20 Construction of the onshore export cable and jointing pits is likely to result in the temporary loss of potential breeding, feeding or roosting habitat, restricted to a 20 m wide corridor along the onshore cable route. This is expected to affect any particular local stretch of cable route for no more than two seasons (if cable burial activities undertaken in two separate activities), as habitat will be restored after cable installation. Construction of the substation will result in the short term loss of habitat in the temporary working area and the long term loss of habitat within the substation footprint.

Loch of Strathbeg SPA and SSSI

10.6.5.21 At approximately 2.5 km distant from the export cable and 14.4 km distant from the substation, no habitat will be lost within the SPA or SSSI. However there is likely to be some connectivity of individuals between the SPA and the export cable. Geese are highly mobile species, foraging within a radius of up to 20 km of roost sites (Patterson, 2006). Locally, SNH's Loch of Strathbeg GMS operates during March and April when geese are vulnerable prior to migration, providing valuable refuges.

10.6.5.22 Compared to overall foraging range and the likelihood of alternative habitat available, the impact magnitude of habitat loss caused by the export cable and substation is considered to be negligible to this VER of international conservation value, resulting in at worst an indirect, short term, temporary, negative impact of **minor significance**.

Terrestrial Breeding Birds

10.6.5.23 The herring gull colony is outside the onshore cable route and approximately 25.7 km distant from the substation, therefore no breeding habitat will be lost for this species (negligible magnitude).

10.6.5.24 The magnitude of habitat loss for breeding birds found within the onshore cable route depends on each species' population, foraging range, habitat preferences and flexibility to cope with any loss. An unknown number of passerine territories are likely to be significantly affected by the export cable and substation. However, this would be for one breeding season only for cable installation and substation construction within the temporary working area, although long term within the substation footprint. Impacts are unlikely to be significant at anything above local level for the majority of species, which should easily recover over the long term.

10.6.5.25 In a worst case scenario, a number of territories of regionally-important species (e.g. quail, tree sparrow) may be impacted, leading to an impact caused by the export cable and substation of low-medium magnitude on these VERs, and resulting in an indirect, short term, temporary, negative impact of **minor significance** on their regional populations.

Coastal Wintering Birds

10.6.5.26 A small amount of foraging or roosting habitat may be lost along the shoreline due to cable installation, potentially affecting wader species in particular, which may be specialised and rely on particular niches. However the magnitude of such impacts is likely to be low considering the overall habitat available within potential foraging range and the mobility of birds during winter. Coastal wintering birds are unlikely to be affected by substation construction, as the buildings will be set approximately 500 m inland. As the assemblage is of regional conservation value, this will result in an indirect, short term, temporary, negative impact caused by the export cable and substation of **minor significance** for any species.

Disturbance / Displacement

10.6.5.27 Construction is planned to commence in 2015. The export cable and jointing pits will pass through the shoreline and some agricultural areas where goose usage is likely.

Loch of Strathbeg SPA and SSSI

10.6.5.28 The long term significance of disturbance on wintering geese in the vicinity of the onshore cable route and substation is difficult to assess accurately due to the fluidity of flock movements within the Loch of Strathbeg catchment area. Geese are known to have a variable tolerance for disturbance at roosting and feeding sites depending on the source and duration of disturbance and opportunity for habituation. Impact is likely to be most significant during times of peak numbers during staging in early autumn (mid September to November) and early spring (late March to April), when birds are in poorer condition.

10.6.5.29 The SPA is approximately 2.5 km from the onshore cable route and 14.4 km from the substation, thus no birds within the SPA will be disturbed by any construction related activities. Keller (1991) found that pink-footed and greylag geese wintering in north east Scotland tended to avoid areas of fields 100 m from the nearest road, and not visit fields with centres closer than 100 m from any road. The impact of roads and landscape features on field utilisation of pink-footed geese in autumn and spring was studied by Madsen (1985). The disturbance distance of roads with traffic volume of more than 20 cars per day was approximately 500 m in autumn and less in spring. This is dependent on landscape (for example: windbreaks, banks, etc.) which was shown to reduce disturbance distance to approximately 200 to 300 m. The median disturbance distance given by Hötker *et al*., (2006) for geese around wind farms is 370 m.

10.6.5.30 Construction will be staged, with relatively small sections of the onshore cable route undergoing works at any time. Displacement of geese due to construction disturbance (increased noise and human presence) is therefore likely to be restricted to one small area at a time, up to approximately 500 m from the activity. This is not likely to affect a significant proportion of the geese SPA populations. Prolonged and repeated disturbance along the route is not anticipated for each single cable burial activity, with construction works progressing in a linear fashion without the need to return to a previous area of work (unless environmental constraints negate linear progression). Disturbance will be temporary and birds will have the opportunity to return to a site once the disturbance has been removed.

10.6.5.31 The magnitude of disturbance / displacement impacts caused by the export cable and substation is predicted to be low, short term and reversible, therefore the impact on this VER of international conservation value is at worst direct, short term, temporary, negative and of **moderate significance**.

Terrestrial Breeding birds

10.6.5.32 A herring gull colony within Fraserburgh town lies approximately 180 m from the onshore cable route; however, these birds are likely to be habituated to human disturbance. The colony is 25.7 km distant from the substation. Thus, no adverse impacts are predicted (negligible magnitude).

10.6.5.33 Depending on the timing of construction works in any particular location, it is possible that some farmland breeding birds may be temporarily disrupted by construction of the export cable and substation, which may lead to brood failure or abandonment of a territory. This might occur over one breeding season at most, when construction may overlap with breeding activities.

10.6.5.34 In a worst case scenario, this would lead to an impact caused by the export cable and substation of low-medium magnitude on VERs of regional conservation value, and result in a direct, short term, temporary, negative impact of **minor significance**.

Coastal Wintering Birds

10.6.5.35 The distance at which avoidance behaviour takes place varies between shoreline species, independent of site. Differences can also occur depending on local conditions (for example: the availability of suitable habitat will influence response), with birds more likely to tolerate disturbance either if there is no alternative habitat, or the habitat within disturbance distance is of particularly high quality (Gill *et al.,* 2001).

10.6.5.36 Smit and Visser (1993) recorded distances of up to 120 m for roosting waders and gulls taking flight in response to human activity. IECS (Institute of Estuarine and Coastal Studies) (2007) studied responses of shorebirds to flood defence works in the Humber Estuary and showed that birds continued to feed within 200 m of piling operations. During repair work along a pipeline, birds remained within 100 m when workers were active, and flocks returned to the nearby vicinity within 15 mins of activity ceasing. Construction activity using a mechanical digger caused birds to remain 100 m from the locality, but return within 30 mins of cessation.

10.6.5.37 A literature review of shorebird disturbance by Cutts *et al.,* (2009) showed a minimal impact of more than 300 m from feeding or roosting birds, with curlew being the most sensitive and common wader species showing responses out to 150 m.

10.6.5.38 It is therefore the case that any activities associated with cable installation will be short term in nature and likely to displace feeding or roosting shorebirds within a 300 m radius. Whilst this may affect feeding activities, it is unlikely that any VER will be significantly affected over the course of a whole winter, thereby increasing mortality rates. Birds are likely to be able to feed in the vicinity of the onshore cable route soon after activity has ceased. Coastal wintering birds are unlikely to be affected by substation construction, as the buildings will be set approximately 500 m inland.

10.6.5.39 No more than a low magnitude impact is predicted for any VER, resulting in a direct, short term, temporary, negative impact caused by the export cable and substation of **minor significance** on regional populations.

Operation (Ornithology)

10.6.5.40 As the cable will be installed approximately 1 m underground, and restoration of habitat affected during installation of the cable and jointing pits will take place immediately afterwards, operation impacts of the export cable on ornithological VERs are mainly expected to be negligible. Exceptions to this may occur due to human activity associated with repair works along the cable route (no maintenance works for the onshore export cable are predicted). Such repair works are likely to be rare and only as a result of third party intervention. Operation impacts of the substation will mostly relate to operational noise. Potential operation impacts of the export cable and substation on ornithological VERs are:

- Export cable: temporary, short term disturbance and displacement due to increased noise and presence of humans and machinery due repair works; and
- Substation: long term disturbance and displacement due to increased noise.

Loch of Strathbeg SPA and SSSI

10.6.5.41 As explained in relation to construction, the SPA itself will be unaffected by any works due to the distance being beyond the likely zone of influence from any activities. Whilst some geese using the vicinity of the onshore cable route may be disturbed during feeding, this would be very much a short term impact restricted to the period of repair. Although the duration of such activity is unknown, it is likely to take place over a very small area, and so the magnitude of impact is likely to be negligible. Geese are unlikely to be affected by noise or human presence in the vicinity of the substation. This would result in no more than an indirect, short term, temporary, negative impact caused by the export cable and substation of **minor significance** on this VER of international conservation value.

Terrestrial Breeding Birds

10.6.5.42 Due to the limited, local extent of any operations, only a small number of farmland bird territories would likely be affected by operation of the export cable. Noise from the substation however could interfere with territorial display. This is unlikely to be significant to any VER resulting in a negligible-low magnitude impact caused by the export cable and substation, with at worst an indirect, short term, temporary, negative impact of **minor significance** in a worst case scenario for rarer species such as quail or corn bunting.

Coastal Wintering Birds

10.6.5.43 As with breeding birds, the temporary displacement of shorebirds from feeding or roosting activity during operation of the export cable is unlikely to be significant to any VER, resulting in a negligible to low impact magnitude. Coastal wintering birds are unlikely to be affected by substation construction, as the buildings will be set approximately 500 m inland. This would result in an indirect, short term, temporary, negative impact caused by the export cable and substation of **negligible significance** on any species at a regional level.

Decommissioning (Ornithology)

10.6.5.44 Although the timing and duration of decommissioning works are unknown, it is likely that they will be of a similar nature to those during construction. The predicted significance of impacts for ornithological VERs during construction outlined above are therefore also applicable to decommissioning of the export cable, jointing pits and substation, although the confidence in such predictions are lower due to the uncertainty of timing and also the possibility that species assemblage, numbers and distribution may change over the long term.

Habitat VERs

Receptor Sensitivity

10.6.5.45 The following paragraphs assess the conservation value and sensitivity of habitat VERs, these are shown in Table 10.6-7 below. Four conservation designated sites were selected as habitat VERs as they may be influenced by the development. Habitats with the potential to overlap with Annex I habitats, UK BAP or NE LBAP priority habitats were also selected.

Table 10.6-7 Conservation Value of Habitat VERs

Habitat VER	Status within Onshore Cable Route and Qualifying Features	Conservation Value (descending order)
Buchan Ness to Collieston SAC	South of the onshore cable route, this area is designated for its vegetated sea cliffs.	International
Loch of Strathbeg SPA, Ramsar and SSSI	North east of the onshore cable route, this area is designated for its breeding bird assemblage and fen meadow, eutrophic loch and sand dunes habitats.	International
Rora Moss SSSI	East of the onshore cable route this area is designated for its raised bog habitat.	National

Habitat VER	Status within Onshore Cable Route and Qualifying Features	Conservation Value (descending order)
Dry Modified Bog	Recorded in four areas within the onshore cable route. This habitat has been extensively disturbed. One NVC (National Vegetation Community) community is both an Annex I habitat and a UK BAP priority habitat: M19a.	Regional
Blanket Bog	Recorded in four areas within the onshore cable route. Two NVC communities are both Annex I habitat and UK BAP priority habitat: M17a and M19a.	Regional
Acid / Neutral Flush	Recorded in several areas within the onshore cable route. Two NVC communities are UK BAP priority habitat: M6c and M23; and three NVC communities are both Annex I habitats and UK BAP priority habitats: M2b, M4 and M5.	Regional
Dune Grassland Coastland	North end of onshore cable route. These habitats are listed as Annex I habitats, UK BAP and LBAP priority habitats.	Regional
Semi-Improved and Unimproved Neutral Grassland	Scattered across the onshore cable route. These habitats are listed as UK BAP and LBAP priority habitats.	Regional
Watercourses and Standing Water	The River Ugie is the major watercourse crossing the onshore cable route, with a number of smaller burns also present. Large watercourses are listed as UK BAP priority habitats while smaller burns are listed as NE LBAP priority habitats.	Regional
Swamp, Marginal and Inundation Vegetation	These habitats are listed as both UK BAP and NE LBAP priority habitats.	Regional
Waters of Philorth LNR	Overlaps the onshore cable route by approximately 100 m at Fraserburgh Bay, this area is designated for its estuarine environment	Local
Marshy Grassland	This habitat is associated with UK BAP priority habitats.	Local
Waterbodies	Waterbodies in the form of small ponds are present across the onshore cable route and are listed as a priority habitat within the NE LBAP.	Local
Plantation and Semi-Natural Woodlands	Woodland is included on both the UK BAP and the NE LBAP, with areas of semi-natural woodland included on the SBL; however these areas of habitat are small and fragmented.	Local
Arable Land	Farmland, field margins and boundary habitat are listed on the NE LBAP.	Local
Improved Grassland	Farmland, field margins and boundary habitat are listed on the NE LBAP.	Local
Tall Ruderal Herb And Fern	Field margins are listed on the NE LBAP.	Local
Amenity Grassland	Amenity grassland is listed on the NE LBAP as important within an urban context for conservation throughout the area.	Local
Scattered and Dense Scrub	Both scattered and dense scrub are listed in a number of UK BAP priority habitats, however the fragmented nature of these habitats within the onshore cable route lessens their importance within the national context.	Local
Ephemeral / Short Perennial	This habitat is listed on the UK BAP as a priority habitat within the Maritime and Cliff Slopes UK BAP.	Local

Impact Assessment (Habitats)

Construction (Habitats)

Pollution of Conservation Designated Sites

10.6.5.46 The export cable, jointing pits and substation may affect conservation designated sites through water borne pollution into water systems linking the corridor to the designated sites (for example: through a fuel, chemical or oil pollution incident, through increased sedimentation and turbidity in run-off, or through direct habitat loss).

10.6.5.47 Buchan Ness to Collieston SAC lies approximately 770 m from the onshore cable route and 1.4 km from the substation. As the qualifying feature of the SAC is vegetated sea cliffs, the impact magnitude of pollution on this VER of international conservation value is likely to be negligible. Overall significance caused by the export cable and substation is therefore likely to be direct, medium term, temporary, negative and **minor**.

10.6.5.48 The Loch of Strathbeg Ramsar and SSSI lie approximately 2.5 km from the onshore cable route and 14.4 km from the substation. This substantial distance will dissipate any pollution incident in linking water systems. For detail on the Loch of Strathbeg watershed, refer to Chapter 3.7 and Chapter 9.3 (Hydrology, Geology and Hydrogeology). The impact of pollution on this VER of international conservation value will be of negligible magnitude, therefore the impact caused by the export cable and substation will be direct, short term, temporary, negative and of **minor significance**.

10.6.5.49 Rora Moss SSSI lies approximately 610 m from the onshore cable route and 10.4 km from the substation, and as such will not suffer any direct habitat loss. However the site is designated for its raised bog community which is dependent on the integrity of the surrounding hydrology for the continued existence of the species creating the protected habitat. A pollution event is unlikely to cause disruption to this VER of national conservation value, impact magnitude will therefore be negligible and impact significance caused by the export cable and substation will be direct, short term, temporary, negative and **negligible**.

10.6.5.50 The Waters of Philorth LNR overlaps the onshore cable route by approximately 100 m at Fraserburgh Bay and lies approximately 23.4 km from the substation. The distance from the substation is sufficient to negate any impact. The LNR is designated for its sand dune and estuarine habitats. Pollution of sand dune habitat could occur through fine dusts from trenching or a spill of hazardous chemicals from construction plant. However the onshore cable route contains in an in-built 250 m buffer so the LNR in fact lies a minimum of approximately 625 m from any works. Moreover, as the onshore cable route is very wide here (approximately 2.8 km) the potential working area inside the buffer is also very wide, thus reducing the possibility that works may take place at the edge closest to the LNR (the east edge). Pollution of estuarine habitat could occur through particulate run-off from trenching or through a spill of hazardous chemicals from construction plant. Such pollution could reach the LNR via the Water of Philorth burn which crosses the onshore cable route before reaching the estuary and LNR approximately 60 m downstream. Such pollution is unlikely however, this LNR is vulnerable due its small size (0.2 km^2), its close proximity to the onshore cable route and its direct connection to the cable route via the burn. This VER of local conservation value may be exposed to an impact of high magnitude and therefore the impact caused by the export cable and substation will be indirect, short term, temporary, negative and of **minor** significance.

Pollution of Terrestrial Habitats

10.6.5.51 Pollution can arise in the form of fine sediment dusts associated with earthworks, track construction, borrow pit activities and transportation of construction material along temporary roads. Pollution of habitats may also occur from the release of environmentally hazardous chemicals (e.g. fuels and oils from construction plant). This has the potential to result in the loss of vegetation and / or alteration of substrate chemistry through an increase in nutrients from either substances required to deal with chemical spills or the spills themselves. These have the potential to result in detrimental changes to vegetation communities in the long term. Even in a worst case scenario however, a pollution event is only likely to impact a localised area. The impact magnitude is therefore low and impacts caused by the export cable and substation on terrestrial habitat VERs of local-regional conservation value will be direct, medium term, temporary, negative and range from **negligible-minor significance**.

Pollution of Freshwater Habitats

10.6.5.52 There is potential for watercourses to be impacted during construction by a variety of pollution types. These include sediment run-off from earthworks and infrastructure giving rise to changes in water turbidity levels, oxygen saturation levels and water pH. There is also the potential for pollution to arise through chemical spills from hazardous materials, including fuels and oils. The magnitude of these impacts is influenced by a variety of factors including flow levels within the watercourse, with pollution and sedimentation during low flows having a higher potential impact than during high flows when greater dilution occurs. Therefore, for the purpose of this chapter, these impacts have been assessed as a worst case scenario of pollution or sedimentation occurring during a period of low water flow.

10.6.5.53 For freshwater habitat VERs of local-regional conservation value, a medium impact magnitude caused by the export cable and substation would lead to a direct, medium term, temporary, negative impact of **minor significance**.

Damage and Disturbance to Habitats

10.6.5.54 Construction will cause some damage to habitats and changes to community composition. Wet habitats such as blanket bog and flush systems are especially sensitive to damage, as shown in Table 10.6-8 below. The dune grassland coastland habitat at the Fraserburgh Bay landfall site will be left in as natural condition as possible; this is because HDD will be the installation method used here, this method is technically feasible for up to 1 km and the dune grassland habitat extends for approximately 300 m at its widest point. For all habitat VERs, as conservation values range from local-regional and the impact magnitude of construction ranges from negligible-medium, impact significance caused by the export cable and substation will therefore be direct, medium term, temporary, negative and range from **negligible-minor**.

Table 10.6-8 Impact Significance of the Export Cable on Habitat VERs Caused by Damage and Disturbance during Construction

Habitat VER	Conservation Value	Impact Magnitude	Impact Significance (descending order)
Blanket Bog	Regional	Medium	Minor

Habitat VER	Conservation Value	Impact Magnitude	Impact Significance (descending order)
Acid / Neutral Flush	Regional	Medium	Minor
Dry Modified Bog	Regional	Low	Minor
Dune Grassland Coastland	Regional	Low	Minor
Semi-improved and Unimproved Neutral Grassland	Regional	Low	Minor
Watercourses and Standing Water	Regional	Medium	Minor
Swamp, Marginal and Inundation Vegetation	Regional	Low	Minor
Waterbodies	Local	Medium	Minor
Plantation and Semi-Natural Woodlands	Local	Medium	Minor
Arable Land	Local	Medium	Minor
Marshy Grassland	Local	Low	Negligible
Improved Grassland	Local	Low	Negligible
Tall Ruderal Herb And Fern	Local	Low	Negligible
Amenity Grassland	Local	Negligible	Negligible
Dense / Scattered Scrub	Local	Low	Negligible
Ephemeral / Short Perennial	Local	Low	Negligible

Operation (Habitats)

Pollution or Damage to Terrestrial Habitats during Maintenance Activities

10.6.5.55 There is the potential for temporary damage and disturbance to habitats during maintenance operations and emergency works on the export cable. This may lead to temporary habitat loss and / or permanent habitat degradation. Maintenance that requires use of machinery could result in a pollution incident adversely affecting surrounding terrestrial habitats. Due to the infrequent nature of these works there is a low likelihood of this damage occurring, however the possible emergency nature of these works and lack of an ECoW (Ecological Clerk of Works) during these times could lead to a medium level of damage in a localised area. Impact magnitude caused by the export cable and substation is likely to be medium, thus pollution or damage impacts on terrestrial habitat VERs of local-regional conservation value will be direct, short term, temporary, negative and of **minor significance**.

Pollution or Damage to Freshwater Habitats during Maintenance Activities

10.6.5.56 Maintenance activities during operation may result in pollution incidents impacting aquatic habitats and species. There is also the potential for these activities to result in the disturbance of fish species through noise and vibration generated through the operation of machinery. As maintenance activities will be carried out infrequently and be relatively short term, the risk of pollution events and disturbance is reduced in comparison to the construction phase. Impact magnitude caused by the export cable and substation is likely to be low-medium, thus pollution or damage impacts on freshwater habitat VERs of local-regional conservation value will be direct, short term, temporary, negative and of **negligible-minor significance**.

Decommissioning (Habitats)

10.6.5.57 Although the timing and duration of decommissioning works are unknown, it is likely that they will be of a similar nature to those during construction. The predicted significance of impacts for habitats VERs during construction outlined above are therefore also applicable to decommissioning of the export cable and the substation, although the confidence in such predictions are lower due to the uncertainty of timing and also the possibility that habitats may change over the long term.

Otter and Badger VERs

Otter

10.6.5.58 Otters are a European protected species, thus any development with potential negative impacts on otters may require a licence to proceed.

10.6.5.59 Baseline results confirm that otters inhabit the River Ugie and its tributaries. The majority of otter prints, spraints and couches were found along the River Ugie and the Burn of Faichfield (a tributary of the River Ugie). Further evidence was found along drainage ditches and by ponds.

Habitat Loss

10.6.5.60 HDD (horizontal directional drilling) will be used for cable installation across large watercourses, for detail, refer to Chapter 9.3 (Hydrology, Geology and Hydrogeology). HDD plans and procedures will be agreed in advance with SEPA. The nearest otter evidence (a spraint) to the substation is 6.6 km away. There will be no direct impacts to otters in terms of habitat loss caused by the export cable or substation.

Disturbance

10.6.5.61 Otters are mainly active from dusk through the night to dawn and thus can be affected by early morning and late evening construction activities. During the longer nights of autumn and winter otters are also likely to be active during daily construction. However, disturbance impacts on active otters will be limited as construction activities will be relatively localised and short term. Otter resting sites (holts and couches) are occupied through the day when most construction activity will occur; thus it is possible that otters may be affected within the onshore cable route during construction. However, as the nearest otter evidence (a spraint) to the substation is 6.6 km away it is unlikely that the substation will cause any negative impacts.

10.6.5.62 Otters are also at risk of becoming trapped in excavations or pipework left open overnight. If a method of escape is not provided, injury or death can result. Standard procedures, specifically CEMP, will be in place to address this risk.

10.6.5.63 As a VER of international conservation value, the magnitude of habitat loss and disturbance impacts caused by the export cable and substation is predicted to be low, leading to an impact of direct and indirect, short term, temporary, negative and **moderate significance** for otter.

Badger

10.6.5.64 Badgers are legally protected under the Protection of Badgers Act 1992.

Habitat Loss and Disturbance

10.6.5.65 Any habitat loss or damage within 30 m of a sett, or sett destruction itself, will require a license from SNH.

10.6.5.66 Indirect impacts may occur on badger populations as commuting paths and foraging areas may be lost or disrupted, and foraging habitat may be disturbed or temporarily fragmented. The increased levels of human and construction activity will also disturb badgers. Badgers are also at risk of becoming trapped in excavations or pipework left open overnight. If a method of escape is not provided, injury or death can result. Standard procedures, specifically CEMP, will be in place to address this risk. The nearest badger evidence (hair) to the substation is 2.4 km away, suggesting that habitat in the vicinity of the substation is not highly suitable for badgers.

10.6.5.67 As a VER of national conservation value, the magnitude of habitat loss and disturbance impacts caused by the export cable and substation is predicted to be medium, leading to an impact of direct and indirect, short term, temporary, negative and **moderate significance** for badger.

Bat Roost and Habitat Suitability VER

10.6.5.68 Bat habitat surveys identified that the onshore cable route includes only small areas of high value bat habitat (mature deciduous woodlands with water and set in a connected landscape with buildings). There are few linear habitat features crossing the route which appear to connect areas of nearby high value habitat / roost potential. The substation location lies entirely within low value bat habitat. Thus, it is likely the main issues will be:

- A few areas of mature trees which might need to be felled and which could contain crevices suitable for bats to roost, thereby threatening bat roosts;
- A few connected linear elements where commuting or foraging bats may be disturbed by works, and where potential loss of the linear feature could impact on population viability; and
- A few areas of high value bat habitat where loss of trees may reduce habitat connectivity, and / or reduce the amount of sheltered foraging habitat.

10.6.5.69 Although the conservation value of bats is high, the importance of Aberdeenshire populations within a UK context is low, and species biodiversity will also be low. Without mitigation however, disturbance / displacement impacts could have negative consequences on breeding, roosting or commuting bats in such sparse and marginal quality bat habitat.

10.6.5.70 The bat habitat is of local conservation value; the magnitude of habitat loss and disturbance / displacement impacts caused by the export cable and substation are medium; impacts are both, direct and indirect, short term, temporary, negative and of **minor-moderate significance**.

10.6.6 Proposed Monitoring and Mitigation

Ornithological VERs

Construction (Ornithology)

10.6.6.1 Although no impacts of major significance on ornithological VERs were predicted from any aspect of construction, an impact of moderate significance was predicted as a result of potential disturbance / displacement to geese connected with the Loch of Strathbeg SPA and SSSI. Mitigation will therefore be required to ensure any impacts will be tolerable and not significant on SPA populations. In addition, there is a need to follow best practice during construction to ensure compliance with legislation concerning disturbance to terrestrial breeding birds.

Loch of Strathbeg SPA and SSSI

10.6.6.2 On a temporal scale, construction activity and vehicle access should seek to avoid the most sensitive periods for disturbance to overwintering geese within 500 m of designated refuge and feeding areas, as identified by the Loch of Strathbeg GMS, during staging in early autumn from mid-September to November, and particularly in early spring from late March to April.

10.6.6.3 The diurnal timing of construction activity should seek to avoid the critical period of dawn and dusk goose migration within 500 m of the Loch of Strathbeg roost site and key foraging areas during the wintering period.

10.6.6.4 On a spatial scale, construction activity and vehicle access should be minimised to prevent excessive disturbance / habitat loss degradation, particularly near important goose feeding areas identified by the Loch of Strathbeg GMS.

Terrestrial Breeding Birds

10.6.6.5 Under the Wildlife and Countryside Act 1981 as amended by the Nature Conservation (Scotland) Act 2004, it is an offence with only limited exceptions, to:

- Intentionally or recklessly take, interfere with, damage or destroy the nest of any wild bird whilst it is in use or being built;
- Intentionally or recklessly take, interfere with or destroy the egg of any wild bird; or
- Intentionally or recklessly disturb any wild bird listed on Schedule 1 while it is nest-building, or at (or near) a nest containing eggs or young, or disturb the dependent young of such a bird.

10.6.6.6 Best practice will be necessary to reduce the possibility of illegal damage, destruction or disturbance to occupied bird nests during construction (or during any maintenance work during operation). Three best practice measures will be adopted: timing, preconstruction surveys and the presence of an ECoW during works.

10.6.6.7 If feasible, construction activities within areas of identified sensitivity to breeding birds will be timed to avoid the main breeding season from mid-March to July inclusive, so as to avoid nest destruction and disturbance to breeding birds. SNH (2011) however recognise that this is normally not possible, as this season coincides with the best weather for construction. In such situations, SNH recommend that preconstruction breeding bird surveys take place.

10.6.6.8 Preconstruction surveys will be undertaken to locate nesting birds in the vicinity of construction works to ensure nests are not disturbed. Works may be programmed to avoid disturbance, or an area can be cordoned off. With a large site such as the onshore cable route, a number of surveys will be required as construction progresses through the site. If quail, or any other Schedule 1 species, is recorded breeding, buffer distances must be enforced to avoid committing an offence. In this case, and also if birds are nesting outside of controlled areas but in the opinion of the ECoW within possible disturbance zones, the work will either be re-scheduled or the nest site cordoned-off and destruction prevented. Buffer distances are species and site-specific, and will be agreed with SNH prior to construction. For quail, a buffer of up to 100 m is likely to be sufficient as the species breeds within agricultural landscapes already characterised by regular farming activities.

10.6.6.9 Compliance with the law will be achieved by appointment of a suitably experienced ornithologist as ECoW to locate any active nests close to construction works shortly before these commence. There will be a clear line of responsibility for ensuring these measures are followed.

10.6.6.10 The passerine species recorded within the onshore cable route display greater habitat use flexibility in the winter, as territorial behaviour is absent or decreased and juveniles have dispersed. For most passerines, prioritising construction during winter months will allow birds to temporarily avoid impacts.

10.6.6.11 Of the more uncommon and potentially sensitive species recorded, quails are present from late April to late summer only, and so no adverse impacts will result if activities are scheduled outside this period. Corn buntings show high site fidelity, but will temporarily relocate during the winter if a preferable food source becomes available.

10.6.6.12 Standard mitigation requires that habitats affected by construction will be restored to previous use, and this will avoid any long term impacts of construction activity.

Coastal Wintering Birds

10.6.6.13 No significant effects were predicted for coastal wintering birds and so no specific mitigation is required under the terms of the EIA Regulations. Nevertheless, numbers of coastal species will be higher in winter months, and so it would be advantageous for coastal work to take place during summer months. This will minimise impacts on wintering birds.

Operation (Ornithology)

10.6.6.14 No significant effects were predicted during operation. However significant routine maintenance activities which have the potential to cause disturbance to wintering geese should not be undertaken from October to March (inclusive) within 500 m of areas that support important numbers of geese, unless there is an overriding public interest (e.g. a compromise of security of supply or safety).

10.6.6.15 Similarly, routine maintenance or emergency works may have to comply with the Wildlife and Countryside Act 1981 legislation outlined above if works are to take place during the breeding season to avoid nest destruction and disturbance to terrestrial breeding birds.

10.6.6.16 Emergency maintenance should be carried out with due regard to the protection of SPA qualifying features and terrestrial breeding birds. An emergency works environmental action plan should be prepared to ensure minimal environmental impacts.

Decommissioning (Ornithology)

10.6.6.17 Decommissioning impacts are deemed to be similar to those of construction. As such, refer to the construction phase paragraphs for mitigation.

Habitat VERs

Construction (Habitats)

Pollution of Conservation Designated Sites

10.6.6.18 Mitigation will be implemented through enforcement of CEMP and construction method statements. For further detail, refer to Chapter 9.3 (Hydrology, Geology and Hydrogeology). These include:

- Adhere to SEPAs PPGs, especially in relation to the safe storage of fuel, oils and chemicals;
- Maintain vehicles and plant to avoid leaks; and
- Time works to avoid heavy rainfall when the risk of fine sediment being transported from earthworks is significantly increased.

Pollution of Terrestrial Habitats

10.6.6.19 Mitigation will be implemented through enforcement of CEMP and construction method statements. For further detail, refer to Chapter 9.3 (Hydrology, Geology and Hydrogeology). These include:

- Adhere to SEPAs PPGs, especially in relation to the safe storage of fuel, oils and chemicals;
- Maintain vehicles and plant to avoid leaks;
- Time works to avoid heavy rainfall when the risk of fine sediment being transported from earthworks is significantly increased;
- Delimit working areas to minimise the zone of potential impact; and
- Employ best practice in relation to construction techniques.

10.6.6.20 Compliance with the law will be achieved by appointment of a suitably experienced ECoW to ensure works are carried out in accordance with construction method statements and CEMP.

Pollution of Freshwater Habitats

10.6.6.21 The following mitigation measures will be implemented:

- Cable route design will minimise potential impacts through identification of constraints and subsequent micro-siting;
- Careful sediment control near burns; and
- Avoid trenching alongside the River Ugie.

Operation (Habitats)

Pollution or Damage to Terrestrial Habitats during Maintenance Activities

10.6.6.22 The proposed mitigation outlined above in relation to construction will also apply during operation.

Pollution or Damage to Freshwater Habitats during Maintenance Activities

10.6.6.23 The proposed mitigation outlined above in relation to construction will also apply during operation.

Decommissioning (Habitats)

10.6.6.24 The decommissioning impacts of the onshore export cable are deemed to be similar to those of construction. As such, refer to the construction phase paragraphs for mitigation.

Otter and Badger VERs

Otter

Construction

10.6.6.25 Baseline results (Chapter 4.7: Terrestrial Ecology) confirm that otters inhabit the River Ugie and its tributaries. The following mitigation will be implemented to minimise impacts on this species:

- Cover all excavations (trenches, trial pits, and pipelines) when not in use to prevent entry by otters;
- Where excavations cannot be covered, provide a means of escape (e.g. a plank);
- Avoid night working where possible;
- When night working cannot be avoided, lighting will be shuttered and focussed on the work area only, and directed away from watercourses using beam-deflectors to minimise light spill. Lighting will be kept to an absolute minimum of 100 m from holts or other resting places;
- Works within 100 m of holts or other resting places will cease 1 hr before dusk and commence 1 hr after dawn to minimise disturbance during otters' main activity times;
- Adhere to SEPAs PPGs, especially in relation to the safe storage of fuel, oils and chemicals, these will be stored 10 m away from watercourses in bunded containers; and
- Speed limits will be restricted to 20 mph to minimise risk of collision with otters. This should be reduced to 15 mph within 25 m either side of any mammal paths identified by the ECoW as likely to be used by otters and which cross watercourses.

Operation

10.6.6.26 The proposed mitigation outlined above in relation to construction will also apply during operation.

Decommissioning

10.6.6.27 The decommissioning impacts of the onshore export cable are deemed to be similar to those of construction. As such, refer to the construction phase paragraphs for mitigation.

Badger

Construction

10.6.6.28 Baseline results (Chapter 4.7: Terrestrial Ecology) confirm that badgers inhabit the onshore cable route. In accordance with SNH guidelines, construction cannot take place within 30 m of a badger sett without a development licence. If sett(s) cannot be avoided by micro-siting, they should be destroyed under license outside the badger breeding season (30 November to 01 July). An ECoW will be employed to ensure no significant impacts on badgers occur, and that works are conducted in accordance with best practice. Sett location will be checked prior to construction. Toolbox talks will be given to construction staff and an emergency protocol given to contractors in the event of encountering a badger or sett. If new sett(s) are found within 30 m of the construction footprint, micro-siting or an application to SNH will be required. The following mitigation is proposed to minimise impacts on this species:

- Impose protection zones 30 m from sett(s) and mark with brightly coloured tape;
- Excavations more than 0.5 m deep will be fenced or covered when not in use to prevent entry by badgers;
- Pipes of diameter > 20 cm will be capped nightly to prevent entry by badgers;
- Avoid night working where possible;
- When night working cannot be avoided, lighting will be shuttered and focussed on the work area only using beam-deflectors to minimise light spill. Lighting will be kept to an absolute minimum of 100 m from sett(s);
- Works within 100 m of sett(s) will cease 1 hr before dusk and commence 1 hr after dawn to minimise disturbance during badgers' main activity times;
- Adhere to SEPAs PPGs, especially in relation to the safe storage of fuel, oils and chemicals; and
- Speed limits will be restricted to 15 mph to minimise the risk of collision with badgers.

Operation

10.6.6.29 The proposed mitigation outlined above in relation to construction will also apply during operation.

Decommissioning

10.6.6.30 The decommissioning impacts of the onshore export cable are deemed to be similar to those of construction. As such, refer to the construction phase paragraphs for mitigation.

Bat Roost and Habitat Suitability VERs

10.6.6.31 The bat roost and habitat suitability assessment aimed to inform future, targeted baseline field surveys for bats. These surveys should define:

- Potential roosts in trees which may need to be felled; and
- Key commuting or foraging areas that may be subject to significant disturbance (e.g. where hedgerows, woodland or trees may be removed).

10.6.6.32 Targeted baseline field surveys for bats have been delayed until a precise cable route has been designed.

10.6.6.33 Targeted surveys should be undertaken during bats' active season, between May and September inclusive. Key periods for survey within this are maternity (June-July), when nursery colonies are most vulnerable and detectable, and dispersal-mating (August-September) when bats move to different roosts and males set up courtship roosts. Survey methods should include use of Anabat or similar passive remote bat detectors, dawn and dusk commuting watch surveys, tree inspections to assess roost potential and walked transects with detectors to establish bat use of any higher value habitat affected. Control surveys will gather reference data from nearby habitat to permit the effective interpretation of the survey data and guide mitigation. In a few cases internal and external building inspections may be required if a building lies very close to the cable route where a roost could be significantly disturbed by works; such buildings may require dawn re-entry surveys to prove roosts, or dusk surveys to prove numbers and species. Hedges and trees should be maintained in their original condition as much as possible. Trees which have roosts or high risk of roosts may need climbing surveys, or exclusion under licence.

10.6.6.34 The surveys will investigate the local bat population and activity and the presence and value of any important habitat features. Assessment of habitat value and potential impacts will take account of the survey results, in combination with the national or international status of each species as described by Wray *et al*., (2010).

10.6.7 Habitats Regulations Appraisal

10.6.7.1 As part of the Habitat Regulations, predicted impacts on internationally designated sites will be assessed by the competent authority through consideration of each site's conservation objectives (refer to Chapter 4.1: Designated Sites). While the majority of sites were scoped out of assessment, effects on Loch of Strathbeg SPA (relevant qualifying species: greylag goose and pink-footed goose) were considered in this impact assessment.

10.6.7.2 The assessment by the competent authority is based on whether the following summary of designated site conservation objectives will be affected by negative impacts caused by the export cable and substation:

1. To maintain the population / distribution / extent of qualifying species / habitats on site;
2. To maintain the distribution and extent of habitats supporting qualifying species;

3. To maintain the structure, function and supporting processes of qualifying habitats and habitats supporting qualifying species;
4. No significant disturbance to qualifying species / habitats; and
5. To maintain distribution of typical species as components of qualifying habitats.

10.6.7.3 As part of the EIA process for designated sites and to provide the relevant information to the competent authority for an Appropriate Assessment, the following table summarises the impacts the proposed development will have on the Loch of Strathbeg SPA (Table 10.6-9 below) in respect to the criteria listed above.

Table 10.6-9 Assessment of the Loch of Strathbeg SPA per Conservation Objectives

Criterion	Assessment
Population of the Species as a Viable Component of the Site	Negligible
Distribution of the Species within the Site	Negligible
Distribution and Extent of Habitats Supporting the Species	Negligible
Structure, Function and Supporting Processes of Habitats Supporting the Species	Negligible
No Significant Disturbance of the Species	Negligible

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