4 Biological Environment

4.5 Intertidal Ecology

4.5.1 Baseline Information

Introduction

4.5.1.1 This chapter explains the intertidal ecology at the modified export cable landfall site of the modified export cable at Inverboyndie and assesses the potential effects of the installation, operation and decommissioning of the modified offshore transmission infrastructure (OfTI) on sensitive intertidal benthic ecological receptors.

4.5.1.2 Intertidal benthic ecology refers to the coastal habitats and associated plants and animal species and communities present between the high and low mean spring tide marks. Information on the ecology of intertidal area at the study area was acquired from a biotope mapping survey conducted within the embayment at Inverboyndie Beach. Site specific survey and analysis methodologies were agreed with Marine Scotland Science (MSS) and followed JNCC Procedural Guidelines 3-1 (Wyn & Brazier, 2001). A detailed account of the site specific survey together with presentation of relevant physical and biological sample data and results is provided in Technical Appendix 4.5 A – Intertidal Ecology Characterisation. Note that the subtidal benthic ecology associated with the modified TI is described in Chapter 4.1: Benthic Ecology.

Consultations

4.5.1.3 Table 4.5-1 below provides a description of the only consultation relevant for the intertidal ecology assessment received to date.

Table 4.5-1 Summary of Consultations

Organisation	Consultation Response	MORL Approach
Marine Scotland Science (MSS)	Statutory agreement of site specific survey and analysis methodologies.	A Phase 1 intertidal habitat mapping survey was conducted over a low water spring tide occasion.

Baseline Characteristics

4.5.1.4 The following describes the baseline intertidal ecology of the export cable landfall and onshore cable route within the study area (Figure 4.5-1). Information presented in this baseline derives from desktop studies and site specific surveys as detailed below.

Desktop Studies

4.5.1.5 Terry & Sell (1986) categorise local beaches as exposed indicating the strong influence of wave action along northern facing shores in the outer Moray Firth. Rocky habitats are characterised by upper shore green and red ephemeral algae such as *Prasiola stipitata* and *Porphyra umbilicalis* with winkles (*Littorina saxatilis*), a mid shore barnacle (*Semibalanus balanoides*) dominated zone with bladderwrack (*Fucus vesiculosus*), blue mussels (*Mytilus edulis*), limpets(*Patella vulgata*) and dog whelk (*Nucella lapillus*) and mixed red algae species and a lower shore zone with a range of turf forming and crustose red algae, thong weed (*Himanthalia elongata*), kelp (*Alaria esculenta*) and a diverse range of cryptic amphipod and isopod crustaceans (Terry & Sell, 1986).

4.5.1.6 Local sediment shores may be regarded as high energy intertidal environments exhibiting a relatively steep profile and comprising moderate to well sorted mobile sands as defined by surveys at Fraserburgh at Rattray (Eletheriou & Robertson, 1988; MORL, 2012). The sediment fauna is naturally impoverished due to the dynamic nature of the sediments and is dominated by crustaceans typical of mobile sands.

4.5.1.7 The beach landfall site at Inverboyndie does not hold any statutory designation for nature conservation.

Site Specific Surveys

4.5.1.8 Field work was conducted in accordance with JNCC Procedural Guidelines 3-1 (Wyn & Brazier, 2001) and comprised the mapping of intertidal habitats between the mean high water spring tide mark (MHWS) and the mean low water spring tide mark (MLWS). Conspicuous plants and animals associated with each habitat were recorded. Both the habitat and species data were subsequently combined and used to classify biotopes.

4.5.1.9 The survey was conducted over one day (20/05/14). Survey comprised modified Phase I habitat mapping techniques within 250 m either side of the expected landfall location. In addition to the mapping of habitats, the surveys also included sediment dig over sampling for determination of faunal content and to assist biotope classification following guidance described in JNCC Procedural Guidelines 3-1 (Wyn & Brazier, 2001). A total of 30 sampling points were selected.

4.5.1.10 Six biotope classifications (Connor *et al.*, 2004) were ascribed to the intertidal region of the landfall site. A biotope map for the foreshore at Inverboyndie is presented in Figure 4.5-2. A summary of the biotopes found is provided in Table 4.5-2. No species of nature conservation importance were recorded.

Table 4.5-2 Impact Assessment Summary

Biotope Classification and Community	Representative Beach Photograph	Description of Habitat
LS.LSa.MoSa Barren or amphipod-dominated mobile sand shores.		Extensive across the study area. Clean mobile sandy shores with no or very little infauna. May be duned or rippled due to wave action or tidal currents.
LS.LSa.FiSa.Po Polychaete/amphipod-dominated fine sand shores		Mid shore rippled clean sand biotope remaining damp throughout tidal cycle characterised by lugworms (*Arenicola marina*).
LR.FLR.Eph.Ent Ephemeral green or red seaweed communities (freshwater or sand-influenced)		Upper shore mixed sand and cobble biotope within influence of freshwater run off characterised by the green ephemeral alga *Enteromorpha* spp.

Biotope Classification and Community	Representative Beach Photograph	Description of Habitat
LR.FLR.Eph.EntPor Ephemeral green or red seaweed communities (freshwater or sand-influenced)		Mid to lower shore mixed sand and coble biotope present to the far west of the intertidal survey area and characterised by ephemeral green and red algae with lugworms.
LR.MLR.BF.Fser.R *Fucus serratus and red seaweeds on moderately exposed lower eulittoral rock*		Lower shore rocky biotope supporting barnacles, crustose and mixed foliose red and brown fucoid algae, limpets and whelks.
IR.MIR.KR.Ldig.Bo *Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders		Sublittoral fringe rock biotope supporting kelp, fucoid algae and mixed red algae.

4.5.1.11 Survey results are consistent with an exposed, high energy, clean sandy intertidal environment. Sediments contained little or no infauna which is likely a function of the dynamic environment and associated sediment mobility. Rock habitats supported a range of red, green and brown seaweeds together with common limpet, whelk and barnacle species typical of the region.

Important Habitats

4.5.1.12 Rocky boulder and bedrock communities, represented by the biotopes LR.FLR.Eph.EntPor, LR.MLR.BF.Fser.R and IR.MIR.KR.Ldig.Bo (see Table 4.5-2) are indicative of Annex I rocky reef habitats (Habitats Directive EEC/92/43). Intertidal rocky areas need to be connected to a sublittoral reef for the rocky aggregation to qualify as an Annex I rock reefs, as they tend to be subtidal.

4.5.1.13 Diverse under boulder communities, represented by the biotope IR.MIR.KR.Ldig.Bo, can be present under intertidal boulders therefore, the habitat is listed as a priority habitat for conservation under the UK Biodiversity Action Plan.

Legislative and Planning Framework

4.5.1.14 The legislation and guidance relevant to the intertidal ecology assessment is in line with that described in Chapter 4.1 Benthic Ecology.

4.5.2 Impact Assessment

Summary of Effects and Mitigation

4.5.2.1 This section assesses the likely significant effects of the installation, operation and decommissioning of the offshore export cable on intertidal ecology at the landfall location at Inverboyndie.

4.5.2.2 Potential effects of the installation and decommissioning of the modified OfTI on intertidal benthic ecology relate to temporary direct sediment disturbance and temporary raised suspended sediment concentrations and sediment deposition. Potential operational effects relate to EMF and heat emissions and habitat and associated community change. The following effects were assessed as being of **no significance** to benthic ecological receptors including habitats and species (collectively termed biotopes). This reflects the short duration, localised and infrequent nature of the effects and the tolerance and recoverability of receptors.

- Temporary direct intertidal habitat disturbance;
- Temporary increases in suspended sediment concentrations and sediment deposition;
- Heating and EMF effects; and
- Habitat and community change.

Summary of Impacts

4.5.2.3 The beach habitats and associated intertidal communities at Inverboyndie are indicative of highy dynamic (wave exposed) environmental conditions including regular sediment disturbance. The significance of the effect of sediment disturbance by the cable burial tool is therefore considered to be not significant as the local intertidal communities will already be tolerant to these effects and will be able to recover quickly. The spatial extent of the effect will be very small, of short duration and highly infrequent. Under boulder communities are illustrative of Biodiversity Action Plan (BAP) habitats. Significant direct disturbance to this habitat type was assessed to be of minor significance

4.5.2.4 Accidental spills of fuels or oils or other chemicals used during the construction, operation and decommissioning of the modified OfTI have the potential to adversely affect the intertidal ecology although adherence to an EMP will minimise associated risk and mitigate for potential effects.

4.5.2.5 The construction will mostly take place during low tide occasions so any suspension of sediment fines within the overlying water column will be very limited. Jointing pits will be constructed above MHWS and therefore will not contribute to this potential effect.

4.5.2.6 Effects of heat and EMF emissions on intertidal benthic ecology are considered to be of no significance due to the burial of the cables and the distance separation provided by cable protection material.

4.5.2.7 Rock material used for cable protection will likely serve a comparable function as the natural rock over which it is laid and will provide attachment surfaces for colonising encrusting and attaching fauna and flora from surrounding reproducing populations. Consequently, the effect of original habitat loss and habitat change is considered to be not significant.

Proposed Mitigation Measures and Residual Effects

4.5.2.8 Table 4.5-3 below summarises the mitigation for each identified effect. Significant effects arising from the modified OfTI on intertidal ecology are not predicted. As such, no specific mitigation is proposed. Best practice, however, would be to minimise the quantities of cable protection material (if used) to reduce the effect of loss of original habitat and habitat change.

Table 4.5-3 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 / minor	N / a	Not significant
Temporary Increased Suspended Sediment Concentrations and Sediment Deposition	Sand and rock biotopes	Not significant	N / a	Not significant
Operation				
Heating and EMF Effects	Sensitive and deep-burrowing species	Not significant	N / a	Not significant
Habitat and Community Changes	Rock habitat and species	Not significant	N / a	Not significant

Introduction to Impact Assessment

4.5.2.9 The installation of the offshore export cable has the potential to directly affect intertidal habitats as a result of the action of the cable burial tool during installation and indirectly affect adjacent areas through sediment re-suspension and deposition 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 physical and biological indications are that the site is a high energy habitat prone to frequent natural perturbation.

Details of Impact Assessment

4.5.2.10 The methodology for the determination of impact significance is presented in Chapter 4.1 – Benthic Ecology and follows the methods applied during previous site investigations associated with the original cable route (MORL, 2012 Chapter 10.5 Intertidal Ecology).

4.5.2.11 Table 4.5-4 presents the project parameters used to 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.

4.5.2.12 Note that if horizontal directional drilling (HDD) was selected as the installation option then there would be no adverse effects on the intertidal benthic ecology as the cable would pass underneath the beach at a depth sufficient to avoid disturbance to any burrowing fauna.

Rochdale Envelope Parameters Considered in the Assessment

Table 4.5-4 Rochdale Envelope Parameters Considered in the Assessment

Potential Effect	Rochdale Envelope Scenario Assessed
Construction & Decommissioning	
Temporary Direct Intertidal Habitat Disturbance	Total footprint = 7,200 m² based on • Beach width / cable length of 300 m • Affected width per trench: 6 m • Four trenches, to constructed two at a time at a minimum of 1 year apart. Equating to <0.1% of total beach area at Inverboyndie Beach
Temporary increases in suspended sediments and sediment deposition	Qualitative assessment based on the re- suspension of sandy sediments arising from the installation of export cable via trenching during in-coming tides. Sand material to be transported/dispersed by tidal currents and wave action
Operation	
EMF and heat emissions	Qualitative assessment based on theoretical avoidance of localised affected areas by sensitive benthic species.
Habitat and community change	Qualitative assessment based on the theoretical possibility of cable installation in intertidal rocky areas and use of concrete mattressing or rock protection material.
Cumulative	
No cumulative or in-combination effects identified (Section 4.5.3).	

EIA Methodology

4.5.2.13 Receptors considered within the assessment of the modified OfTI on intertidal ecology include the intertidal biotopes as classified and mapped during the site specific survey (see sections 4.5.1.8 to 4.5.1.10). Consideration of intertidal species is implicit within the assessment at biotope level.

Impact Assessment

Construction

Temporary direct intertidal habitat disturbance

4.5.2.14 Direct disturbances to intertidal habitats will occur as a result of the action of the cable burial tool and as well as the movement of construction plant and machinery over adjacent areas. In sedimentary habitats, this may cause crushing, abrasion, displacement and mortality of species resulting in a loss of species diversity abundance and biomass within the footprint. Trenching in rocky habitats would remove substrata and the fauna and flora attaching to it resulting in a permanent scar which may be subsequently in-filled with transient sediments.

4.5.2.15 The total area of disturbance is considered to be very small representing <0.1% of the total beach area. The effect will only occur once at any one location. Following cessation of the activity any disturbed sediments will be rapidly dispersed by successive in-coming tides with full recovery of the beach sediment structure expected within a few tidal cycles and after consolidation of the beach sediments to pre-construction conditions. The trenches 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. Consequently, the magnitude, frequency and duration of direct disturbances are therefore assessed to be very low and this is likely to be similar regardless of the final installation technique. 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. The surfaces of cut rocks would be rapidly re-colonised by local fauna and flora from the surrounding reproducing populations.

4.5.2.16 Receptor sensitivity is therefore very low for the most part and minor / medium in relation to the under-boulder BAP habitat in light of its nature conservation value and the overall effect of habitat disturbance is therefore assessed to be **not significant / minor**.

4.5.2.17 Note that if HDD is employed (if found to be technically feasible) there will be no direct effect on the intertidal area as the cable will pass under it.

4.5.2.18 This assessment carries low uncertainty as the effects are quantifiable.

Temporary Increases In Suspended Sediment Concentrations and Sediment Deposition

4.5.2.19 The biotopes recorded at Inverboyndie are considered not to be 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).

4.5.2.20 Cable installation within the intertidal area is likely to be undertaken during low tide periods 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 very low. The sensitivity of the biotopes to the effect of temporary sediment disturbances and re-settlement is also considered very low as a result of the naturally perturbed environment at Inverboyndie and associated effects of sediment suspension, scour and deposition. Accordingly, the overall effect is assessed to be **not significant** with low uncertainty.

Operation

4.5.2.21 Generic effects of the export cable associated with the operation activities are considered to be minimal and include heating and EMF as well as physical disturbance associated with any maintenance. The placement of cable protection material may result in localised habitat and community change.

Heat emissions

4.5.2.22 As explained in section 4.5.2.6 above, 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.

4.5.2.23 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).

4.5.2.24 The cable target burial depth is 1 m whereas sediment dwelling species, such as worms, bivalves and small amphipod crustaceans, typically reside within the uppermost few centimetres. As such, intertidal sediment species are unlikely to be directly exposed to a permanent increase in sediment temperature. The presence of rock cable protection material (if used) provides a distance separation between species receptors and the export cable.

4.5.2.25 Furthermore, upper sediment layers on exposed beaches 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.

4.5.2.26 The duration of the effect will last throughout the operation of the modified OfTI but its spatial extent is expected to be highly localised. Effect magnitude is thus judged to be very low. The target burial depth and distance separation caused by the presence of cable protection material (if used) means that species 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 are not expected. Receptor sensitivity is thus considered to be very low. Accordingly, the significance of effects from heating from export cables within the intertidal area is assessed to be **not significant**.

4.5.2.27 This assessment carries low uncertainty due to the absence of significant effects from monitoring studies (MMO, 2014).

Electromagnetic fields (EMFs)

4.5.2.28 The effects of EMFs on benthic ecology have been described in section XXX above. Studies on the effects of EMFs on benthic invertebrate fauna are limited but those that do exist indicate that geomagnetic orientation occurs in molluscs (e.g., nudibranchs (Cain et al., 2005) and chitons (Bochert and Zettler, 2006)) and crustaceans (sandhoppers) (Bochert and Zettler, 2006).

4.5.2.29 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).

4.5.2.30 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). However, in the absence of more comprehensive evidence, uncertainty remains when predicting potential impacts of EMFs on benthic invertebrate communities.

4.5.2.31 The offshore export cable 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.

4.5.2.32 The overall effect of EMFs from export cables on marine benthic invertebrates is assessed to be **not significant** based on the small footprint of the impact and perceived insensitivity of the benthic invertebrates as discussed above.

4.5.2.33 This assessment carries medium uncertainty as the number of experimental field studies addressing invertebrate tolerance/sensitivity to EMF is currently rather limited. However, the offshore export cable will be buried so that potential EMF effects will be reduced.

Habitat and Community Change

4.5.2.34 In the event that burial of the export cable cannot be achieved due to the presence of rock for example, then the cable may be surface laid and protected by concrete matressing or rock protection material. Depending upon the nature of the final material used, its surfaces may be less complex than the surrounding natural rock with fewer micro-niches for colonisation by encrusting and attaching fauna and flora. Consequently, the mattressing and rock protection material may support a reduced diversity of intertidal species resulting in a change in the habitat and community relative to the pre-construction condition.

4.5.2.35 The effect will be highly localised to the actual protection material and will last for the duration of the operation of the modified OfTI and will be reversible upon decommissioning. Effect magnitude is thus judged to be **minor**. Diversity of intertidal species within the intertidal area at Inverboyndie is not predicted to be affected as a result of the placement of cable protection material and so receptor sensitivity is considered to **very low**. Accordingly, the effect is assessed to be **not significant**.

4.5.2.36 This assessment carries low uncertainty as the magnitude of effect is quantifiable. This assessment carries low uncertainty as the magnitude of effect is quantifiable.

Decommissioning

4.5.2.37 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**.

Proposed Monitoring and Mitigation

Construction, Operation and Decommissioning

4.5.2.38 No mitigation required.

4.5.3 Cumulative Impact Assessment

Summary

4.5.3.1 It is considered that there is no potential for cumulative impacts on intertidal ecology.

4.5.3.2 Section 4.5.1.11 showed that there are no highly mobile or wide ranging intertidal ecology receptors at Inverboyndie (fish and shellfish are addressed in Chapter 4.2). Accordingly, the appropriate spatial scale for cumulative impact assessment in this regard is very local. Furthermore, likely significant direct and indirect effects of the installation and operation of the modified OfTI on intertidal ecology are predicted to be not significant.

4.5.3.3 Consultation with Aberdeenshire Council indicates that there are no foreseeable plans or projects within the vicinity of the modified offshore export cable landfall and therefore no interaction between scheme effects and those arising from other foreseeable projects. Cumulative impact assessment on intertidal ecology is therefore not appropriate.

4.5.3.4 Effects of the installation of separate cables at the landfall site have been assessed above. The two separate offshore export cable routes (in two separate trenches) will be installed at least one year apart and recovery of intertidal habitats is expected to be complete well within this intervening period. No spatial or temporal interaction of associated effects will therefore occur.

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