moray offshore renewables ltd

Developing Wind Energy In The Outer Moray Firth

Environmental Statement

Modified Transmission Infrastructure for
Telford, Stevenson and MacColl Wind Farms

Technical Appendix 4.1 A

Subtidal Ecology Characterisation

renewables

This document was produced by Fugro EMU Ltd on behalf of Moray Offshore Renewables Ltd

Document Owner	**MORL**				
Document Status	**Final**				
File Name					
Revision	**Date**	**Description**	**Originated By**	**Checked By**	**Approved By**
A1	13/06/2014	Draft for review	PDB	PAE	
A2	20/06/2014	Draft for review	PDB	PAE	
A3	23/06/2014	Final	PDB	PAE	CR

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1 Introduction

1.1 Study Background

1.1.1 Following recent consent award for the development of the Telford, Stevenson and MacColl sites offshore wind farm, Moray Offshore Renewables Ltd. (MORL) (a consortium developer comprising EDP Renovaveis and Repsol Nuevas Energias UK (formerly SeaEnergy Renewables) was subsequently offered an alternative grid connection. Accordingly, MORL commissioned a series of additional technical studies to support a further consent application and associated Environmental Statement (ES) for a new proposed cable route corridor and transmission infrastructure (the modified TI).

1.1.2. This document presents a characterisation of the subtidal benthic ecology of the modified TI. It describes the seabed video survey and grab sampling and analysis methods used to acquire characterisation data along the proposed route corridor of the export cable and provides an interpretation of the subtidal benthic environment in terms of the seabed habitats and conspicuous epifaunal communities observed.

1.1.3. The proposed cable route corridor is approximately 52 km long and runs in an approximately southerly direction between the three consented wind farms and the proposed landfall site at Inverboyndie. The cable route corridor survey results are presented within this Technical Report as indicated in Figure 1.1 (Chart Appendix). Water depths throughout the length of cable range from <10 to >90m below chart datum.

1.2 Aims of the study

1.2.1. Study aims included;

- Characterisation of seabed substrates, features and associated subtidal epifaunal communities within the study area; and
- Collection of sediment samples for chemistry and particle size distribution (PSD) analyses to further aid assessment of potential wind farm impacts.

1.2.2. Benthic ecological characterisation of the three consented wind farm sites (offshore generating station) have been reported previously (MORL, 2012). The intertidal benthic ecology at the new proposed landfall site is presented in Technical Appendix 4.5 A. This report relates solely to the modified TI corridor and close environs.

1.3 The background physical and biological environment

1.3.1. Irving (1996) could not provide any great detail for the sublittoral sediments of the Moray Firth stating only that sand and mixed sediments dominate offshore and that the near shore is often a reflection of the littoral environment to certain degrees.

1.3.2. The predictive MESH seabed habitat map for the Moray Firth area (Figure 1.2 – Chart Appendix) provides a guide to broad seabed habitat types likely to be encountered and indicates that along the modified offshore export cable route corridor deep circalittoral sand dominates with some deep circalittoral and circalittoral / infralittoral coarse sediment, these latter two evident in the nearshore area (Figure 1.2 – Chart Appendix). However, biological community boundaries are unlikely to be so neatly delineated (Eleftheriou *et al.*, 2004).

1.3.3. The water depth in the Moray Firth is generally less than 80 m with the exception of the southeast corner where depths of more than 200 m can occur in fault-related deeps (Adams and Martin, 1986). This is the area known as the Southern Trench which is currently delineated as one of four Marine Protected Area (MPA) Search locations identified by the Scottish Government (Figure 1.3 - see below). The trench is 10 km north of Fraserburgh, reaches at least 250 m in depth and is more than 120 km in length (Holmes *et al*., 2004). This is where a historical record of the cold-water coral *Lophelia pertusa* has been reported (Wilson 1979) although there is no recent evidence to suggest colonies of potential conservation interest exist in the Moray Firth (DTI 2004; Hall-Spencer and Stehfest 2009; Marine Scotland 2012).

1.3.4. Shallow shelf seas have close bentho-pelagic coupling and, therefore, the benthic invertebrate fauna play an important role in nutrient cycling, detrital decomposition as well as providing food for higher trophic levels (Reiss *et al.*, 2009). Furthermore the spatial distribution of species in the different regions of the North Sea is significantly correlated to the food availability (Kröncke, 2006). Wieking and Kröncke (2005) state that in shallow shelf seas, like the North Sea, the major source of organic material is from primary production and benthic organisms must rely on this for their energy and nitrogen requirements.

1.3.5. Hartley and Bishop (1986) investigated the macrobenthos of the Beatrice field from survey work carried out in 1977, 1980 and 1981. Some taxa such as *Spiophanes bombyx* and *Cochlodesma praetenue*, were found across the survey area. The shallower northeast of the sampling grid in this study was on the Smith Bank. Species restricted to these sites, or occuring at the greatest densities here, included the polychaetes *Travisia forbesii* and *Ophelia borealis*, the amphipod *Bathyporeia* spp. and the bivalve molluscs, *Crenella decussata* and *Tellina pygmaea* each of which are characteristic of sand / coarse sand sediments. Taxa widely recorded but absent or at low abundances in the northeast of the grid showed a preference muddier mixed sediments. These included the polychaetes *Pholoe minuta*, *Goniada maculata*, the amphipod *Urothoe elegans*, the bivalve molluscs *Nucula tenuis*, *Dosinia lupinus* and the brittlestar, *Acrocnida brachiata*. While examples of taxa restricted to the deeper stations to the west were the tube building polychaete *Myriochele* sp., the cumacean, *Eudorella truncatula* and the bivalve mollusc *Thyasira flexuosa*. Other benthic fauna with a preference for clean mixed sands, such as the bivalve molluscs *Gari fervensis*, *Abra prismatica* and *Tellina fabula* tended to be reduced or absent from both the coarser shallower sediments of the northeast and the deeper, muddier, stations to the west. Hartley and Bishop (1986) note that the species richness encountered at individual stations was more similar to inshore areas such as Sullom Voe, Shetland than offshore areas of the North Sea.

1.3.6. ERT (2005) also found high species richness from a survey of the Beatrice wind farm demonstrator site. Sites across the survey area were characterised by the polychaetes *Chaetozone setosa*, *Lumbrineris gracilis* and *Exogone hebes*, the amphipods *U. elegans*, *Ampelisca tenuicornis* and *Bathyporeia* spp., the bivalve mollusc *T. fabula* and the pea urchin *E. pusillus.* One site which had a high coverage of dead shell recorded species such as the squat lobster *Galathea intermedia*, the chiton *Leptochiton asellus* and the brittle star *Amphipholis squamata* as well as an abundance of the small fanworm *Jasminiera caudata*.

1.3.7. Samples of medium to coarse sands taken just north-east of the Beatrice oilfield for the Jacky oilfield development (Ithaca Energy, 2008) were mostly dominated by *S. bombyx*, *T. pygmaea*, *C. pratenue* and *E. pusillus*. Two stations with high proportions of gravel and pebbles were dominated by epifaunal species such as *G. intermedia* and *L. asellus*.

1.3.8. Historically, benthic studies within the Moray Firth have focused on the Smith Bank and the Beatrice Field (Eleftheriou *et al*., 2004). The communities studied on the Smith Bank and Beatrice field have shown considerable persistence in the medium term (Eleftheriou *et al*., 2004). This suggests relatively stable environments.

1.3.9. The Clean Seas Environment Monitoring Programme (CSEMP) site in the outer Moray Firth (previous name Station 105) located just inside the southern edge of the western development area was found to be dominated by *Myriochele* sp. (18%) and the mollusc *Circomphalus casina* (9%) (UK NMP 1994).

1.3.10. Cefas (2005), in a study of the benthic ecology of the western North Sea identified two clusters in the northern North Sea with sites in the Moray Firth clustered in Group F. The top five characterising species were *Galathowenia oculata*, *Goniada maculata*, *Spiophanes kroeyeri*, *Amphiura filiformis* and *Paramphinome jeffreysii*.

1.3.11. Rees *et al*. 2007 in their analysis of the North Sea Benthos Project 2000 data grouped sites in the Moray Firth with those in the central and northern North Sea at depths >50m (mean depth of 96m). These sites were composed of muddy sand and fine sand and had *Myriochele* sp., *A. filiformis* and *Spiophanes* spp. as the dominant fauna (Rees *et al.*, 2007; Reiss *et al.*, 2009).

1.3.12. Calloway *et al*. (2002) in a study of the epibenthos of the North Sea identified a northern North Sea station cluster which occurred between 50-100 m (within which the Moray Firth site was found). The characterising species were whelks such as *Neptunea antiqua* and *Colus gracilis*, the hermit crabs *Pagurus pubescens* and *Anapagurus laevis* as well as other species such as *Hydroides norvegica*, *Hyas coarctatus*, *Flustra foliacea* and *Epizoanthus papillosus*. Jennings *et al*. (1999) identified some similar species as well as *Asterias rubens*, *Crangon allmani* and *Astropecten irregularis*. Attached species accounting for similarity within the northern North Sea cluster were the hydroids *Flustra foliacea*, *Hydrallmania falcata*, *Lafoea dumosa*, the sponge *Suberites ficus*, the sea-squirt *Ciona intestinalis* and the bryozoan *Alcyonidium diaphanum* (Jennings *et al.*, 1999).

1.3.13. Beatrice Offshore Wind Ltd (BOWL) undertook a comparable cable route video survey just over 20 km west of the proposed corridor as part of the EIA investigations and development application for the Beatrice Offshore Wind Farm (BOWL, 2012 and 2013). The Beatrice study found burrowed mud and fine-medium sand with shell fragments dominated their study area. In the offshore area the burrowed mud habitat, although with a low density of sea pens, was identified as the biotope SS.SMu.CFiMu.SpnMeg - Sea pens and burrowing megafauna in circalittoral. Inshore areas were mainly fine-medium sands and gravels with small patches of cobble reef. This area was considered to be a fairly rich example of the biotope SS.SCS.CCS.PomB Pomatoceros triqueter with barnacles, coralline algae and bryozoan crusts on unstable circalittoral cobbles and pebbles. It was noted that the biotope may be considered as being potential Annex I cobble reef (Irving, 2009). The sublittoral area closest to the shore was recorded as being composed very clean fine sand with no visible epifauna.

1.3.14. The Marine (Scotland) Act 2010 makes provision for the publication of certain species and habitats that are considered important for nature conservation. These are referred to as Priority Marine Features (PMFs). There are fourteen invertebrate species referred to in the current draft recommended PMF list (eight in the species list and nine associated with a particular biotope in the habitat PMF list). Of those seventeen species only three are regarded to have some likelihood of being found in the area of the offshore infrastructure study area. These are the European spiny lobster (*Palinurus elephas*), the Ocean quahog (*Arctica islandica*) (both PMF species) and the mud burrowing amphipod *Maera loveni* which is associated with a burrowed mud PMF habitat. Figure 1.3 presents the distribution of these species.

1.3.15. The OSPAR Threatened and Declining (T&D) habitat 'Sea-pen and burrowing megafauna communities' has been found across the southern half of the Moray Firth (Figure 1.4 – Chart Appendix). This habitat broadly equates to the burrowed mud MPA search feature. Burrowed mud extends across the southern half of the Moray Firth and as such is likely to intersect with the cable route. The biotope 'Seapens and burrowing megafauna in circalittoral soft mud' SS.SMu.CFiMu.SpnMeg (Connor *et al*., 2004) is considered a component of both the OSPAR T&D and PMF "burrowed mud" habitat features. Furthermore, Greathead *et al.* (2007) have maps showing the location of seapens around Scotland with both *Pennatula phosphorea* and *Virgularia mirabilis* found at various locations in the Moray Firth.

1.3.16. Hydrography clearly helps shape the glacially derived sedimentary environment in this area and although sediment plays an important role in defining biological communities (Eleftheriou *et al.*, 2004), benthic biotopes can only really be adequately mapped through survey work. Therefore from the predicted habitats map (Figure 1.2 – Chart Appendix) the extent of the seapen and burrowing megafauna habitat, typically found in a range of sediments from muddy sands with varying mixtures of shell and gravel to fine, clay-dominated muds (Hughes, 1998) might not be guessed at (Figure 1.4 – Chart Appendix).

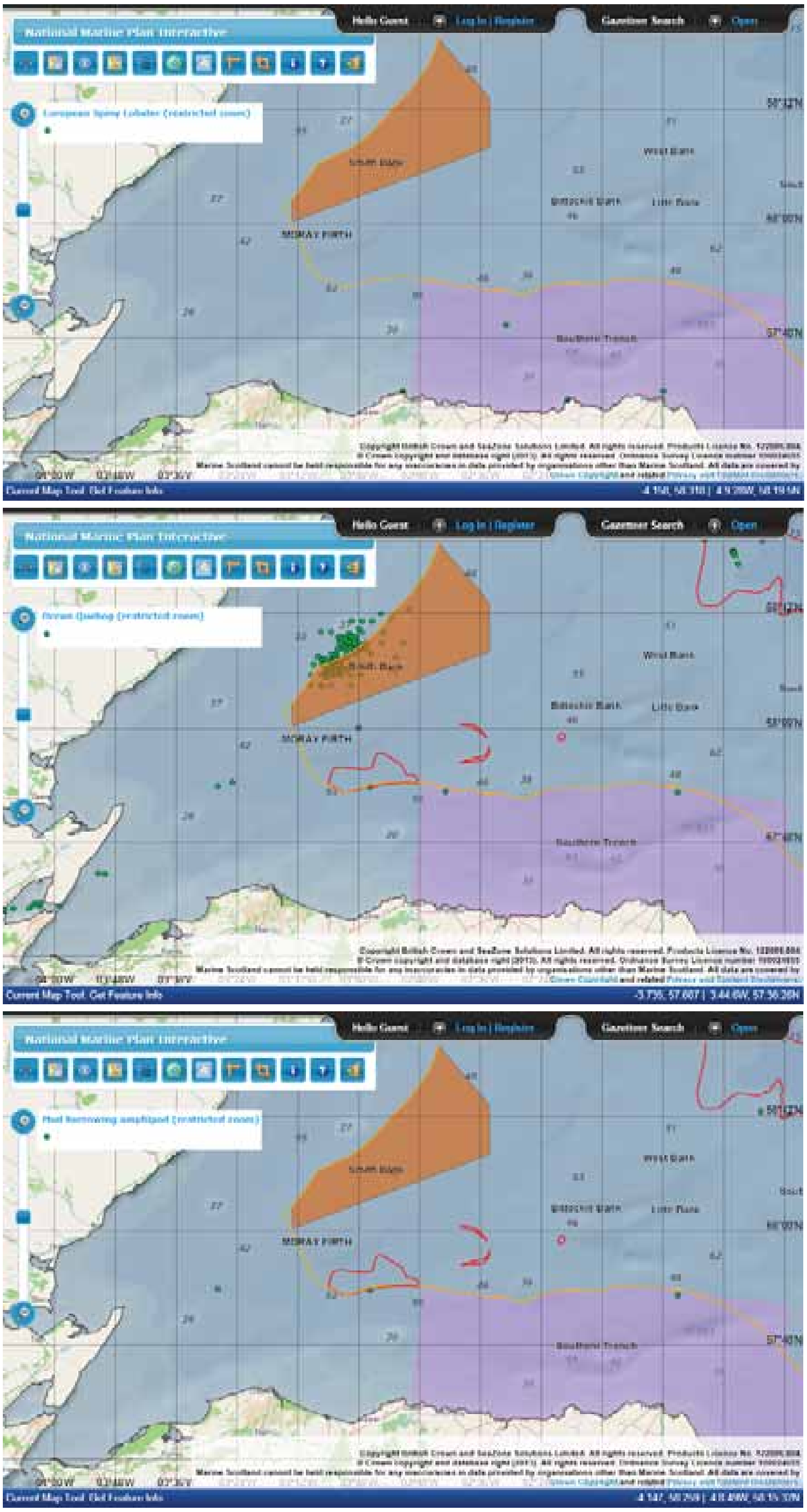

Figure 1.3: Distribution maps of PMF species (area in pink is an MPA 'Search location'; area in orange is the R3 zone; area outlined in red is 'offshore deep sea muds'; snapshots taken from Marine Scotland's interactive National Marine Plan).

2 Method

2.1 Survey Design

2.1.1. Following receipt of advice from Marine Scotland a seabed video survey of the entire proposed cable route was undertaken with samples of seabed sediment taken at selected points for PSD analysis and sediment chemistry. Survey specifications, sample analyses and data analyses were agreed with Marine Scotland prior to mobilisation to ensure statutory requirements were addressed (Fugro EMU, 2014). Table 2.1 summarises the sampling effort. The vessel track and sampling array is presented in Figure 2.1 (Chart Appendix).

Table 2.1: Summary of sample stations.

Sampling techniques	No. stations	Purpose	Representative photograph of kit
Seabed digital video and stills photography	n/a	Collection of seabed images to inform habitat and epifaunal community assessment.	
0.1 m^2 Day Grab sampling	10	Collection of seabed sediment samples for sediment chemistry analysis and associated PSD.	

2.1.2. The survey was conducted over ten days (16th - 26th of May, 2014). All survey work was undertaken on board the survey vessel MV Ocean Dawn. Summary survey logs are provided in Appendix I.

Sample positioning for each of the grabs and seabed video samples was achieved using Fugro EMU's Hemisphere Crescent V100 DGPS which has a stated horizontal accuracy of <0.6 m (95% confidence). Navigation and position recording was achieved using Trimble's HYDROPro software version 2.30.844.

2.1.3. Observer records were collated throughout each video deployment including substrate type and conspicuous epifauna together with any observations of burrows and tubes, (i.e. *Nephrops* burrows).

2.1.4. Upon return from the field, the seabed digital video footage was fully reviewed on Fugro EMU's office video editing suite to identify and describe the characterising habitat types and associated epifauna.

2.1.5. The subtidal benthic ecology survey was conducted following the Cefas Guidelines described in Ware & Kenny (2011). Methods also followed those applied at the three consented wind farms and at Beatrice to ensure data compatibility across the Moray developments and to permit a consistent EIA and cumulative effects assessment (MORL, 2012, BOWL, 2012).

2.1.6. The survey array was designed to provide adequate coverage of the predicted direct and indirect effects of the installation, operation and decommissioning of the export cables and representing the main characterising habitats present as determined from the following data sources:

- Admiralty chart data;
- Desk review/gap analysis (drawing upon scoping report); and
- Consultation with Marine Scotland Science and Scottish Natural Heritage (SNH).

2.1.7. The subtidal survey included the following techniques;

- seabed imagery via drop down video for habitat assessment; and
- single $0.1m^2$ Day sample at selected sample locations for PSD and sediment chemical analyses.

2.1.8. Geophysical data was not available to inform the subtidal benthic ecology survey. The subtidal ecology survey was therefore a continuous seabed digital video tow, with collection of photographic stills, along the centre line of the proposed cable corridor. In this way the presence, status and distribution of epibenthic species, biotopes and potential sensitive receptors, such as PMF or Annex I features, was recorded throughout the entire length of the proposed subtidal portion of the export cable corridor up to an inshore point where the bathymetry allowed safe vessel access (typically around the 5 m contour). Photographs were collected to represent each habitat, community and feature type.

2.1.9. In the event that the subsequent geophysical data identifies a seabed feature not covered by the video survey, then a pre-construction video survey shall be undertaken to ground-truth the feature and inform any micro-siting, as necessary.

2.2 Seabed video and photographic stills

2.2.1. All video footage and photographic stills were geo-referenced and used to assign epibenthic biotopes based on the habitat and species present.

2.2.2. Species were identified and semi-quantified using the SACFOR abundance scale from both the video footage and selected representative photographic stills (Table 2.2). Substrate composition was recorded based upon principal sediment characteristic (i.e. rippled fine sand, coarse sand etc). Epibenthic biotope classification was then conducted using the JNCC Marine Habitat Classifications for Britain and Ireland (Connor *et al.*, 2004) based on those communities present. Classified epibenthic biotopes, were mapped throughout the export cable corridor. The extents of the boundaries will be interpolated using acoustic data drawn from the geophysical surveys, once available. Any sensitive features, such as PMF or Annex I habitats will be recorded and shown on the biotope map.

Table 2.2: SACFOR abundance scales (Source Hiscock, 1996).

Growth Form			Size of individuals/colonies				Density
%cover	Crust/Meadow	Massive/Turf	<1cm	1-3cm	3-15cm	>15cm	
>80%	S		S				>1/0.001 m^2
40-79%	A	S	A	S			1-9/0.001 m^2
20-39%	C	A	C	A	S		1-9/0.01 m^2
10-19%	F	C	F	C	A	S	1-9/0.1 m^2
5-9%	O	F	O	F	C	A	1-9/ m^2
1-5% or density	R	O	R	O	F	C	1-9/10 m^2
<1% density	R	R		R	O	F	1-9/100 m^2
					R	O	1-9/1000 m^2
						R	<1/1000 m^2

Key: S = Superabundant, A = Abundant, C = Common, F = Frequent, O = Occasional, R = Rare, P = present (used when the abundance of an organism could not be estimated accurately).

2.3 Sediment Grab Sampling

2.3.1. At all 10 stations, a 0.1m^2 Day grab with stainless steel buckets was successfully deployed to obtain sediment samples for laboratory chemistry and PSD analyses (see Figure 2.1 – Chart Appendix). Prior to deployment at each station the metal sample bucket of the grab was cleaned with pentane to prevent cross contamination between samples.

2.3.2. Upon retrieval of each sample on board the vessel a sub-sample of between 200-500 g was collected for PSD analysis. In addition, the top few centimetres of sediment was also sub-sampled and carefully placed in pre-treated labelled sample jars depending upon the chemical analysis required and stored frozen prior to laboratory testing for the following parameters:

- Metals - Arsenic (As) , Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg), Nickel (Ni), Lead (Pb), Tin (Sn), Zinc (Zn);
- Organotins (Dibutyl Tin, Dioctyl Tin, Diphenyl Tin, Tetrabutyl Tin, Tributyl Tin, Triphenyl Tin)
- Total petroleum hydrocarbons;
- Polycyclic aromatic hydrocarbons (PAHs) – (16 US EPA Priority Pollutants); and
- Polychlorinated biphenyls (PCBs), ICES 7 congeners (PCB 28, 52, 101, 118, 138, 153, 180).

2.4 Laboratory methods

Particle Size Distribution (PSD) Analysis

2.4.1. PSD analysis was undertaken at Fugro EMU's sediment laboratory using in house methods based on BS1377: Parts 1 – 3: 1990 (dry sieving) and BS13320: 2009 (laser diffraction). The latter method was used to analyse the <63 µm sediment fraction.

2.4.2. Representative sub-samples of each sediment sample were oven dried to constant weight at 105 ±5°C before routinely wet sieving to remove silt and clay-sized particles of <63 µm. The remaining coarser material was again oven dried to constant weight at 105 ±5°C followed by dry sieving through a series of mesh apertures corresponding to 0.5 Phi units as described by the Wentworth scale. The <63 µm sediment fraction was routinely subjected to further analysis via laser diffraction at 0.5 Phi intervals to determine the proportion and distribution of the silt/clay components. The weight of the sediment fraction retained on each mesh was subsequently measured and recorded and merged with the laser diffraction data.

Sediment Chemistry analyses

2.4.3. Samples taken for sediment chemistry analyses were sub-contracted to an experienced UKAS accredited chemistry laboratory. Results were compared to Cefas Action Levels (AL), OSPAR Coordinated Environmental Monitoring Programme (CEMP) criteria as laid out by the UK Clean Seas Environmental Monitoring Programme (CSEMP) and Canadian guideline values to aid assessment of the possible ecological significance of the levels of contaminants found.

2.4.4. Cefas (2003) guidelines are represented by a set of non-regulatory Action Levels which form part of a wider body of evidence for assessment of disposal of dredged materials to sea. Marine Scotland requires, in general, concentrations of contaminants below Revised Cefas Action Level 1 as these are considered of little concern with respect to possible effects on the marine environment. Concentrations above Revised Action Level 2 however suggest that the material is unsuitable for disposal at sea. Values between Levels 1 and 2 may prompt further investigatory work prior to disposal of the material to sea.

2.4.5. Canadian guidelines (CCME 2001) are presented in the form of Interim Sediment Quality Guidelines (ISQGs), principally Threshold Effects Levels (TEL) and Probable Effect Levels (PEL). Generally, concentrations below the TEL are considered the minimal effect range within which adverse effects rarely occur. Above the PEL is the range within which adverse effects frequently occur while between the TEL and PEL is the possible effect range within which adverse effects occasionally occur.

3 Results

3.1 Biological conditions

3.1.1. Full results of the image analysis including sediment habitat types, conspicuous epifauna and associated biotope classifications for the video survey are presented in Appendix 3. The Appendix comprises two parts; (1) an initial spreadsheet showing SACFOR species abundance data and sediment data and (2) biotope descriptions drawing upon the initial spreadsheet information. Summary seabed habitat, species and biotope information is presented in Table 3.1 (the order roughly equates to traversing the proposed cable route from the offshore to the nearshore environment).

Table 3.1: Summary of habitat, species and biotope information from video and static image data.

Sediment habitat type and biotope classification	Characteristic epibenthic species	Areas recorded	Representative seabed image
Slightly shelly, slightly muddy sand. Small areas of dense coarse shelly sand forming small patches of coarse sand waves with coarse shell aggregations in the recesses. **Sublittoral sand SS.SSA** Not enough mud evident to allocate a muddy sand biotope (SS.SSA.CMuSa)	?*Pleuronectes platessa* *Alcyonidium diaphanum* *Alcyonium digitatum* *Asterias rubens* Asteroidea Callionymidae *Chaetopterus* tubes Decapoda Diatomaceous aggregation *Flustra foliacea* Gadiformes Hydroid/Bryozoan mixed substrate Inachinae *Luidia ciliaris* *Microchirus variegatus* Paguridae *Pecten maximus* PLEURONECTIFORMES Triglidae	Offshore area. At the start of the proposed cable route. See Figure 3.1 (Chart Appendix)	
Slightly shelly, slightly muddy rippled sand. Coarse shelly sand waves occur across the area, with coarse mixed sediment of gravel pebbles and cobbles within the recesses. Regular outcrops of larger areas of coarse mixed sediment **Sublittoral sand SS.SSa with Circalittoral mixed sediment SS.SMx.CMx**	?*Pleuronectes platessa* ?*Thuiaria thuja* *Alcyonium digitatum* Ammodytidae *Aphrodita aculeata* *Asterias rubens* ASTEROIDEA *Astropecten irregularis* *Buccinum undatum* Callionymidae *Cancer pagurus* CARIDEA *Chaetopterus* tubes *Crossaster papposus* Diatomaceous aggregation *Tubularia indivisa* *Echinus esculentus* *Flustra foliacea* Gadiformes *Hydrallmania falcata* Hydroid/Bryozoan mixed substrate *Liocarcinus spp.* *Luidia sarsi*	Offshore area. Two sections in the northern area towards the start of the proposed cable route See Figure 3.1 (Chart Appendix)	

Sediment habitat type and biotope classification	Characteristic epibenthic species	Areas recorded	Representative seabed image
	Metridium senile *Microchirus variegatus* *Ophiura ophiura* Paguridae *Pecten maximus* PLEURONECTIFORMES Plumulariidae *Securiflustra securifrons* *Spirobranchus* sp. Triglidae *Trisopterus lamarkii*		
Slightly shelly, slightly muddy rippled sand. Small holes and small burrows evident across the area. Larger fractions of shell hash visible in places. **Seapens and burrowing megafauna in circalittoral fine mud SS.SMu.CFiMu.SpnMeg** Coarse variant with *Virgularia mirabilis* dominant.	*Alcyonium digitatum* *Asterias rubens* *Astropecten irregularis* Callionymidae *Chaetopterus* tubes Diatomaceous aggregation Echinoidea *Henricia* sp. Hydroid/Bryozoan mixed substrate *Ophiura ophiura* Paguridae *Pecten maximus* *Pennatula phosphorea* PLEURONECTIFORMES Triglidae *Virgularia mirabilis*	Offshore. See Figure 3.1 (Chart Appendix)	
Area dominated by coarse mixed sediment forming small to approx. 0.5m high coarse gravelly shelly sand waves in places. Large shell hash and gravelly pebbles deposited within the recesses with the occasional cobble. One small boulder seen. Area interspersed with slightly shelly, slightly muddy rippled sand. **Sublittoral sand and muddy sands SS.SSa, with circalittoral mixed sediments SS.SMx.CMx**	*?Abietinaria abietina* *?Thuiaria thuja* *Asterias rubens* *Atelecyclus rotundatus* Bryozoa crust Callionymidae Diatomaceous aggregation *Flustra foliacea* Gadiformes Hydroid/Bryozoan mixed substrate *Luidia ciliaris* *Munida rugosa* *Ophiura ophiura* Paguridae *Pecten maximus* PLEURONECTIFORMES *Sertularia* sp. *Spirobranchus* sp? *Trisopterus lamarkii* *Urticina* sp.	Offshore. See Figure 3.1 (Chart Appendix)	
Area dominated by coarse mixed sediment forming small to approx. 0.5m high coarse gravelly shelly sand waves in places. Large shell hash and gravelly pebbles deposited within the recesses with the occasional cobble. **Circalittoral mixed sediments SS.SMx.CMx**	*Agonus cataphractus* *Alcyonium digitatum* Buccinidae Callionymidae *Flustra foliacea* Hydroid/Bryozoan mixed substrate *Luidia sarsi* *Munida rugosa* *Ophiura ophiura* Paguridae *Pecten maximus* *Sertularia* spp.	Offshore. See Figure 3.1 (Chart Appendix)	

Sediment habitat type and biotope classification	Characteristic epibenthic species	Areas recorded	Representative seabed image
Sandy mud/muddy sand with burrows, mounds and holes. Area of dense bioturbation. **Seapens and burrowing megafauna in circalittoral fine mud SS.SMu.CFiMu.SpnMeg**	*?Echinocardium cordatum* *Anguilla anguilla/Myxine glutinosa* *Anseropoda placenta* *Asterias rubens* ASTEROIDEA Asteroidea (*?Leptasterias muelleri*) *Astropecten irregularis* Callionymidae *Cancer pagurus* *Chaetopterus* tubes Gadiformes Gobiidae *Henricia* Hydroid/Bryozoan mixed substrate *Liocarcinus* *Lumpenus lampretaeformis* *M.merlangus* or *T.minutus* Majoidea *Nephrops norvegicus* *Ophiura ophiura* Paguridae *Pennatula phosphorea* PLEURONECTIFORMES Triglidae *Tubularia indivisa* *Virgularia mirabilis*	Offshore. Note that in the more southerly areas, the burrowed mud had the occasional hydroid cluster and outcrop of *Tubularia*. The fish that are noted were more prevalent to the north. See Figure 3.1 (Chart Appendix)	
Low lying, relatively even sandy mud/muddy sand and large sections of coarse mixed sediment with boulders and cobbles. **Circalittoral mixed sediments. SS.SMx.CMx** (within areas of SS.SMu.CFiMu.SpnMeg)	*Cancer pagurus* *Ceramaster/Hippasteria* *Echinus esculentus* *Hydrallmania falcata* Hydroid/Bryozoan mixed substrate *Munida rugosa* *Nemertesia ramosa* *Pecten maximus* *Sertularia* *Spirobranchus* *Tubularia indivisa*	Offshore. See Figure 3.1 (Chart Appendix)	
Low lying, relatively even sandy mud/muddy sand with small burrows, small mounds and holes. Within this area, large sections of coarse mixed sediment with boulders and cobbles. **Circalittoral mixed sediments SS.SMx.CMx, within Seapens and burrowing megafauna in circalittoral fine mud SS.SMu.CFiMu.SpnMeg**	*Tubularia indivisa* *Hydrallmania falcata* *Sertularia* *Nemertesia ramosa* Hydroid/Bryozoan mixed substrate *Spirobranchus* *Munida rugosa* *Cancer pagurus* *Pecten maximus* *Ceramaster/Hippasteria* *Echinus esculentus*	Offshore. See Figure 3.1 (Chart Appendix)	

Sediment habitat type and biotope classification	Characteristic epibenthic species	Areas recorded	Representative seabed image
Area of hard ground, potentially bedrock in places. Area over-laid with a very coarse mixture of shelly silty sandy, gravelly pebbly cobble matrix with the occasional boulder. A thin covering of mobile sand of varying depths evident over the hard ground. **Circalittoral mixed sediments SS.SMx.CMx.**	*Alcyonium digitatum* *Asterias rubens* ASTEROIDEA Bryozoa crust *Cancer pagurus* Corallinaceae *Echinus esculentus* *Flustra foliacea* Hydroid/Bryozoan mixed substrate *Liocarcinus* *Metridium senile* *Munida rugosa* Paguridae *Pecten maximus* Plumulariidae *Sabella* tube *Spirobranchus* *Tubularia indivisa* *Urticina*	Offshore. See Figure 3.1 (Chart Appendix)	
Area of what appears to be hard ground in places, over-laid with a very coarse mixture of shelly sandy, gravelly pebbly cobble matrix with a few boulders in places coupled with extensive patches of rippled sand. **Circalittoral mixed sediments SS.SMx.CMx with Sublittoral sand and muddy sands SS.SSA**	?*Omalosecosa ramulosa* *Agonus cataphractus* *Alcyonium digitatum* Ammodytidae Bryozoa crust Callionymidae *Cancer pagurus* *Chaetopterus* tubes *Crossaster papposus* *Echinus esculentus* *Flustra foliacea* Gobiidae Henricia Hydroid/Bryozoan mixed substrate *Lanice conchilega* *Liocarcinus* *Metridium senile* *Munida rugosa* Paguridae *Pecten maximus* PLEURONECTIFORMES Plumulariidae *Porania pulvillus* PORIFERA *Spirobranchus* Triglidae *Trisopterus esmarkii* Tubes in Sediment (Oweniidae) *Tubularia indivisa* *Urticina*	Offshore. See Figure 3.1 (Chart Appendix)	 

Sediment habitat type and biotope classification	Characteristic epibenthic species	Areas recorded	Representative seabed image
Inshore area of rippled sand with a few holes and a biofilm (?diatom) evident across the area which transitions to bedrock and boulder reef with algae further inshore. Sublittoral sand and muddy sands SS.SSA Faunal and algal crusts with Pomatoceros triqueter and sparse Alcyonium digitatum on exposed to moderately wave-exposed circalittoral rock CR.MCR.EcCr.FaAlCr.Pom (sheltered inshore variant) Bedrock and boulder reef CR.MCR.EcCr.FaAlCr.Pom Faunal and algal crusts with Pomatoceros triqueter and sparse Alcyonium digitatum on exposed to moderately wave-exposed circalittoral rock	**Sand** ASTEROIDEA PLEURONECTIFORMES Biofilm **Reef** ?*Abietinaria abietina* Hydroid/Bryozoan mixed substrate *Alcyonium digitatum* *Urticina* *Metridium senile* *Spirobranchus* *Munida rugosa* *Cancer pagurus* *Gibbula* Bryozoa crust ASTEROIDEA *Marthasterias glacialis* *Crossaster papposus* *Echinus esculentus* Labridae Corallinaceae Encrusting Brown Algae	Inshore area. See Figure 3.1 (Chart Appendix)	  
Coarse rippled sand becoming finer inshore with a few holes. Sublittoral sand and muddy sands.SS.SSA (Section 3)	DECAPODA (?*Liocarcinus*) Paguridae *Cancer pagurus* *Astropecten irregularis* ASTEROIDEA *Lophius piscatorius* Ammodytidae Gadiformes Gobiidae PLEURONECTIFORMES	Inshore area. See Figure 3.1 (Chart Appendix)	

3.1.2. A total of four biotopes were classified along the modified offshore export cable route corridor occurring both singly and as twinned mosaics in some instances. The biotopes encountered included one EUNIS Level 3 Main habitat (SS.SSA), one Level 4 Biotope complex (SS.SMx.CMx), one Level 5 Biotope (SpnMeg) and one Level 6 Sub-biotope (FaAlCr.Pom). The 'Seapens and burrowing megafauna in circalittoral fine mud', SS.SMu.CFiMu.SpnMeg, dominated across the area and occurred in two variant forms. In the inshore area where the rock biotope CR.MCR.EcCr.FaAlCr.Pom was encountered it was also found in two forms.

3.1.3. Other Level 5 sediment biotopes will have been present in the area would require grab sampling in order to discriminate them with any confidence. One Level 5 biotope that was indicated to a degree was '*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment', SS.SMx.CMx.FluHyd (Appendix 3). However, in the corridor surveyed the evidence for it was weak at best and therefore, while it was noted it was not considered definitive enough to be included in the habitat list.

3.1.4. Figure 3.1 (Chart Appendix) shows the distribution of the classified biotopes (biotope map). Once the side scan sonar data from the geophysical survey becomes available this figure will also indicate the interpolated extent of the biotopes within the corridor.

3.1.5. The biotope map (Figure 3.1 – Chart Appendix) shows that the offshore benthic environment was dominated by sand and muddy sand (SSA), fine mud (SS.SMu.CFiMu) and mixed sediment (SS.SMx.CMx) biotopes. Typical epifauna noted from the seabed video for the offshore SSA habitats were large Pagurid crabs and an array of fish including gurnards, thick backed sole, flat fish, (often plaice) and gadiform fish, largely unidentifiable due to quality of image. A few King scallop (*Pecten maximus*) were seen and small numbers of starfish (common starfish (*Asterias rubens*), Seven-armed starfish (*Luidia ciliaris*)). The hydroid/bryozoan mixed turf and very small occurrences of hornwrack *Flustra foliacea*, were rarely seen, found on small amounts of slightly coarser sediment. Across the area, a gelatinous, filamentous substance was observed, believed to be a diatomaceous floc.

3.1.6. This area of sand and muddy sand was followed in the offshore area by a region where SSA occurred with SS.SMx.CMx. The fauna on the sediment here largely comprised Pagurid crabs, a few small crabs (notably *Liocarcinus*) and a selection of flat fish including plaice and thick backed sole. A variety of starfish were distributed across the area including the sand star (*Astropecten irregularis*), the sun star (*Crossaster papposus*), *Luidia sarsi* and common starfish (*A. rubens*). The foliose hydroid/bryozoan turf including *Hydrallmania* and *Flustra* were largely concentrated on the areas of coarse mixed sediment. A rare occurrence of *Metridium senile* was seen on a large cobble. *Pecten maximus* were more notable across both the sandy and coarser sediments of the site.

3.1.7. When first encountered the sea pen and burrowing megafauna community SS.SMu.CFiMu.SpnMeg occurred in the form of a coarse sediment variation of this biotope. SpnMeg was clearly indicated but the sedimentary conditions excluded the classical representation associated with *Nephrops* grounds. The main fauna noted were flat fish, gurnards, a few starfish and pagurid crabs. Hydroid/bryozoan turf of largely indefinable composition was scattered throughout. King scallop occurred sporadically. The diatomaceous floc was again present across the area. Of particular note was the abundance of the slender sea pen *Virgularia mirabilis* which was very evident and occurred frequently whilst only one phosphorescent sea pen *Pennatula phosphorea* was noted.

3.1.8. The sea pen habitat was followed by another mosaic of SSA and SS.SMx.CMx. Here the main fauna noted were hydroid/bryozoan turf, including hornwrack (*F. foliacea*), *Sertularia*, *Abietinaria* and potentially, the bottle-brush hydroid (*Thuiaria thuja*). Flat fish, a few starfish and pagurid crabs were evident, along with the round crab (*Atelecyclus rotundatus*). The rugose squat lobster (*Munida rugosa*) was occasionally seen in the coarse sediment. King scallop was noted as occurring in higher densities here occurring relatively regularly throughout.

3.1.9. The SSa/CMx area gave way to an area of solely SS.SMx.CMx comprising coarse gravelly shelly sand waves in places. The main fauna noted were foliose hydroid/bryozoan turf, including *Flustra*, and *Sertularia*. A few starfish and pagurid crabs were evident, along with *M. rugosa* which was occasionally seen in the coarse sediment. King scallop occurred only rarely.

3.2.0. The typical SS.SMu.CFiMu.SpnMeg occurred extensively in the offshore area. Burrowing megafauna were clearly evident, including the phosphorescent sea pen and in some areas, slender sea pen (*Virgularia mirabilis*). Norway lobster (*Nephrops norvegicus*) was sporadically seen. Flat fish were present and a few starfish including goose foot starfish (*Anseropoda placenta*). Pagurid crabs and the occasional decapod (possibly *Liocarcinus*), were in evidence. Gurnards and a few small gadoid fish were also present. Additionally, the edible crab (*Cancer pagurus*) was observed.

3.2.1. A more low-lying form of the SpnMeg biotope was also seen here. In these areas there was a relatively even sandy mud/muddy sand substrate with small burrows and small mounds and holes. Bioturbation was therefore evident but not as deep or dense as those areas more suited to Norway lobster. Occasional small boulders and areas of coarser sediment, with a few cobbles, and mixed pebbles and large shell hash occurred in places. Burrowing megafauna were evident, including the phosphorescent sea pen. Flat fish and a few starfish were also seen, as well as a few large King scallop. The coarser substrate had more dense aggregations of hydroid/bryozoan turf and a very small amount of oaten pipes hydroid *Tubularia indivisa*. Boulders with the plumose anemone *Metridium senile* were present. Sediment with small polychaete tubes forming a 'mat' in places were believed to be a species in the family Oweniidae. Of particular note in this region was the rare occurrence of what is thought to be the burrowing sea anemone *Arachnanthus sarsi*, a PMF in Scotland (Plate 1). Unfortunately, the quality of the image is such that a degree of caution is necessary with respect to the identification which has been recorded as ?*Arachnanthus sarsi*. No previous records of the species on the east coast of mainland Scotland could be found. The site where it was observed was roughly 400 m from a grab sampling station (KPA 30). The sediment at this location had a Folk class of slightly gravelly muddy sand and the highest recorded percentage of mud for any of the ten stations sampled at 43.14%.

Plate 1 **?***Arachnanthus sarsi (red box)*

3.2.2. Areas of CMx sometimes occurred within SpnMeg habitat. Within this area, large sections of coarse mixed sediment with boulders and cobbles was seen. Burrowing megafauna was still evident in the areas of softer sediment but the bioturbation was not as deep or dense as areas more suited to *Nephrops*. These coarser sections were dominated by hydroid/bryozoan turf, small amounts of oaten pipes hydroid *T. indivisa* and, a notable amount of the rugose squat lobster under the boulders and cobbles. Occasional edible sea urchin (*Echinus esculentus*) and a few King scallop were seen as was one edible crab.

3.2.3. Once the SpnMeg was no longer present the CMx habitat with a reduced amount of mud in evidence, had a fauna largely comprised of coralline algae and bryozoan crusts with sparse outcrops of foliose hydroid/bryozoan turf including hornwrack *Flustra foliacea* and Plumulariidae, with rare oaten pipes hydroid *T. indivisa*. Very small outcrops of dead man's fingers (*Alcyonium digitatum*) were present and rare edible sea urchin. Rugose squat lobster were present under many of the boulders and cobbles, with small crabs such as *Liocarcinus* also evident. Occasionally a large edible crab was seen and a very occasional King scallop. Small starfish were scattered across the area. Discarded fishing rope debris was also present.

3.2.4. The area of CMx gave way to a mixed region of CMx and SSa. In this area what appeared to be hard ground in places was over-laid with a very coarse mixture of shelly sandy, gravelly pebbly cobble matrix with a few boulders in places. Mobile sand of varying depths provided a thin covering over the hard ground and in places, extensive patches of rippled sand occurred, before returning to coarse mixed sediment. Where this occurred further offshore the sand became coarser and thicker in nature, forming coarse sand waves with large shell debris within the recesses. The coarse ground had sparse hydroid/bryozoan turf with a few starfish, small amounts of the soft coral *A. digitatum*, rare oaten pipes hydroid and *Urticina* anemones. Boulders were particularly covered in dense hydroid/bryozoan turf, with large clusters of hornwrack. Rugose squat lobster were regularly seen across the area under the coarser sediment. King scallop were often seen as well as the occasional edible crab. In some sand patches tubes of the sand mason worm (*Lanice conchilega*) became evident, mixed with smaller tubes believed to be of the family Oweniidae. In the deeper coarser sand waves, sand eels were present.

3.2.5. In the CMx/SSA habitat small colonies of serpulid worms thought to be either *Salmacina dysteri* or *Filograna implexa* were noted (Plate 2). Video data were not sufficient to confirm species identity in this instance. It may be that the species is in fact *S. dysteri* but it would require sampling and closer taxonomical analysis to confirm this identity. These clusters were only present within a short area of the transect suggesting a sparse distribution.

Plate 2 Serpulid colonies (note stills image taken from a transect to the west of the video track reported here but in similar habitat and used because of the clarity of the image).

3.2.6. Across the inshore area rippled sand, with a few holes, was encountered with a thin biofilm in evidence across the area. Only a few flat fish were evident here. This area of inshore sand, gradually gave way to a bedrock and boulder reef. Small outcrops of rock with the brown alga *Saccharina latissima* and long foliose red and brown algal fronds were seen. Where the reef became more established, only foliose red algal fronds remained (i.e. ?*Delesseria sanguinea*, sea beech), before the algal cover disappeared completely. The area then became a bedrock, boulder and cobble reef, undulating and rising to around 1-2.0m approx. in height at its greatest point. A cobble, pebble and gravelly sand matrix was evident within the recesses in places. There were small areas where a thin film of sediment was evident on the hard rock surfaces.

3.2.7. The bedrock and boulder reef was densely covered by a crust of what is believed to be a brown alga, with coralline algae and bryozoan crusts also strongly present. *Spirobranchus* worm tubes were clearly visible. The edible urchin *E. esculentus* was very common across the area, along with a frequent presence of the soft coral *A. digitatum*. Small starfish recorded as Asteroidea but probably the common starfish *A. rubens* were often seen. Sun star were very frequent here and the edible crab was noted as occasional.

3.2.8. The area of reef gave way to coarse rippled sand which gradually became finer closer inshore with a few holes. A few starfish are scattered across the area along with large pagurid crabs, flat fish and gadoid fish in places. One monkfish *Lophius piscatorius* was seen. In the coarser sand, sand eel were more apparent.

3.2 Features of conservation interest

3.2.1. The extensive presence of the biotope SS.SMu.CFiMu.SpnMeg Seapens and burrowing megafauna in circalittoral fine mud along the proposed cable corridor indicated the presence of the PMF burrowed mud across the area survey. This habitat is also captured by the Scottish biodiversity list (under Scotlands Biodiversity strategy) as 'Mud habitats in deep water'.

3.2.2. In the inshore area the rock biotope CR.MCR.EcCr.FaAlCr.Pom Faunal and algal crusts with *Pomatoceros triqueter* and sparse *Alcyonium digitatum* on exposed to moderately wave-exposed circalittoral rock was encountered and is illustrative of the Annex I (Habitats Directive) Reef. This was found over a distance of approximately 1.1 km.

3.2.3. The presence of what appears to be the burrowing anemone *Arachnanthus sarsi* was also noted. This species is on the Scottish biodiversity list and has been recommended as a PMF.

3.2.4. The deep water coral *Lophelia pertusa*, which has previously been recorded to the east in the area of the Moray Firth called the Southern Trench (Hall-Spencer & Stehfest, 2009), was not observed at any point from the video survey of the proposed cable route.

3.3 Sediment type (PSD)

3.3.1. Full results of the particle size distribution analyses of the grab samples are presented in Appendix IV and are summarised in Figure 3.3 (Chart Appendix). A total of five Folk sediment classifications (Folk, 1954) were identified following laboratory analysis as summarised in Table 3.3 below.

Table 3.3 Summary of the grab sample sediment analyses

Folk classification	Number of stations (n=10) Sediment description	Representative seabed photograph
Gravelly sand gS	1 station (KPA45) % gravel = 18.93 % sand = 79.26 % mud = 1.82 Poorly sorted	
Slightly gravelly sand (g)S	2 stations (KPA50, KPA58) Mean % gravel = 1.19 Mean % sand = 94.99 Mean % mud = 3.82 Moderately sorted	
Slightly gravelly muddy sand (g)mS	5 stations (KPB12, KPA37, KPA30, KPA21, KPA17) Mean % gravel = 0.04 Mean % sand = 72.75 Mean % mud = 27.21 Poorly sorted	

Folk classification	Number of stations (n=10) Sediment description	Representative seabed photograph
Muddy sand mS	1 station (KPA12) % gravel = 0 % sand = 76.91 % mud = 23.09 Poorly sorted	
Muddy sandy gravel msG	1 station (KPB7) % gravel = 56.62 % sand = 35.37 % mud = 8.02 Very poorly sorted	

3.3.2. The grab sample data are consistent with the expected distribution, as indicated by both the predicted habitats (Figure 1.2 – Chart Appendix) and the seabed video surveillance, with coarser sediments at the start and end of the proposed cable route and muddier sediments in the midsection. The dominant sediment fractions were very fine to medium grade sands (particles of diameter between 63-500 µm). With two exceptions the gravel component was considerably less than 2%. Station KPB7, closest to shore, had the largest percentage of gravel of any of the samples at 56.62%. Video evidence confirmed the coarser stonier nature of the inshore sediments. The sample from the offshore Station KPA45 had 18.93% gravel, though as the grab photo illustrates this was shell gravel (Appendix II).

3.3.3. Levels of mud particles (<63 µm diameter) ranged from 1.82% at station KPA45 in the offshore deep circalittoral coarse sediments to 43.14% at station KPA30 in the midsection of the proposed cable route. The five muddiest stations (slightly gravelly muddy sand) occurred consecutively over a distance of just over 25 km from the offshore area to within about 10 km of the coast (Table 3.4, Figure 3.3 – Chart Appendix). Video data showed that this, more silty sediment supported burrowing fauna as evidenced by the density of burrows and mounds. Two species of seapens, *Pennatula phosphorea* and *Virgularia mirabilis*, also typified the sediments in this area. These observations accord with historic findings of burrowed muddy seabed habitats with sea pens as illustrated in Figure 1.4 (Chart Appendix). The biotope classification **SS.SMu.CFiMu.SpnMeg** has been attributed to this sediment habitat (which describes sea pens and burrowing megafauna in circalittoral fine mud) and is clearly supported by the increased mud fraction found. It is a component biotope of the "burrowed mud" Scottish PMF and therefore represents a habitat of potential conservation importance in Scotland.

3.4 Sediment chemistry

3.4.1. Full results of the sediment chemistry analyses are presented in Appendix 5. A summary of the results are provided in Tables 3.4 to 3.6.

Table 3.4 Summary results of the sediment chemistry analyses for metals, organotins and total hydrocarbons

Determinand	Units	KPA58 (52.0m)	KPA50 (51.2m)	KPA45 (54.8m)	KPA37 (70.0m)	KPA30 (87.1m)	KPA21 (75.1m)	KPA17 (84.3m)	KPA12 (94.0m)	KPB12 (37.4m)	KPB7 (20.0m)
Mercury : Dry Wt	mg/kg	0.00352	0.00381	0.00538	0.0113	0.0134	0.0113	0.0165	0.0184	0.0235	<0.002
Aluminium, HF Digest : Dry Wt	mg/kg	16700	19200	6770	21400	29800	31000	13700	15600	37300	19600
Barium, HF Digest : Dry Wt	mg/kg	259	257	115	308	320	347	339	419	436	270
Arsenic, HF Digest : Dry Wt	mg/kg	5.46	3.2	*24.6*	4.07	4.9	4.75	4.91	5.94	*11.2*	4.87
Cadmium, HF Digest : Dry Wt	mg/kg	0.056	0.042	0.038	0.171	0.141	0.14	0.132	0.148	0.151	0.07
Chromium, HF Digest : Dry Wt	mg/kg	25	12.5	10.2	*67.1*	*70.7*	*53.6*	46.8	*58.8*	*52.7*	11.4
Copper, HF Digest : Dry Wt	mg/kg	3.51	2.52	2.05	6.36	6.01	6.28	6.67	7.4	10.6	2.04
Lead, HF Digest : Dry Wt	mg/kg	9.62	7.89	8.86	9.04	9.99	10.1	10.8	12.2	17.3	6.65
Nickel, HF Digest : Dry Wt	mg/kg	4.19	3.7	3.64	14.6	15.6	14.7	15.5	17.2	19.7	3.3
Tin, HF Digest : Dry Wt	mg/kg	0.806	0.553	<0.5	1.2	1.25	1.28	1.24	1.38	1.93	0.74
Zinc : HF Digest : Dry Wt	mg/kg	10.2	8.4	10	26.5	28.7	28.5	31.3	33.4	48.2	13.6
Dibutyl Tin : Dry Wt as Cation	ug/kg	<4	<4	<4	<4	<5	<4	<4	<4	<4	<4
Dioctyl Tin : Dry Wt as Cation	ug/kg	<4	<4	<4	<4	<5	<4	<4	<4	<4	<4
Diphenyl Tin : Dry Wt as Cation	ug/kg	<3	<3	<2	<3	<3	<3	<3	<3	<3	<2
Tetrabutyl Tin : Dry Wt as Cation	ug/kg	<3	<3	<2	<3	<3	<3	<3	<3	<3	<2
Tributyl Tin : Dry Wt as Cation	ug/kg	<4	<4	<4	<4	<5	<4	<4	<4	<4	<4
Triphenyl Tin : Dry Wt as Cation	ug/kg	<3	<3	<2	<3	<3	<3	<3	<3	<3	<2
Hydrocarbons : Total : Dry Wt as Ekofisk	mg/kg	0.502	0.436	0.801	1.63	2.63	1.52	2.36	1.87	3.21	0.14

Below all guideline values
Above Cefas AL1 (below OSPAR)
Above Canadian TEL
LOD below guideline value

Metals

3.4.2. All results were below OSPAR, Cefas and Canadian action levels with the exception of Arsenic and Chromium (Appendix 5; Table 3.4).

3.4.3. The concentration of Arsenic was above the Cefas revised AL1 (20 mg/kg) and the Canadian TEL (7.24 mg/kg) in the sample taken from Site KPA45 (24.6 mg/kg) and above the Canadian TEL in the sample taken from Site KPB12 (11.2 mg/kg). However, all results for the concentration of Arsenic were below the OSPAR Background Assessment Concentration (BAC) of 25 mg/kg.

3.4.4. The concentration of Chromium was above the Cefas revised AL1 (50 mg/kg) and the Canadian TEL (52.3 mg/kg) in the samples taken from Sites KPA37 (67.1 mg/kg), KPA 30 (70.7 mg/kg), KPA21 (53.6 mg/kg), KPA12 (58.8 mg/kg) and KPB12 (52.7 mg/kg). However, all results for the concentration of Chromium were below the OSPAR Background Assessment Concentration (BAC) of 81 mg/kg.

Organotins

3.4.5. The Cefas AL1 for Tributyltin (TBT, DBT and MBT) is 100 µg/kg. The concentrations of organotins for all samples were below the limit of detection (LOD) available from the analyses. Marine Scotland requires a LOD of 10 µg/kg of TBT (Appendix 5; Table 3.4). The LOD achieved for TBT by the analytical laboratory used to assess the samples was <4 µg/kg.

3.4.6. OSPAR (2009) states that the, '*large majority of the* [TBT] *concentrations fall into assessment classes B and C, and would not be expected to affect the reproductive capability of sensitive gastropod species*'. Class C concentrations of TBT in sediments are in the range 2 µg/kg–<50 µg/kg and, therefore, the concentrations found from the proposed cable route samples are unlikely to present a problem in this respect.

Total Hydrocarbons

3.4.7. The concentration of hydrocarbons was low in all samples, ranging from 0.14 mg/kg at Site KPA7 to 2.63 mg/kg at Site KPA30, well below the revised Cefas AL1 of 100 mg/kg (Appendix 5; Table 3.4).

PAHs

3.4.7. PAH concentrations were low in samples from all sites with the majority below the LOD available from the analyses. All results were below the available guideline values (Appendix 5; Table 3.5).

PCBs

3.4.8. PCB concentrations were below the LOD available from the analyses in all cases. All results were below the available guideline values (Appendix 5; Table 3.6).

Table 3.5 Summary results of the sediment chemistry analyses for PAHs

Determinand	Units	KPA58 (52.0m)	KPA50 (51.2m)	KPA45 (54.8m)	KPA37 (70.0m)	KPA30 (87.1m)	KPA21 (75.1m)	KPA17 (84.3m)	KPA12 (94.0m)	KPB12 (37.4m)	KPB7 (20.0m)
Acenaphthene : Dry Wt	ug/kg	<2	<2	<2	<2	2.07	<2	<2	<2	2.34	<2
Acenaphthylene : Dry Wt	ug/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Anthracene : Dry Wt	ug/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzo(a)anthracene : Dry Wt	ug/kg	<2	<2	<2	<2	<2	<2	2.39	<2	<2	<2
Benzo(a)pyrene : Dry Wt	ug/kg	<2	<2	<2	2.24	3.3	2.13	3.93	2.74	2.16	<2
Benzo(b)fluoranthene : Dry Wt	ug/kg	<10	<10	<10	<10	<10	<10	10.5	<10	<10	<10
Benzo(e) pyrene : Dry Wt	ug/kg	<5	<5	<5	<5	6.72	<5	7.7	<5	<5	<5
Benzo(ghi)perylene : Dry Wt	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(j)fluoranthene : Dry Wt	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthene : Dry Wt	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Chrysene/Triphenylene: Dry Wt	ug/kg	<3	<3	<3	<3	3.3	<3	4.08	<3	<3	<3
Chrysene : Dry Wt	ug/kg	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dibenzo(ah)anthracene: Dry Wt	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Dibenzothiophene : Dry Wt	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Fluoranthene : Dry Wt	ug/kg	<2	<2	<2	2.87	4.29	3.07	6.99	3.96	4.26	<2
Fluorene : Dry Wt	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Indeno(1,2,3-c,d)pyrene: DryWt	ug/kg	<10	<10	<10	<10	10.1	<10	<10	<10	<10	<10
Naphthalene : Dry Wt	ug/kg	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Perylene : Dry Wt	ug/kg	<5	<5	<5	<5	<5	<5	9.11	5.33	24.4	7.57
Phenanthrene : Dry Wt	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Pyrene : Dry Wt	ug/kg	<3	<3	<3	<3	3	<3	4.77	<3	3.12	<3

Below all guideline values
LOD below guideline values

Table 3.6 Summary results of the sediment chemistry analyses for PCBs

Determinand	Units	KPA58 (52.0m)	KPA50 (51.2m)	KPA45 (54.8m)	KPA37 (70.0m)	KPA30 (87.1m)	KPA21 (75.1m)	KPA17 (84.3m)	KPA12 (94.0m)	KPB12 (37.4m)	KPB7 (20.0m)
PCB - 028 : Dry Wt	ug/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB - 052 : Dry Wt	ug/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB - 101 : Dry Wt	ug/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB - 118 : Dry Wt	ug/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB - 138 : Dry Wt	ug/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB - 153 : Dry Wt	ug/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB - 180 : Dry Wt	ug/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

LOD below guideline values

4 Discussion and Conclusions

4.1 This study has characterised the epibenthic habitats and associated faunal communities within the proposed modified offshore export cable route corridor. These data are used to inform the EIA to be provided in support of the development application.

4.2 A total of 4 biotopes were classified along the proposed offshore export cable route corridor occurring both singly and as twinned mosaics in some instances. The biotopes encountered included one EUNIS Level 3 Main habitat (SS.SSA), one Level 4 Biotope complex (SS.SMx.CMx), one Level 5 Biotope (SpnMeg) and one Level 6 Sub-biotope (FaAlCr.Pom).

4.3 The 'Seapens and burrowing megafauna in circalittoral fine mud', SS.SMu.CFiMu.SpnMeg, biotope dominated across the area and occurred in two variant forms, a typical form with highly conspicuous mounds and burrows and a slightly coarser sediment with lower-lying mounds expression. In the inshore area where the rock biotope CR.MCR.EcCr.FaAlCr.Pom was encountered it was also found in two forms one of which was the sheltered variant noted by Connor *et al*. (2004). Biotopes were mapped and a figure produced to illustrate the distribution of habitats recorded along the proposed cable route.

4.4 A number of the classified biotopes related to potential habitats of nature conservation significance including the following:

- Burrowed mud (recommended priority marine feature); and
- Stony and rocky reefs (EC Habitats Directive Annex I habitat 'Reefs').

4.5 In addition the possible presence of a species also listed as a PMF, *Arachnanthus sarsi* the burrowing anemone which lives in a parchment-like tube was noted. From the available records it appears that the species has not been recorded from the east coast of mainland Scotland previously.

4.6 A total of five Folk sediment classifications (Folk, 1954) were identified from the ten stations sampled for PSA. These included gravelly sand, slightly gravelly sand, slightly gravelly muddy sand, muddy sand and muddy sandy gravel. The dominant sediment fractions were very fine to medium grade sands and the five muddiest stations occurred in the area where the sea pen communities were recorded.

4.7 All sediment chemistry results for metals were below the guideline OSPAR, Cefas and Canadian values with the exception of Arsenic and Chromium. For these two determinands levels at some stations breached both Cefas AL1 and Canadian TEL guideline concentrations but in all cases were below the corresponding OSPAR guideline value. The concentrations of organotins for all samples were below the limit of detection (LOD) available from the analyses. The LOD achieved by the analytical laboratory was better than that required by Marine Scotland for the analysis of TBT. Furthermore in accordance with OSPAR (2009) the concentrations of TBT in sediments analysed from the modified export cable route corridor would be not be expected to affect the reproductive capability of any sensitive gastropod species and hence were considered unlikely to present a problem in this respect. The concentration of total hydrocarbons was low in all samples and well below the revised Cefas AL1. The concentration of PAHs and PCBs were below the LOD in most instances and below the available guideline values in all cases.

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Appendix 1 – Survey logs

Appendix I Grab Log

Moray Cable Route 2014 J/3/03/2610
(1 Sheet)

Site No.	Date	Grab Logsheet No.	Depth (m BCD)	UTM WGS84 Z30 N		Sample Size	Metals Sample	Hydrocarbons Sample	PSA	Photograph of sample?	*In-situ* sediment description	Sediment features (includes: burrows, tubes, casts, smell)	Sediment anoxia (includes: None, streaks, patches, layers, depth of layer)	Anthropogenic features (includes: sewage derived material, other)	Conspicuous Fauna
				Eastings	Northings										
KPA02	24/05/14	6	19.4	515861.0	6395296.0	1/2	1	3	Yes	Yes	Slightly shelly sand	None	None	None	None
KPA12	24/05/14	5	95.0	519091.8	6404741.0	Full	1	3	Yes	Yes	Sandy mud	Tubes	None	None	None
KPA17	24/05/14	4	85.6	520622.7	6409510.0	Full	1	3	Yes	Yes	Sandy mud	Tubes	None	None	*Echinocardium cordatum, Liocarcinus holsatus*
KPA21	24/05/14	4	76.6	520421.9	6413497.0	1/2	1	1	Yes	Yes	Sandy mud	Tubes	None	None	None
KPA21	24/05/14	4	76.1	520421.6	6413507.0	3/4	-	2	No	No	Sandy mud	Tubes	None	None	None
KPA30	24/05/14	2	88.7	519972.5	6422475.0	Full	1	3	Yes	Yes	Sandy mud	None	Patches	None	None
KPA37	24/05/14	2	71.4	519624.2	6429477.0	2/3	1	3	Yes	Yes	Sandy mud	Tubes	Layer	None	None
KPA45	24/05/14	2	55.8	519214.3	6437467.0	Full	1	3	Yes	Yes	Slightly gravelly, shelly sand (Shell hash)	Tubes	None	None	*Lanice* sp. tubes
KPA50	24/05/14	1	52.0	518964.3	6442465.0	2/3	1	3	Yes	Yes	Silty shelly sand	None	Patches	None	Hydroid
KPA58	24/05/14	1	52.0	518558.2	6450451.6	3/4	1	3	Yes	Yes	Silty sand	Tubes	None	None	None
KPB07	24/05/14	6	49.1	523024.3	6398324.0	3/4	1	3	Yes	Yes	Silty, gravelly, shelly sand	None	None	None	Plumularidae
KPB12	24/05/14	5	87.4	520345.4	6402541.0	1/2	1	1	Yes	Yes	Sandy mud	Tubes	None	None	None
KPB12	24/05/14	5	87.4	520349.9	6402533.0	3/4	-	2	No	No	Sandy mud	None	None	None	None

Appendix I Grab Quality Log

Moray Cable Route 2014 J/3/03/2610

(1 Sheet)

Site No.	Attempts	Successful sample collected (Y/N)	Brief description of problems with sample	Size of sample retained	Additional Notes on Quality of Retained Samples
KPA07	3	N	The first attempt was water only, the second attempt had a pebble in the grab jaw and the third attempt was a scraping	N/A	
KPA23	3	N	First attempt was a scraping, attempts 2 and 3 had a pebble in the grab jaw	N/A	The third sample was taken 100m south of the original site in an effort to acquire a successful sample
KPA50	2	Y	First attempt had a shell in the grab jaw, sample was washed out	2/3	
KPB04	1	N	The attempt had a cobble in the grab jaw	N/A	

Appendix I Static Image Log
Moray Cable Route J/3/03/2610
(12 Sheets)

Stills PICT No.	Date	UTM WGS84 Z30N	
		Eastings	Northings
A116	18/05/2014	516716.6	6398178.0
A117	18/05/2014	516706.0	6398167.4
A118	18/05/2014	516679.7	6398142.2
A119	18/05/2014	516669.5	6398128.0
A120	18/05/2014	516648.8	6398100.3
A121	18/05/2014	516628.5	6398072.6
A122	18/05/2014	516604.6	6398016.8
A123	18/05/2014	516584.0	6397962.2
A124	18/05/2014	516570.4	6397881.1
A125	18/05/2014	516569.1	6397853.6
A126	18/05/2014	516562.7	6397834.4
A127	18/05/2014	516559.4	6397782.9
A128	18/05/2014	516557.5	6397769.4
A129	18/05/2014	516552.6	6397681.2
A130	18/05/2014	516543.7	6397639.0
A131	18/05/2014	516533.0	6397574.3
A132	18/05/2014	516530.4	6397564.1
A133	18/05/2014	516529.6	6397559.3
A134	18/05/2014	516495.4	6397504.7
A135	18/05/2014	516488.5	6397478.6
A136	18/05/2014	516482.2	6397466.3
A137	18/05/2014	516460.7	6397397.0
A138	18/05/2014	516430.9	6397275.7
A139	18/05/2014	516432.4	6397213.6
A140	18/05/2014	516440.5	6397147.1
A141	18/05/2014	516467.2	6396974.3
A142	18/05/2014	516483.1	6396921.9
A143	18/05/2014	516498.7	6396886.4
A144	18/05/2014	516508.2	6396865.7
A145	18/05/2014	516465.5	6396793.2
A146	18/05/2014	516411.0	6396759.3
A148	18/05/2014	516360.4	6396678.1
A149	18/05/2014	516370.8	6396494.4
A150	18/05/2014	516319.1	6396459.2
A151	18/05/2014	516289.1	6396454.5
A152	18/05/2014	516269.4	6396458.6
A153	18/05/2014	-	-
A154	18/05/2014	-	-
A155	18/05/2014	-	-
A156	18/05/2014	516070.0	6396233.9
A157	18/05/2014	516069.0	6396224.9
A158	18/05/2014	516070.2	6396206.2
A159	18/05/2014	516044.9	6396122.1
A160	18/05/2014	516015.0	6396035.0
A161	18/05/2014	516013.6	6396024.0
A162	18/05/2014	516003.8	6395919.8
A163	18/05/2014	515999.3	6395889.5
A164	18/05/2014	515998.4	6395872.9
A165	18/05/2014	515991.4	6395838.8
A166	18/05/2014	515990.9	6395816.9
A167	18/05/2014	515936.1	6395648.1
A168	18/05/2014	515882.1	6395463.9
A169	18/05/2014	515874.1	6395436.3
A172	18/05/2014	515854.0	6395344.9
A173	18/05/2014	515869.3	6395217.5
A174	18/05/2014	515714.3	6394807.1
A175	18/05/2014	515674.9	6394702.0
A176	18/05/2014	515632.9	6394549.7
A177	18/05/2014	515622.4	6394542.9
A178	18/05/2014	515513.8	6394200.6
A179	18/05/2014	515508.9	6394191.4
A180	18/05/2014	515482.4	6394134.9
A183	18/05/2014	522713.1	6399106.2
A184	18/05/2014	522702.9	6399127.0
A185	18/05/2014	522691.1	6399152.1
A186	18/05/2014	522671.9	6399178.6
A187	18/05/2014	522645.3	6399210.5
A188	18/05/2014	522638.1	6399220.8
A189	18/05/2014	522567.0	6399285.6
A190	18/05/2014	522549.8	6399299.4
A191	18/05/2014	522516.6	6399336.5
A192	18/05/2014	522494.5	6399363.0
A193	18/05/2014	522442.8	6399443.3

Stills PICT No.	Date	UTM WGS84 Z30N	
		Eastings	Northings
A194	18/05/2014	522305.3	6399510.0
A195	18/05/2014	522214.1	6399563.9
A196	18/05/2014	521900.0	6399767.8
A197	18/05/2014	521893.9	6399783.8
A198	18/05/2014	521883.0	6400528.2
A199	18/05/2014	521754.6	6400625.4
A200	18/05/2014	521673.2	6400703.6
A201	18/05/2014	521454.3	6400888.7
A202	18/05/2014	521433.2	6400908.3
A203	18/05/2014	521404.9	6400934.0
A204	18/05/2014	521359.9	6400970.6
A205	18/05/2014	521203.1	6401147.5
A209	18/05/2014	523011.3	6398362.6
A210	18/05/2014	523002.1	6398370.1
A211	18/05/2014	522992.7	6398376.5
A212	18/05/2014	522973.3	6398390.8
A213	18/05/2014	522963.4	6398401.8
A214	18/05/2014	522893.3	6398443.2
A215	18/05/2014	522880.9	6398449.3
A216	18/05/2014	522870.6	6398453.8
A217	18/05/2014	522860.3	6398455.8
A218	18/05/2014	522844.3	6398480.6
A219	18/05/2014	522834.0	6398522.6
A220	18/05/2014	522822.7	6398533.6
A221	18/05/2014	522823.1	6398554.1
A222	18/05/2014	522832.9	6398591.4
A223	18/05/2014	522836.0	6398601.9
A224	18/05/2014	522843.7	6398617.5
A225	18/05/2014	522861.5	6398637.3
A226	18/05/2014	522877.5	6398647.9
A227	18/05/2014	522901.1	6398661.9
A228	18/05/2014	522940.7	6398737.1
A229	18/05/2014	522920.4	6398789.3
A230	18/05/2014	522885.8	6398842.3
A231	18/05/2014	522862.5	6398864.8
A232	18/05/2014	522783.7	6398916.1
A233	18/05/2014	522716.5	6398950.7
A234	18/05/2014	522689.9	6398964.9
A235	18/05/2014	522673.8	6398972.6
A236	18/05/2014	522628.9	6398993.5
A237	18/05/2014	522551.9	6399037.7
A238	18/05/2014	522523.2	6399052.6
A240	18/05/2014	524638.5	6395841.7
A241	18/05/2014	524616.0	6395874.5
A242	18/05/2014	524607.8	6395886.9
A243	18/05/2014	524584.9	6395914.6
A244	18/05/2014	524558.9	6395948.2
A245	18/05/2014	524489.8	6396044.9
A246	18/05/2014	524478.8	6396062.7
A247	18/05/2014	524461.0	6396088.0
A248	18/05/2014	524456.2	6396101.1
A249	18/05/2014	524440.9	6396123.7
A250	18/05/2014	524419.0	6396158.1
A251	18/05/2014	524386.7	6396233.3
A252	18/05/2014	524356.0	6396276.8
A253	18/05/2014	524134.4	6396608.0
A254	18/05/2014	524122.4	6396640.2
A255	18/05/2014	524114.2	6396659.1
A256	18/05/2014	524092.4	6396688.7
A257	18/05/2014	524086.8	6396728.2
A258	18/05/2014	524084.3	6396746.8
A259	18/05/2014	523957.1	6397172.3
A260	18/05/2014	523637.0	6397520.2
A261	18/05/2014	523612.0	6397538.8
A262	18/05/2014	523523.7	6397596.6
A263	18/05/2014	523517.7	6397601.1
A264	18/05/2014	523387.0	6397750.1
A265	18/05/2014	523377.4	6397766.1
A266	18/05/2014	523366.0	6397794.4
A267	18/05/2014	523167.0	6398233.5
A269	18/05/2014	525657.8	6394139.3
A270	18/05/2014	525649.5	6394151.4
A271	18/05/2014	525643.0	6394160.9
A272	18/05/2014	525636.2	6394170.2
A273	18/05/2014	525629.4	6394178.8
A274	18/05/2014	525623.1	6394187.1
A275	18/05/2014	525605.8	6394204.4

Stills PICT No.	Date	UTM WGS84 Z30N	
		Eastings	Northings
A276	18/05/2014	525595.9	6394212.5
A277	18/05/2014	525586.1	6394219.6
A278	18/05/2014	525579.2	6394225.4
A279	18/05/2014	525568.0	6394236.8
A280	18/05/2014	525562.6	6394244.8
A281	18/05/2014	525540.3	6394277.2
A282	18/05/2014	525523.3	6394289.2
A283	18/05/2014	525508.4	6394299.1
A284	18/05/2014	525497.2	6394308.5
A285	18/05/2014	525487.1	6394321.6
A286	18/05/2014	525445.6	6394371.4
A287	18/05/2014	525432.2	6394391.1
A288	18/05/2014	525409.7	6394446.9
A289	18/05/2014	525406.9	6394456.1
A290	18/05/2014	525195.4	6394919.1
A291	18/05/2014	524717.2	6395710.4
A292	18/05/2014	524680.8	6395750.8
A293	18/05/2014	524624.7	6395829.2
A294	18/05/2014	524616.9	6395839.5
B015	19/05/2014	526206.4	6393330.0
B016	19/05/2014	526203.0	6393338.3
B017	19/05/2014	526194.6	6393396.2
B018	19/05/2014	526194.7	6393400.0
B019	19/05/2014	526177.0	6393434.9
B020	19/05/2014	526173.6	6393438.7
B021	19/05/2014	526140.2	6393484.7
B022	19/05/2014	526091.8	6393578.8
B023	19/05/2014	526089.6	6393583.6
B024	19/05/2014	526075.0	6393612.7
B025	19/05/2014	526073.0	6393617.2
B026	19/05/2014	526069.3	6393624.5
B027	19/05/2014	526059.9	6393645.7
B028	19/05/2014	526053.2	6393667.7
B029	19/05/2014	526050.0	6393675.1
B030	19/05/2014	526045.8	6393684.8
B031	19/05/2014	526040.7	6393694.8
B032	19/05/2014	526036.8	6393700.5
B033	19/05/2014	526022.0	6393728.3
B034	19/05/2014	526017.8	6393740.1
B035	19/05/2014	526011.4	6393757.2
B036	19/05/2014	526002.0	6393781.5
B037	19/05/2014	525998.9	6393790.2
B038	19/05/2014	525996.8	6393799.2
B039	19/05/2014	525991.6	6393824.6
B040	19/05/2014	525986.4	6393862.8
B041	19/05/2014	525986.5	6393871.5
B042	19/05/2014	525985.7	6393880.9
B043	19/05/2014	525985.4	6393895.3
B044	19/05/2014	525984.8	6393899.9
B045	19/05/2014	525981.1	6393913.5
B046	19/05/2014	525975.5	6393930.2
B047	19/05/2014	525973.5	6393947.1
B048	19/05/2014	525970.3	6393969.1
B049	19/05/2014	525963.9	6393984.3
B050	19/05/2014	525959.8	6393989.9
B051	19/05/2014	525957.8	6393992.9
B052	19/05/2014	525937.3	6394016.5
B053	19/05/2014	525934.8	6394020.8
B054	19/05/2014	525915.1	6394039.4
B055	19/05/2014	525897.0	6394057.1
B056	19/05/2014	525883.4	6394074.9
B057	19/05/2014	525868.4	6394093.1
B058	19/05/2014	525857.1	6394109.8
B059	19/05/2014	525843.3	6394133.3
B060	19/05/2014	525836.3	6394143.4
B061	19/05/2014	525835.0	6394148.8
B062	19/05/2014	525821.0	6394169.2
B063	19/05/2014	525811.2	6394181.4
B064	19/05/2014	525805.2	6394193.5
B066	19/05/2014	521252.7	6401104.3
B067	19/05/2014	521253.7	6401111.4
B068	19/05/2014	521230.4	6401290.4
B069	19/05/2014	521228.2	6401296.3
B070	19/05/2014	521211.4	6401336.4
B071	19/05/2014	521148.8	6401426.8
B072	19/05/2014	521113.9	6401474.2
B076	19/05/2014	521036.7	6401593.7

Stills PICT No.	Date	UTM WGS84 Z30N	
		Eastings	Northings
B077	19/05/2014	520929.6	6401693.5
B078	19/05/2014	520787.6	6401826.6
B079	19/05/2014	520599.2	6402106.8
B080	19/05/2014	520438.9	6402308.8
B081	19/05/2014	520025.1	6402997.9
B082	19/05/2014	519914.5	6403204.7
B083	19/05/2014	519906.1	6403217.2
B084	19/05/2014	519814.4	6403364.7
B085	19/05/2014	519666.2	6403545.6
B086	19/05/2014	519491.8	6403771.4
B087	19/05/2014	519487.7	6403795.4
B088	19/05/2014	519468.8	6403922.5
B089	19/05/2014	519357.7	6404174.3
B090	19/05/2014	519304.6	6404212.2
B091	19/05/2014	519250.9	6404253.3
B092	19/05/2014	519168.6	6404359.6
B093	19/05/2014	519155.9	6404422.1
B094	19/05/2014	519150.0	6404481.2
B095	19/05/2014	519149.9	6404491.7
B096	19/05/2014	519148.0	6404639.8
B097	19/05/2014	519141.8	6404663.5
B098	19/05/2014	519112.5	6404749.8
B099	19/05/2014	519167.0	6404866.0
B100	19/05/2014	519163.4	6404909.0
B102	19/05/2014	516877.0	6398237.4
B103	19/05/2014	516890.1	6398255.9
B104	19/05/2014	516902.1	6398275.3
B105	19/05/2014	516907.5	6398286.2
B106	19/05/2014	516917.9	6398309.2
B107	19/05/2014	516929.4	6398382.1
B108	19/05/2014	516945.2	6398431.2
B109	19/05/2014	516986.7	6398500.2
B110	19/05/2014	517007.1	6398542.1
B111	19/05/2014	517025.2	6398579.5
B112	19/05/2014	517045.4	6398609.3
B113	19/05/2014	517035.2	6398703.7
B114	19/05/2014	517029.8	6398712.8
B115	19/05/2014	517042.5	6398787.5
B116	19/05/2014	517125.0	6398929.5
B117	19/05/2014	517210.5	6399170.1
B118	19/05/2014	517216.2	6399188.2
B119	19/05/2014	517488.4	6400006.9
B120	19/05/2014	517508.3	6400078.2
B121	19/05/2014	517526.8	6400136.2
B122	19/05/2014	517539.9	6400178.1
B123	19/05/2014	517557.2	6400265.6
B124	19/05/2014	517575.7	6400339.2
B125	19/05/2014	517576.6	6400351.7
B126	19/05/2014	517578.4	6400365.1
B127	19/05/2014	517579.9	6400372.9
B128	19/05/2014	517608.9	6400432.5
B129	19/05/2014	517658.0	6400572.3
B130	19/05/2014	517688.0	6400671.7
B131	19/05/2014	517691.9	6400686.3
B132	19/05/2014	517695.2	6400695.6
B133	19/05/2014	517699.4	6400709.1
B134	19/05/2014	517703.5	6400725.1
B135	19/05/2014	517716.3	6400784.1
B136	19/05/2014	517746.2	6400862.9
B138	19/05/2014	517810.5	6401012.5
B139	19/05/2014	517815.5	6401022.9
B140	19/05/2014	517828.2	6401044.3
B141	19/05/2014	517849.4	6401085.8
B142	19/05/2014	517853.3	6401102.2
B143	19/05/2014	517898.0	6401246.9
B144	19/05/2014	517902.4	6401263.4
B145	19/05/2014	517911.4	6401301.9
B146	19/05/2014	518345.9	6402542.5
B147	19/05/2014	518351.1	6402559.7
B148	19/05/2014	518452.1	6402845.2
B152	19/05/2014	518797.6	6403755.0
B153	19/05/2014	518807.3	6403768.0
B154	19/05/2014	518843.4	6403832.0
B155	19/05/2014	518877.3	6403921.9
B156	19/05/2014	518885.0	6403944.3
B157	19/05/2014	518895.3	6404010.9
B158	19/05/2014	518932.4	6404176.0

Stills PICT No.	Date	UTM WGS84 Z30N	
		Eastings	Northings
B159	19/05/2014	518938.7	6404240.2
B160	19/05/2014	518961.6	6404339.3
B161	19/05/2014	519057.0	6404580.4
B162	19/05/2014	519107.1	6404723.8
B164	19/05/2014	519150.8	6404871.8
B165	19/05/2014	519147.7	6404893.4
B166	19/05/2014	519347.7	6405452.8
B167	19/05/2014	519355.6	6405500.5
B168	19/05/2014	519699.1	6406621.5
B169	19/05/2014	519902.8	6407016.9
B174	19/05/2014	520133.8	6407751.4
B175	19/05/2014	520138.2	6407765.2
B176	19/05/2014	520144.4	6407779.2
B177	19/05/2014	520263.7	6408053.0
B178	19/05/2014	520348.4	6408438.6
B179	19/05/2014	520350.2	6408446.0
B180	19/05/2014	520353.4	6408455.7
B181	19/05/2014	520448.5	6408697.5
B182	19/05/2014	520583.3	6409066.6
B183	19/05/2014	520609.3	6409146.5
B184	19/05/2014	520672.1	6409372.0
B185	19/05/2014	520657.7	6409418.0
B186	19/05/2014	520645.4	6409449.8
B187	19/05/2014	520626.2	6409534.5
B188	19/05/2014	520593.1	6409798.6
B189	19/05/2014	520593.1	6409807.1
B190	20/05/2014	520575.0	6410129.2
B191	20/05/2014	520572.3	6410140.4
B192	20/05/2014	520571.5	6410149.8
B193	20/05/2014	520570.6	6410159.7
B194	20/05/2014	520578.4	6410421.2
B213	20/05/2014	520622.1	6410571.2
B214	20/05/2014	520614.5	6410783.9
B215	20/05/2014	520612.2	6410813.7
B216	20/05/2014	520583.4	6410934.8
B217	20/05/2014	520567.6	6411003.4
B218	20/05/2014	520554.4	6411038.6
B219	20/05/2014	520523.8	6411342.9
B220	20/05/2014	520523.4	6411776.0
B221	20/05/2014	520516.1	6412219.5
B222	20/05/2014	520463.1	6412591.0
B223	20/05/2014	520458.6	6413133.2
B224	20/05/2014	520459.1	6413147.0
B225	20/05/2014	520451.0	6413339.0
B226	20/05/2014	520452.5	6413361.1
B228	20/05/2014	520458.1	6413526.3
B229	20/05/2014	520457.2	6413533.6
B230	20/05/2014	520418.5	6413646.6
B231	20/05/2014	520411.9	6413722.3
B232	20/05/2014	520413.3	6413774.2
B233	20/05/2014	520432.7	6413966.1
B234	20/05/2014	520432.3	6413975.2
B235	20/05/2014	520428.2	6414064.7
B236	20/05/2014	520484.8	6414309.5
B237	20/05/2014	520495.1	6414611.8
B238	20/05/2014	520481.0	6414689.6
B239	20/05/2014	520476.1	6414707.4
B240	20/05/2014	520469.1	6414724.0
B241	20/05/2014	520462.7	6414766.6
B242	20/05/2014	520459.2	6414785.0
B243	20/05/2014	520453.7	6414815.5
B244	20/05/2014	520452.0	6414833.9
B245	20/05/2014	520434.4	6414950.1
B246	20/05/2014	520429.3	6415281.7
B247	20/05/2014	520418.9	6415363.6
B248	20/05/2014	520403.3	6415423.6
B249	20/05/2014	520401.9	6415431.3
B250	20/05/2014	520400.1	6415452.7
B251	20/05/2014	520395.7	6415509.4
B252	20/05/2014	520397.6	6415522.6
B253	20/05/2014	520402.6	6415548.1
B254	20/05/2014	520374.5	6415929.5
B257	20/05/2014	520277.3	6416536.9
B258	20/05/2014	520240.3	6416749.8
B259	20/05/2014	520240.8	6416951.5
B260	20/05/2014	520215.7	6417219.2
B261	20/05/2014	520215.1	6417228.0

Stills PICT No.	Date	UTM WGS84 Z30N	
		Eastings	Northings
B262	20/05/2014	520200.8	6417283.4
B265	20/05/2014	520104.3	6419432.6
B266	20/05/2014	520110.1	6419421.1
B267	20/05/2014	520112.6	6419254.5
B268	20/05/2014	520115.7	6419239.7
B269	20/05/2014	520117.5	6419230.4
B270	20/05/2014	520118.9	6419225.0
B271	20/05/2014	520120.8	6419218.1
B272	20/05/2014	520122.6	6419209.8
B273	20/05/2014	520123.8	6419195.7
B274	20/05/2014	520133.1	6419149.7
B275	20/05/2014	520131.2	6419130.7
B276	20/05/2014	520127.1	6419121.4
B277	20/05/2014	520119.9	6419081.4
B278	20/05/2014	520120.0	6419077.3
B279	20/05/2014	520121.3	6419069.0
B280	20/05/2014	520122.3	6419052.4
B281	20/05/2014	520127.7	6418999.2
B282	20/05/2014	520159.3	6418305.0
B283	20/05/2014	520160.0	6418300.7
B284	20/05/2014	520159.9	6418292.2
B285	20/05/2014	520140.0	6418254.4
B286	20/05/2014	520128.7	6418243.5
B287	20/05/2014	520198.0	6417547.2
B289	20/05/2014	519920.7	6421913.4
B290	20/05/2014	520105.2	6421179.2
B291	20/05/2014	520034.2	6421035.0
B292	20/05/2014	520050.2	6421025.3
B293	20/05/2014	520042.9	6420016.9
B294	20/05/2014	520037.9	6419958.5
D002	20/05/2014	519847.8	6424253.2
D004	21/05/2014	519628.2	6428446.8
D005	21/05/2014	519629.1	6428437.5
D006	21/05/2014	519656.1	6428245.5
D007	21/05/2014	519685.9	6428107.1
D008	21/05/2014	519745.4	6427630.9
D009	21/05/2014	519773.1	6427351.2
D010	21/05/2014	519805.9	6426954.7
D011	21/05/2014	519807.9	6426935.2
D012	21/05/2014	519811.1	6426890.1
D013	21/05/2014	519813.0	6426858.1
D016	21/05/2014	519544.5	6431157.3
D017	21/05/2014	519566.6	6430874.6
D018	21/05/2014	519591.7	6430541.9
D019	21/05/2014	519594.3	6430369.0
D020	21/05/2014	519612.0	6430151.7
D021	21/05/2014	519612.6	6429936.6
D022	21/05/2014	519599.4	6429645.0
D023	21/05/2014	519606.3	6429373.1
D024	21/05/2014	519634.1	6429136.0
D025	21/05/2014	519643.0	6429107.9
D026	21/05/2014	519647.3	6429097.1
D027	21/05/2014	519651.7	6429084.0
D028	21/05/2014	519652.3	6429080.9
D029	21/05/2014	519658.3	6429046.0
D032	21/05/2014	519402.2	6434346.5
D033	21/05/2014	519426.3	6434029.7
D034	21/05/2014	519426.0	6434024.4
D035	21/05/2014	519425.9	6434019.7
D036	21/05/2014	519503.9	6433190.3
D037	21/05/2014	519488.4	6432873.1
D038	21/05/2014	519486.7	6432865.1
D039	21/05/2014	519493.0	6432588.0
D040	21/05/2014	519504.8	6432290.7
D041	21/05/2014	519504.8	6432281.0
D044	21/05/2014	519240.0	6437552.9
D045	21/05/2014	519244.6	6437547.0
D046	21/05/2014	519255.0	6437537.2
D047	21/05/2014	519274.0	6437517.2
D048	21/05/2014	519278.6	6437510.1
D049	21/05/2014	519285.2	6437499.7
D050	21/05/2014	519301.3	6437488.2
D051	21/05/2014	519310.3	6437472.7
D052	21/05/2014	519322.5	6437417.2
D053	21/05/2014	519320.3	6437352.1
D054	21/05/2014	519303.5	6437255.6
D055	21/05/2014	519298.6	6437235.0

Stills PICT No.	Date	UTM WGS84 Z30N	
		Eastings	Northings
D056	21/05/2014	519283.2	6437107.1
D057	21/05/2014	519280.2	6437097.6
D058	21/05/2014	519274.2	6437065.3
D059	21/05/2014	519315.8	6435838.3
D060	21/05/2014	519309.7	6435711.8
D061	21/05/2014	519304.8	6435487.0
D076	21/05/2014	519101.2	6440342.2
D077	21/05/2014	519106.6	6440306.1
D078	21/05/2014	519111.3	6440251.3
D079	21/05/2014	519112.2	6440235.4
D080	21/05/2014	519111.5	6440218.7
D081	21/05/2014	519110.1	6440200.8
D082	21/05/2014	519109.8	6440181.8
D083	21/05/2014	519109.9	6440153.8
D084	21/05/2014	519109.8	6440133.0
D085	21/05/2014	519108.2	6440115.5
D086	21/05/2014	519095.0	6439977.4
D087	21/05/2014	519091.4	6439917.8
D088	21/05/2014	519091.2	6439903.9
D089	21/05/2014	519090.9	6439673.5
D090	21/05/2014	519091.3	6439596.1
D091	21/05/2014	519117.9	6439369.9
D092	21/05/2014	519119.2	6439354.8
D093	21/05/2014	519133.8	6439243.4
D094	21/05/2014	519132.9	6439229.4
D095	21/05/2014	519146.8	6438956.9
D096	21/05/2014	519147.7	6438934.3
D097	21/05/2014	519148.4	6438907.5
D098	21/05/2014	519142.2	6438810.7
D099	21/05/2014	519144.7	6438677.3
D100	21/05/2014	519146.0	6438668.2
D101	21/05/2014	519148.5	6438656.8
D102	21/05/2014	519159.1	6438616.5
D103	21/05/2014	519186.2	6438544.4
D104	21/05/2014	519198.1	6438508.2
D105	21/05/2014	519200.3	6438494.1
D106	21/05/2014	519196.0	6438247.9
D107	21/05/2014	519194.6	6438225.9
D108	21/05/2014	519177.4	6438117.4
D109	21/05/2014	519173.2	6438096.8
D110	21/05/2014	519162.8	6438000.2
D111	21/05/2014	519165.6	6437960.8
D112	21/05/2014	519167.9	6437947.6
D113	21/05/2014	519193.6	6437344.8
C003	21/05/2014	519080.3	6440402.8
C004	21/05/2014	519073.4	6440409.4
C005	21/05/2014	519069.2	6440427.6
C006	21/05/2014	519068.7	6440439.1
C007	21/05/2014	519066.8	6440494.1
C008	21/05/2014	519068.1	6440557.8
C009	21/05/2014	519068.7	6440577.0
C010	21/05/2014	519061.2	6440662.6
C011	21/05/2014	519047.5	6441075.5
C013	21/05/2014	518965.6	6442596.1
C014	21/05/2014	518963.3	6442611.3
C015	21/05/2014	518963.9	6442620.2
C016	21/05/2014	518965.5	6442638.9
C017	21/05/2014	518964.3	6442661.0
C018	21/05/2014	518956.0	6442818.7
C019	21/05/2014	518841.0	6444233.9
C020	21/05/2014	518836.0	6444241.3
C021	21/05/2014	518830.4	6444247.0
C022	21/05/2014	518832.3	6444302.0
C023	21/05/2014	518824.7	6444323.1
C024	21/05/2014	518824.6	6444329.3
C025	21/05/2014	518826.3	6444335.7
C026	21/05/2014	518841.3	6444363.6
C027	21/05/2014	518844.0	6444569.6
C028	21/05/2014	518850.3	6444581.8
C029	21/05/2014	518851.3	6444588.8
C030	21/05/2014	518828.6	6444699.4
C031	21/05/2014	518822.6	6444721.2
C032	21/05/2014	518824.9	6444755.9
C033	21/05/2014	518809.7	6444966.8
C034	21/05/2014	518819.8	6445090.6
C035	21/05/2014	518819.6	6445095.0
C036	21/05/2014	518829.6	6445145.4

Stills PICT No.	Date	UTM WGS84 Z30N	
		Eastings	Northings
C037	21/05/2014	518790.5	6445434.4
C038	21/05/2014	518790.6	6445442.0
C039	21/05/2014	518793.0	6445454.3
C040	21/05/2014	518794.1	6445462.4
C045	21/05/2014	518822.3	6445534.2
C046	21/05/2014	518813.8	6445572.9
C047	21/05/2014	518793.7	6445606.9
C048	21/05/2014	518785.6	6445636.6
C049	21/05/2014	518773.6	6445675.1
C050	21/05/2014	518759.9	6445772.9
C051	21/05/2014	518759.9	6445777.3
C052	21/05/2014	518758.7	6445851.2
C053	21/05/2014	518767.7	6445971.6
C054	21/05/2014	518771.8	6445998.0
C055	21/05/2014	518771.7	6446015.9
C056	21/05/2014	518778.1	6446138.1
C057	21/05/2014	518778.4	6446152.6
C058	21/05/2014	518777.9	6446158.1
C059	21/05/2014	518779.5	6446184.3
C060	21/05/2014	518786.9	6446265.4
C061	21/05/2014	518785.7	6446319.3
C062	21/05/2014	518786.1	6446323.4
C063	22/05/2014	518784.2	6446398.8
C064	22/05/2014	518742.4	6446554.7
C065	22/05/2014	518691.0	6446741.7
C066	22/05/2014	518690.8	6446805.8
C067	22/05/2014	518683.9	6446823.4
C068	22/05/2014	518679.9	6446835.9
C069	22/05/2014	518693.0	6446886.1
C070	22/05/2014	518698.4	6446985.9
C071	22/05/2014	518668.6	6447021.8
C072	22/05/2014	518712.4	6447103.1
C073	22/05/2014	518743.1	6447135.4
C074	22/05/2014	518765.5	6447162.5
C075	22/05/2014	518780.6	6447200.4
C076	22/05/2014	518786.4	6447258.9
C077	22/05/2014	518776.6	6447278.6
C078	22/05/2014	518763.2	6447330.9
C079	22/05/2014	518742.7	6447391.3
C080	22/05/2014	518743.4	6447424.1
C081	22/05/2014	518695.6	6447558.3
C082	22/05/2014	518670.7	6447765.7
C083	22/05/2014	518668.3	6447774.7
C084	22/05/2014	518677.0	6447874.5
C085	22/05/2014	518681.9	6447903.3
C086	22/05/2014	518687.2	6447932.0
C087	22/05/2014	518691.1	6447949.6
C088	22/05/2014	518723.8	6448140.5
C089	22/05/2014	518718.5	6448180.8
C090	22/05/2014	518711.5	6448259.4
C092	22/05/2014	518651.0	6448610.8
C093	22/05/2014	518650.2	6448623.1
C094	22/05/2014	518648.7	6448633.0
C095	22/05/2014	518642.0	6448725.4
C096	22/05/2014	518633.0	6448814.2
C097	22/05/2014	518637.3	6448974.0
C098	22/05/2014	518637.3	6449037.0
C099	22/05/2014	518630.7	6449193.6
C100	22/05/2014	518610.2	6449384.7
C101	22/05/2014	518606.5	6449529.8
C102	22/05/2014	518608.0	6449553.3
C103	22/05/2014	518597.6	6449834.9
C104	22/05/2014	518578.4	6449999.7
C105	22/05/2014	518572.3	6450037.2
C106	22/05/2014	518560.3	6450256.9
C107	22/05/2014	518559.0	6450263.0
C108	22/05/2014	518558.3	6450269.4
C109	22/05/2014	518553.8	6450388.6

Appendix I Video Log

Moray Cable Route 2014 J/3/03/2610
(1 Sheet)

Start Site	End Site	Date	Video (V) Logsheet No.	Start Time (GMT)	Start Depth (m BCD)	WGS84 UTM Z30N			
						Start Position		End Position	
						Eastings	Northings	Eastings	Northings
KPA5	KPA3	18/05/2014	1-3	06:27	39.3	516822.9	6398288.3	516411.0	6396759.3
KPA3	KPA2	18/05/2014	3-6	18:15	23.4	516439.1	6396863.2	515863.0	6395394.8
KPA2	KPA0	18/05/2014	7	11:40	19.6	515859.6	6395385.6	515390.5	6393942.7
KPB8	KPB11	18/05/2014	8-10	14:35	59	522720.9	6399090.3	521132.7	6401332.2
KPB7	KPB8	18/05/2014	11-13	17:20	49.4	523025.9	6398341.6	522469.4	6399078.3
KPB4	KPB2	18/05/2014	14-18	19:10	37.9	524649.6	6395791.5	523046.7	6398333.1
KPB2	KPB0	18/05/2014	19-21	21:59	18.8	525663.9	6394130.6	524616.9	6395839.5
KPB0	KPB2	19/05/2014	22-23	04:06	5.1	526212.7	6393308.0	525798.8	6394200.5
KPB10	KPB14	19/05/2014	24-26	06:09	71.3	521248.3	6401081.9	519142.1	6404962.4
KPA5	KPA8	19/05/2014	27-31	11:40	36.1	516859.0	6398210.1	517794.7	6400989.6
KPA8	KPA11	19/05/2014	32-33	14:29	56.5	517798.3	6400983.2	518753.4	6403743.4
KPA10	KPA12	19/05/2014	34-35	17:36	96	518790.8	6403725.5	519125.5	6404833.0
KPA12	KPA15	19/05/2014	36-37	19:14	94.9	519134.0	6404813.5	520085.2	6407641.5
KPA15	KPA18	19/05/2014	38-39	21:57	90.7	520055.8	6407585.6	520586.3	6410556.3
KPA18	KPA21	20/05/2014	40-41	01:22	92.5	520624.6	6410480.4	520468.1	6413559.3
KPA21	KPA24	20/05/2014	42-43	04:23	76.6	520457.7	6413469.7	520425.7	6416526.3
KPA24	KPA25	20/05/2014	44	07:31	65.1	520253.3	6416472.5	520065.9	6417568.3
KPA27	KPA25	20/05/2014	45-47	09:31	64.4	520108.9	6419539.5	520241.4	6417436.2
KPA30	KPA28/27	20/05/2014	48-49	11:50	90.5	519911.5	6422462.6	520137.6	6419491.7
KPA33	KPA32	20/05/2014	50	14:50	79.5	519760.5	6425659.1	519845.4	6424715.8
KPA32	KPA30	20/05/2014	51-52	23:41	81.2	519801.8	6424640.2	519685.9	6428107.1
KPA36	KPA33	21/05/2014	53	03:24	80.1	519745.4	6427630.9	519868.7	6425488.9
KPA39	KPA36	21/05/2014	54	05:24	69.6	519525.5	6431560.3	519698.7	6428430.9
KPA42	KPA39	21/05/2014	55-56	08:26	65.9	519362.6	6434505.2	519530.1	6431545.0
KPA45	KPA42	21/05/2014	57-58	11:53	55.4	519225.9	6437562.9	519354.7	6434475.8
KPA48	KPA46	21/05/2014	59-61	14:37	55.6	519094.5	6440429.3	519040.1	6437353.7
KPA49	KPA50	21/05/2014	62	17:20	55.1	519122.9	6440372.5	519161.3	6442713.2
KPA50	KPA53	21/05/2014	63-66	19:50	51.8	518972.3	6442404.9	518650.4	6445630.5
KPA53	KPA56	21/05/2014	67-69	23:15	50.6	518791.3	6445445.5	518680.7	6448524.9
KPA56	KPA58	22/05/2014	70	02:38	50.3	518682.8	6448466.0	518547.0	6450525.4

Appendix 2 – Grab photographs

Station ID		
KPA12		
KPA17		
KPA21		
KPA30		

Station ID		
KPA37		
KPA45		
KPA50		
KPA58		

Station ID		
KPB7		
KPB12		

Appendix 3 – Video analysis

SACFOR species abundance data and sediment data

Moray Firth Cable Route 2014 Video Analysis
AMB May 2014

Biotope Code	SS.SSa	SS.SSa with areas of SS.SMx.CMx	SS.SSa (Section 2)	SS.SMu.CFiMu.SpnMeg (coarser variant)	SS.SSa with areas of SS.SMx.CMx	SS.SMu.CFiMu.SpnMeg	SS.SMx.CMx
Site areas	KPA 56/57/58	KPA 52/53/54/55/56	KPA 49/50/51/52	KPA 48/49/50	KPA 48/49	KPA 39/40/42/43/44/48	KPA 45/44
Video analysis undertaken by:	AMB	AMB	AMB	AMB	AMB	AMB	AMB
Physical characteristics.							
% Bedrock							
% Boulder V. Large (>1024mm)							
% Boulder Large (>512mm)							
% Boulder Small (>256mm)							
% Cobbles (>64mm)		4			1		1
% Gravel and Pebbles combined (>4mm to 64mm)		15	1	1	20		20
% Shell	3	10	15	15	15		15
% Sand	97	71	84	84	64		64
Biogenic Reef							
Muddy sand/sandy mud (Burrowed mud biotope)						100	
Total	100	100	100	100	100	100	100
% Total Sand, Gravel & Pebbles	97	86	85	85	84	0	84

Feature on 1-5 scale for rock	SS.SSa	SS.SSa with areas of SS.SMx.CMx	SS.SSa (Section 2)	SS.SMu.CFiMu.SpnMeg (coarser variant)	SS.SSa with areas of SS.SMx.CMx	SS.SMu.CFiMu.SpnMeg	SS.SMx.CMx
Surface relief (even - rugged)							
Stability (stable - mobile)							

Feature on 1-5 scale for sediments	SS.SSa	SS.SSa with areas of SS.SMx.CMx	SS.SSa (Section 2)	SS.SMu.CFiMu.SpnMeg (coarser variant)	SS.SSa with areas of SS.SMx.CMx	SS.SMu.CFiMu.SpnMeg	SS.SMx.CMx
Surface relief (even - rugged)	2	3	2	2	3	3	3
Stability (stable - mobile)	3	3	3	3	3	4	3

Species abundance based on SACFOR scale

Biological characteristics	SACFOR	Code							
Porifera									
Porifera	Crust %	C0001							
Cnidaria									
Tubularia indivisa	Turf %	D0166		R					
?Abietinaria abietina	Turf %	D0409					R		
Hydrallmania falcata	Turf %	D0424		R	R		R		
Sertularia	Turf %	D0433					P		P
?Thuiaria thuja	Turf %	D0443		R			R		
Plumulariidae	Turf %	D0447		R					
Nemertesia ramosa	3-15cm	D0466							
Hydroid/Bryozoan mixed substrate	Turf %		R	O	R	O	O	R	O
Anthozoa									
Alcyonium digitatum	Turf %	D0597	R	R		R			R
Virgularia mirabilis	3-15cm	D0618				F			
Pennatula phosphorea	3-15cm	D0623				R		O	
?Arachnanthus sarsi	3-15cm	D0641							
Urticina	3-15cm	D0684					R		
Metridium senile	3-15cm	D0710		R					
Polychaeta									
Aphrodita aculeata	3-15cm	P0019		R	R				
Chaetopterus tubes	3-15cm	P0811	P	P		P		P	
Tubes in Sediment (Oweniidae)	Meadow	P1090							
Lanice conchilega	1-3cm	P1195							
Sabella tube	3-15cm	P1257							
Sabella	3-15cm	P1257							
Spirobranchus	1-3cm	P1339		P			P		
Salmacina tube mass	3-15cm	P1360							

Biotope Code			SS.SSa	SS.SSa with areas of SS.SMx.CMx	SS.SSa (Section 2)	SS.SMu.CFiMu.SpnMeg (coarser variant)	SS.SSa with areas of SS.SMx.CMx	SS.SMu.CFiMu.SpnMeg	SS.SMx.CMx
Site areas			KPA 56/57/58	KPA 52/53/54/55/56	KPA 49/50/51/52	KPA 48/49/50	KPA 48/49	KPA 39/40/42/43/44/48	KPA 45/44
Crustacea									
CIRRIPEDIA	Crust %	R0074							
DECAPODA (?Liocarcinus)	3-15cm	S1276	O	R				R	
CARIDEA	1-3cm	S1293		P					
Nephrops norvegicus	>15cm	S1402							
Paguridae	3-15cm	S1436	O	F	O	O	O	O	O
Munida rugosa	3-15cm	S1478					R		R
Majoidea	3-15cm	S1514						R	
Inachinae	3-15cm	S1520	R						
Macropodia	1-3cm	S1529							
Atelecyclus rotundatus	3-15cm	S1555					R		
Cancer pagurus	>15cm	S1566		O					
Liocarcinus	3-15cm	S1577		R	R			R	
Mollusca									
Gibbula	1-3cm	W0157							
Buccinidae	3-15cm	W0702							R
Pectinidae	3-15cm	W1768		R	R				
Pecten maximus	3-15cm	W1771	R	O	R	O	O		R
Sepia officinalis	>15cm	W2307							
Bryozoa									
Bryozoa crust	Crust %	Y0001					P		
Alcyonidium diaphanum	3-15cm	Y0076	R						
Flustra foliacea	Turf %	Y0187	R	R	R		R		P
Securiflustra securifrons	Turf %	Y0194		R					
?Omalosecosa ramulosa	3-15cm	Y0508							
Echinodermata									
Antedon bifida	3-15cm	ZB0010							
ASTEROIDEA	>15cm	ZB0018	O	O				O	
ASTEROIDEA (?Leptasterias muelleri)	>15cm	ZB0018							
ASTEROIDEA (Asterias or ?Leptasterias muelleri)	>15cm	ZB0018							
Luidia ciliaris	>15cm	ZB0022	O				O		
Luidia sarsi	>15cm	ZB0023		O					O
Astropecten irregularis	3-15cm	ZB0026		R	R	R			
Ceramaster/Hippasteria	3-15cm	ZB0045							
Porania pulvillus	3-15cm	ZB0054							
Anseropoda placenta	3-15cm	ZB0062						O	
Solaster endeca	>15cm	ZB0072							
Crossaster papposus	>15cm	ZB0075		O					
Henricia	3-15cm	ZB0082				R			
Asterias rubens	>15cm	ZB0100	O	F	O	O	O		
Marthasterias glacialis	>15cm	ZB0104						R	
Ophiura ophiura	3-15cm	ZB0170		R	R	R	R		R
ECHINOIDEA	3-15cm	ZB0181				R			
Echinus esculentus	3-15cm	ZB0198		R					
?Echinocardium cordatum	3-15cm	ZB0223							
PISCES									
Juvenile fish (shoal of fry)	1-3cm	ZE0002							
Triakidae (Mustelus)	>15cm	ZF0033				O			
Anguilla anguilla/Myxine glutinosa	>15cm	ZG0011/ZE0006							
Lophius piscatorius	>15cm	ZG0094						O	
GADIFORMES	>15cm	ZG0104	O	O	O		O		
M.merlangus/T.minutus	>15cm	ZG0123/ZG0144							
Trisopterus esmarkii	>15cm	ZG0142		O			O		
Trisopterus minutus	>15cm	ZG0144							
?Merluccius merluccius	>15cm	ZG0149						O	
Triglidae	>15cm	ZG0260	O	O	R	O			
Agonus cataphractus	3-15cm	ZG0291							R
Labridae	>15cm	ZG0386							
Lumpenus lampretaeformis	>15cm	ZG0429							
Ammodytidae	>15cm	ZG0441		P				O	
Callionymidae	>15cm	ZG0450	R	R	O	O	O		O
Gobiidae	3-15cm	ZG0455							
PLEURONECTIFORMES	>15cm	ZG0545	O	O	O	O	O	O	
?Pleuronectes platessa	>15cm	ZG0578	O	O	O				
Microchirus variegatus	>15cm	ZG0588	R	O	O				
ALGAE									
Red and brown algal turf - long	Turf %	Z0001							
Diatomaceous aggregation	Turf %	Z0001	F	O	O	O	R		
Corallinaceae	Crust %	ZM0194							
?Delesseria sanguinea	Turf %	ZM0594							
Encrusting Brown Algae	Crust %	ZR0002							
Saccharina latissima	Turf %	ZR0354							
Biofilm	Crust								
Miscellanea									
Trawl hawsers/fishing debris									
Erect tubes									

Moray Firth Cable Route 2014 Video Analysis
AMB May 2014

Biotope Code			SS.SMu.CFiMu.SpnMeg	SS.SMu.CFiMu.SpnMeg (coarser variant)	SS.SMu.CFiMu.SpnMeg with SS.SMx.CMx	CR.MCR.EcCr.FaAlCr.Pom	SS.SMx.CMx	SS.SSa	CR.MCR.EcCr.FaAlCr.Pom (sheltered shore variant)	SS.SSa (Section 3)	SS.SMx.CMx (with SSa)
Site areas			KPA 8/9/10/11/12/13/14/15 /16/17/18/19/20/21/22/ 23/26/27/28/29/30/31 /32/33/34/35/37/38/39 /40/41/42/44/	KPA 24/26/27/28/29	KPA 26/27	KPB 0/2	KPB 3/4	KPB 0	KPB 0	KPB 2	KPB 4/5/7/8
Video analysis undertaken by:			AMB	AMB	AMB	AMB	AMB	AMB	AMB	AMB	AMB
Physical characteristics.											
% Bedrock						35			35		
% Boulder V. Large (>1024mm)											
% Boulder Large (>512mm)						10	2		10		
% Boulder Small (>256mm)				1	5	15	5		15		1
% Cobbles (>64mm)				2	25	15	48		15		15
% Gravel and Pebbles combined (>4mm to 64mm)			1	3	30	15	23		15		54
% Shell			1	3	5		2			5	5
% Sand					35	10	20	100	10	95	25
Biogenic Reef											
Muddy sand/sandy mud (Burrowed mud biotope)			98	91							
Total			100	100	100	100	100	100	100	100	100
% Total Sand, Gravel & Pebbles			1	3	65	25	43	100	25	95	79
Feature on 1-5 scale for rock			SS.SMu.CFiMu.SpnMeg	SS.SMu.CFiMu.SpnMeg (coarser variant)	SS.SMu.CFiMu.SpnMeg with SS.SMx.CMx	CR.MCR.EcCr.FaAlCr.Pom	SS.SMx.CMx	SS.SSa	CR.MCR.EcCr.FaAlCr.Pom (sheltered shore variant)	SS.SSa (Section 3)	SS.SMx.CMx (with SSa)
Surface relief (even - rugged)						4			4		
Stability (stable - mobile)						2			2		
Feature on 1-5 scale for sediments			SS.SMu.CFiMu.SpnMeg	SS.SMu.CFiMu.SpnMeg (coarser variant)	SS.SMu.CFiMu.SpnMeg with SS.SMx.CMx	CR.MCR.EcCr.FaAlCr.Pom	SS.SMx.CMx	SS.SSa	CR.MCR.EcCr.FaAlCr.Pom (sheltered shore variant)	SS.SSa (Section 3)	SS.SMx.CMx (with SSa)
Surface relief (even - rugged)			3-2	2	3		4	2		2	3
Stability (stable - mobile)			4-3	3	2		2	4		4	3
Species abundance based on SACFOR scale											
Biological characteristics	**SACFOR**	**Code**									
Porifera											
Porifera	Crust %	C0001									R
Cnidaria											
Tubularia indivisa	Turf %	D0166	R	R	R		R				R
?Abietinaria abietina	Turf %	D0409				P			P		
Hydrallmania falcata	Turf %	D0424			P						
Sertularia	Turf %	D0433			P						
?Thuiaria thuja	Turf %	D0443									
Plumulariidae	Turf %	D0447					R				P
Nemertesia ramosa	3-15cm	D0466			R						
Hydroid/Bryozoan mixed substrate	Turf %		R	O	C	R	R		R		O
Anthozoa											
Alcyonium digitatum	Turf %	D0597				F	R		F		R
Virgularia mirabilis	3-15cm	D0618	O								
Pennatula phosphorea	3-15cm	D0623	F	F							
?Arachnanthus sarsi	3-15cm	D0641	R								
Urticina	3-15cm	D0684				R	O		R		O
Metridium senile	3-15cm	D0710	R	R		R	R		R		R
Polychaeta											
Aphrodita aculeata	3-15cm	P0019									
Chaetopterus tubes	3-15cm	P0811	P								P
Tubes in Sediment (Oweniidae)	Meadow	P1090	P	F							P
Lanice conchilega	1-3cm	P1195		p							P
Sabella tube	3-15cm	P1257	R				R				
Sabella	3-15cm	P1257	R								
Spirobranchus	1-3cm	P1339			P	P	P		P		P
Salmacina tube mass	3-15cm	P1360									P

Biotope Code			SS.SMu.CFiMu.SpnMeg	SS.SMu.CFiMu.SpnMeg (coarser variant)	SS.SMu.CFiMu.SpnMeg with SS.SMx.CMx	CR.MCR.EcCr.FaAlCr.Pom	SS.SMx.CMx	SS.SSa	CR.MCR.EcCr.FaAlCr.Pom (sheltered shore variant)	SS.SSa (Section 3)	SS.SMx.CMx (with SSa)
Site areas			KPA 8/9/10/11/12/13/14/15/16/17/18/19/20/21/22/23/26/27/28/29/30/31/32/33/34/35/37/38/39/40/41/42/44/	KPA 24/26/27/28/29	KPA 26/27	KPB 0/2	KPB 3/4	KPB 0	KPB 0	KPB 2	KPB 4/5/7/8
Crustacea											
CIRRIPEDIA	Crust %	R0074									
DECAPODA (?Liocarcinus)	3-15cm	S1276	R							O	O
CARIDEA	1-3cm	S1293									
Nephrops norvegicus	>15cm	S1402	O								
Paguridae	3-15cm	S1436	O	R	R		O			O	O
Munida rugosa	3-15cm	S1478	R	O	F	F	F		F		O
Majoidea	3-15cm	S1514	R								
Inachinae	3-15cm	S1520									
Macropodia	1-3cm	S1529	R								
Atelecyclus rotundatus	3-15cm	S1555	R								
Cancer pagurus	>15cm	S1566	R		R	F	O		F	O	O
Liocarcinus	3-15cm	S1577	R				R				P
Mollusca											
Gibbula	1-3cm	W0157				P			P		
Buccinidae	3-15cm	W0702									
Pectinidae	3-15cm	W1768									
Pecten maximus	3-15cm	W1771	O	R	O		O				O
Sepia officinalis	>15cm	W2307									
Bryozoa											
Bryozoa crust	Crust %	Y0001				O	P		O		P
Alcyonidium diaphanum	3-15cm	Y0076	R								
Flustra foliacea	Turf %	Y0187	R				R				O
Securiflustra securifrons	Turf %	Y0194									R
?Omalosecosa ramulosa	3-15cm	Y0508									R
Echinodermata											
Antedon bifida	3-15cm	ZB0010									
ASTEROIDEA	>15cm	ZB0018	O			F	F	O	F	O	
ASTEROIDEA (?Leptasterias muelleri)	>15cm	ZB0018	R								
ASTEROIDEA (Asterias or ?Leptasterias muelleri)	>15cm	ZB0018	O	R							
Luidia ciliaris	>15cm	ZB0022									
Luidia sarsi	>15cm	ZB0023									
Astropecten irregularis	3-15cm	ZB0026	R							R	
Ceramaster/Hippasteria	3-15cm	ZB0045		R	O						
Porania pulvillus	3-15cm	ZB0054	R								R
Anseropoda placenta	3-15cm	ZB0062	O								
Solaster endeca	>15cm	ZB0072									
Crossaster papposus	>15cm	ZB0075				F			F		O
Henricia	3-15cm	ZB0082	O								O
Asterias rubens	>15cm	ZB0100	O	O			O				
Marthasterias glacialis	>15cm	ZB0104	R			O			O		
Ophiura ophiura	3-15cm	ZB0170									
ECHINOIDEA	3-15cm	ZB0181									
Echinus esculentus	3-15cm	ZB0198		R	R	F	O		F		O
?Echinocardium cordatum	3-15cm	ZB0223	R								
PISCES											
Juvenile fish (shoal of fry)	1-3cm	ZE0002									P
Triakidae (Mustelus)	>15cm	ZF0033									
Anguilla anguilla/Myxine glutinosa	>15cm	ZG0011/ZE0006	R								
Lophius piscatorius	>15cm	ZG0094	O							P	O
GADIFORMES	>15cm	ZG0104	R							P	
M.merlangus/T.minutus	>15cm	ZG0123/ZG0144	R								
Trisopterus esmarkii	>15cm	ZG0142	O								O
Trisopterus minutus	>15cm	ZG0144									
?Merluccius merluccius	>15cm	ZG0149	O								
Triglidae	>15cm	ZG0260									O
Agonus cataphractus	3-15cm	ZG0291									O
Labridae	>15cm	ZG0386				R			R		
Lumpenus lampretaeformis	>15cm	ZG0429	O								
Ammodytidae	>15cm	ZG0441	O							P	P
Callionymidae	>15cm	ZG0450	O	R							O
Gobiidae	3-15cm	ZG0455	O							P	P
PLEURONECTIFORMES	>15cm	ZG0545	O	O				R		O	O
?Pleuronectes platessa	>15cm	ZG0578									
Microchirus variegatus	>15cm	ZG0588									
ALGAE											
Red and brown algal turf - long	Turf %	Z0001							R		
Diatomaceous aggregation	Turf %	Z0001									
Corallinaceae	Crust %	ZM0194				F	P		F		P
?Delesseria sanguinea	Turf %	ZM0594							O		
Encrusting Brown Algae	Crust %	ZR0002				F			F		
Saccharina latissima	Turf %	ZR0354							R		
Biofilm	Crust							P			
Miscellanea											
Trawl hawsers/fishing debris						P	P				
Erect tubes			P	P							

Biotope	Sediment and Fauna Description	Species	Representative Images
Biotope SS.SSa (Offshore Area) Sublittoral sand and muddy sands.	**Sediment Description** Slightly shelly, slightly muddy sand. Small holes regularly seen across the area. Fauna within them not evident. Small areas of dense coarse shelly sand forming small patches of coarse sand waves with coarse shell aggregations in the recesses. **Fauna** Main fauna seen were large Pagurid crabs, and an array of fish including gurnards, thick backed sole, flat fish, (often plaice), and gadiform fish, largely unidentifiable due to quality of image. A few *Pecten maximus* were seen, and small numbers of starfish. The hydroid/bryozoan mixed turf and very small occurrences of *Flustra,* were rarely seen, found on small amounts of slightly coarser sediment. Across the area, a gelatinous, filamentous substance was observed, believed to be a diatomaceous aggregation It occurred as small oozes from the sediment, and formed long filaments. At times, it was observed as a coating on other hydroid/bryozoan growths.	?*Pleuronectes platessa* *Alcyonidium diaphanum* *Alcyonium digitatum* *Asterias rubens* Asteroidea Callionymidae *Chaetopterus* tubes Decapoda Diatomaceous aggregation *Flustra foliacea* Gadiformes Hydroid/Bryozoan mixed substrate Inachinae *Luidia ciliaris* *Microchirus variegatus* Paguridae *Pecten maximus* PLEURONECTIFORMES Triglidae	  

Biotope	Sediment Description		
SS.SSa with SS.SMx.CMx Sublittoral sand and muddy sands with Circalittoral mixed sediment. (Offshore Area) Additional FluHyd may be appropriate in some areas.	Slightly shelly, slightly muddy rippled sand. Coarse shelly sand waves occur across the area, with a coarse mixed sediment of gravel pebbles and cobbles within the recesses. Regular outcrops of larger areas of coarse mixed sediment occurred, with greater epifaunal cover of foliose hydroids and bryozoans. Small holes and small burrows evident across the area. **Fauna** Fauna on the sediment largely comprised Pagurid crabs, a few small crabs (notably *Liocarcinus*) and a selection of flat fish including plaice and thick backed sole. A variety of starfish were distributed across the area. The foliose hydroid/bryozoan turf including *Flustra* and *Hydrallmania* were largely concentrated on the areas of coarse mixed sediment. A rare occurrence of *Metridium senile* was seen on a large cobble. *Pecten maximus* were more notable across both the sandy and coarser sediments of the site. One gadoid fish was seen, potentially hake. **Note** Area noted for sand eels. WGS84 Degminsdecmins 58 09.2191N 002 40.8778W To 58 09.2923N 002 40.8623W Area with noted greater density of Pecten maximus 58 09.4445N 002 40.8467W	?*Pleuronectes platessa* ?*Thuiaria thuja* *Alcyonium digitatum* Ammodytidae *Aphrodita aculeata* *Asterias rubens* ASTEROIDEA *Astropecten irregularis* *Buccinum undatum* Callionymidae *Cancer pagurus* CARIDEA *Chaetopterus* tubes *Crossaster papposus* DECAPODA (?*Liocarcinus*.) Diatomaceous aggregation *Tubularia indivisa* *Echinus esculentus* *Flustra foliacea* Gadiformes *Hydrallmania falcata* Hydroid/Bryozoan mixed substrate *Liocarcinus* *Luidia sarsi* *Metridium senile* *Microchirus variegatus* *Ophiura ophiura* Paguridae *Pecten maximus* PLEURONECTIFORMES Plumulariidae *Securiflustra securifrons* *Spirobranchus* Triglidae *Trisopterus lamarkii*	  

Biotope SS.SSa (Section2) Sublittoral sand and muddy sands	**Sediment Description** Slightly shelly, slightly muddy rippled sand. Coarse shelly sand waves occurred infrequently across the area, with large shell hash notable within the recesses, with a few scattered pebbles. Small holes and small burrows evident across the area. **Fauna** The main fauna noted were flat fish, gurnards, a few gadiform fish, a few starfish and pagurid crabs. Hydroid/bryozoan turf of largely indefinable composition was scattered throughout. One *Ophiura ophiura* was seen, and one sea mouse (*Aphrodita*). The diatomaceous aggregation was present across both sand and coarse sand wave areas. As the coarse sand waves had an ephemeral appearance, it was decided to leave the biotope allocation at SSa. The coarser areas did not appear to warrant a separate biotope, so have been noted here as a feature only.	?*Pleuronectes platessa* *Aphrodita aculeata* *Asterias rubens* *Astropecten irregularis* Callionymidae Diatomaceous aggregation *Flustra foliacea* Gadiformes *Hydrallmania falcata* Hydroid/Bryozoan mixed substrate *Liocarcinus* *Microchirus variegatus* *Ophiura ophiura* Paguridae *Pecten maximus* Pectinidae PLEURONECTIFORMES Triglidae	 

Biotope SS.SMu.CFiMu.SpnMeg (coarser variant) Seapens and burrowing megafauna in circalittoral fine mud	**Sediment Description** Slightly shelly, slightly muddy rippled sand. Small holes and small burrows evident across the area. Larger fractions of shell hash visible in places. **Fauna** The main fauna noted were flat fish, gurnards, a few starfish and pagurid crabs. Hydroid/bryozoan turf of largely indefinable composition was scattered throughout. One *Ophiura ophiura* was seen. *Pecten maximus* occurred sporadically. The diatomaceous aggregation was present across the area. The seapen *Virgularia mirabilis* was very evident, and occurred frequently. Only one *Pennatula* was noted.	*Alcyonium digitatum* *Asterias rubens* *Astropecten irregularis* Callionymidae *Chaetopterus* tubes Diatomaceous aggregation Echinoidea *Henricia* Hydroid/Bryozoan mixed substrate *Ophiura ophiura* Paguridae *Pecten maximus* *Pennatula phosphorea* PLEURONECTIFORMES Triglidae *Virgularia mirabilis*	 

<table>
<tr>
<td>Biotope

SS.SSa with SS.SMx.CMx

Sublittoral sand and muddy sands with Circalittoral mixed sediment.

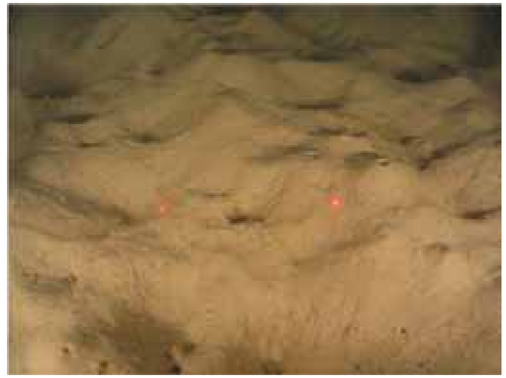
CMx, forming waves, dominated the area. Some support for the additional FluHyd allocation in places.

Although biotope already allocated in the offshore area, kept separate here due to denser coarse waves rather than coarse sediment patches.</td>
<td>Sediment Description
Area dominated by coarse mixed sediment forming small to approx. 0.5m high coarse gravelly shelly sand waves in places. Large shell hash and gravelly pebbles deposited within the recesses with the occasional cobble. One small boulder seen. Area interspersed with slightly shelly, slightly muddy rippled sand. Small holes and small burrows evident across the area.

Fauna
The main fauna noted were hydroid/bryozoan turf, including Flustra, Sertularia, Abietinaria and potentially Thuiaria thuja. Flat fish, a few starfish and pagurid crabs were evident, along with the round crab Atelecyclus rotundatus. Munida rugosa was occasionally seen in the coarse sediment. One Ophiura ophiura was noted. Pecten maximus occurred relatively regularly throughout.

Note. Pecten maximus noted in higher density in this area.</td>
<td>?Abietinaria abietina
?Thuiaria thuja
Asterias rubens
Atelecyclus rotundatus
Bryozoa crust
Callionymidae
Diatomaceous aggregation
Flustra foliacea
Gadiformes
Hydroid/Bryozoan mixed substrate
Luidia ciliaris
Munida rugosa
Ophiura ophiura
Paguridae
Pecten maximus
PLEURONECTIFORMES
Sertularia
Spirobranchus
Trisopterus lamarkii
Urticina</td>
<td>
</td>
</tr>
</table>

Biotope SS.SMx.CMx Circalittoral mixed sediment. Some support for the additional FluHyd allocation in places.	**Sediment Description** Area dominated by coarse mixed sediment forming small to approx. 0.5m high coarse gravelly shelly sand waves in places. Large shell hash and gravelly pebbles deposited within the recesses with the occasional cobble. One small boulder seen. **Fauna** The main fauna noted were foliose hydroid/bryozoan turf, including *Flustra*, and *Sertularia*. A few starfish and pagurid crabs were evident, along with *Munida rugosa* which was occasionally seen in the coarse sediment. One *Ophiura ophiura* was noted. *Pecten maximus* occurred rarely.	*Agonus cataphractus* *Alcyonium digitatum* Buccinidae Callionymidae *Flustra foliacea* Hydroid/Bryozoan mixed substrate *Luidia sarsi* *Munida rugosa* *Ophiura ophiura* Paguridae *Pecten maximus* *Sertularia*	 

Biotope	Sediment Description		
SS.SMu.CFiMu.SpnMeg Seapens and burrowing megafauna in circalittoral fine mud Note that in the more southerly areas, the burrowed mud had the occasional hydroid cluster and outcrop of *Tubularia*. The fish that are noted were more prevalent to the north.	Sandy mud/muddy sand with burrows, mounds and holes. Area of dense bioturbation. In some areas, a low lying form was observed, a relatively even sandy mud/muddy sand with small burrows, small mounds and holes. Bioturbation evident but not as deep or dense as areas more suited to *Nephrops norvegicus*. Occasional small boulder, and areas of coarser sediment, with a few cobbles, and mixed pebbles and large shell hash in places. **Fauna** Burrowing megafauna evident, including the sea pen *Pennatula phosphorea* and in some areas, *Virgularia mirabilis*. *Nephrops* sporadically seen. Flat fish present and a few starfish including *Anseropoda placenta*. Pagurid crabs and the occasional Decapod (?*Liocarcinus*), seen. Gurnards and a few small gadoid fish also present. *Cancer pagurus* observed. In the low-lying form of the biotope, burrowing megafauna evident, including the seapen *Pennatula phosphorea*. Flat fish and a few starfish seen, as well as a few large scallops. The coarser substrate had more dense aggregations of hydroid/bryozoan turf, and a very small amount of *Tubularia indivisa*. Boulder with *Metridium senile* present. Sediment with small polychaete tubes forming a 'mat' in places, believed to be Oweniidae.	?*Echinocardium cordatum* *Anguilla anguilla/Myxine glutinosa* *Anseropoda placenta* *Asterias rubens* ASTEROIDEA Asteroidea (?*Leptasterias muelleri*) *Astropecten irregularis* Callionymidae *Cancer pagurus* *Chaetopterus* tubes DECAPODA (?*Liocarcinus*) Gadiformes Gobiidae Henricia Hydroid/Bryozoan mixed substrate *Liocarcinus* *Lumpenus lampretaeformis* *M.merlangus* or *T.minutus* Majoidea *Nephrops norvegicus* *Ophiura ophiura* Paguridae *Pennatula phosphorea* PLEURONECTIFORMES Triglidae *Tubularia indivisa* *Virgularia mirabilis* **Low lying and coarser area** *Asterias rubens* Asteroidea (*Asterias* or ?*Leptasterias muelleri*) Callionymidae *Ceramaster/Hippasteria* *Echinus esculentus*	  

		Hydroid/Bryozoan mixed substrate *Lanice conchilega* *Metridium senile* *Munida rugosa* Paguridae *Pecten maximus* *Pennatula phosphorea* PLEURONECTIFORMES *Porania pulvillus* Tubes in Sediment (Oweniidae) *Tubularia indivisa*	

Biotope SS.SMx.CMx Within SS.SMu.CFiMu.SpnMeg Circalittoral mixed sediment. within Seapens and burrowing megafauna in circalittoral fine mud There may be some support for the additional FluHyd allocation in places.	**Sediment Description** Low lying, relatively even sandy mud/muddy sand with small burrows, small mounds and holes. Bioturbation evident but not as deep or dense as areas more suited to *Nephrops norvegicus*. Within this area, large sections of coarse mixed sediment with boulders and cobbles. **Fauna** Burrowing megafauna evident in the softer sediment. Coarse section dominated by hydroid/bryozoan turf, small amounts of *Tubularia indivisa,* and a notable amount of *Munida rugosa* under the boulders and cobbles. Occasional *Echinus esculentus* and a few *Pecten maximus* seen. One *Cancer pagurus* seen.	*Cancer pagurus* *Ceramaster/Hippasteria* *Echinus esculentus* *Hydrallmania falcata* Hydroid/Bryozoan mixed substrate *Munida rugosa* *Nemertesia ramosa* *Pecten maximus* *Sertularia* Spirobranchus *Tubularia indivisa*	  

Biotope SS.SMx.CMx Circalittoral mixed sediment. Fauna not considered dense enough to support the additional allocation of FluHyd. However it could be described as an impoverished form.	**Sediment Description** Area of hard ground, potentially bedrock in places. Area over-laid with a very coarse mixture of shelly sandy, gravelly pebbly cobble matrix with the occasional boulder. A thin covering of mobile sand of varying depths evident over the hard ground. **Fauna** Fauna largely comprised of coralline algae and bryozoan crusts with sparse outcrops of foliose hydroid/bryozoan turf including *Flustra foliacea* and Plumulariidae, with rare *Tubularia indivisa*. Very small outcrops of *Alcyonium digitatum* were present, and rare *Echinus esculentus*. Lots of *Munida rugosa* were present under the boulders and cobbles, with small crabs such as *Liocarcinus* evident. Occasionally a large edible crab, *Cancer pagurus* was seen and a very occasional *Pecten maximus*. Small starfish were scattered across the area. Debris of fishing ropes present.	*Alcyonium digitatum* *Asterias rubens* ASTEROIDEA Bryozoa crust *Cancer pagurus* Corallinaceae *Echinus esculentus* *Flustra foliacea* Hydroid/Bryozoan mixed substrate *Liocarcinus* *Metridium senile* *Munida rugosa* Paguridae *Pecten maximus* Plumulariidae *Sabella* tube *Spirobranchus* *Tubularia indivisa* *Urticina*	 

Biotope	**Sediment Description**		
SS.SMx.CMx with SS.SSa Circalittoral mixed sediment with Sublittoral sand and muddy sands Fauna not considered dense enough to support the additional allocation of FluHyd. Small areas could potentially be called an impoverished form.	Area of what appears to be hard ground in places, over-laid with a very coarse mixture of shelly sandy, gravelly pebbly cobble matrix with a few boulders in places. A thin covering of mobile sand of varying depths evident over the hard ground. In places, extensive patches of rippled sand occurred, before returning to coarse mixed sediment. In places and particularly further offshore, the sand became coarser and thicker in some areas, forming coarse sand waves with large shell debris within the recesses. **Fauna** The coarse ground had sparse hydroid/bryozoan turf with a few starfish, small amounts of the soft coral *Alcyonium digitatum*, rare *Tubularia indivisa*, and *Urticina.* Boulders were particularly covered in dense hydroid/bryozoan turf, with large clusters of *Flustra foliacea*. *Munida rugosa* were regularly seen across the area under the coarser sediment. *Pecten maximus* often seen, and the occasional *Cancer pagurus*. In some sand patches, *Lanice conchilega* tubes became evident, mixed with smaller tubes believed to be of the family Oweniidae. In the deeper coarser sand waves, sand eel activity became very noticeable. Note area of sand eels.	?*Omalosecosa ramulosa* *Agonus cataphractus* *Alcyonium digitatum* Ammodytidae Bryozoa crust Callionymidae *Cancer pagurus* *Chaetopterus* tubes *Crossaster papposus* DECAPODA (?*Liocarcinus*) *Echinus esculentus* *Flustra foliacea* Gobiidae *Henricia* Hydroid/Bryozoan mixed substrate *Lanice conchilega* *Liocarcinus* *Metridium senile* *Munida rugosa* Paguridae *Pecten maximus* PLEURONECTIFORMES Plumulariidae *Porania pulvillus* PORIFERA *Spirobranchus* Triglidae *Trisopterus esmarkii* Tubes in Sediment (Oweniidae) *Tubularia indivisa* *Urticina*	Lanice and Oweniidae  Coarse mixed sediment  

<table>
<tr>
<td>INSHORE AREA

Biotope

Inshore Sand
SS.SSa

Sublittoral sand and muddy sands.

Bedrock and boulder reef with algae
CR.MCR.EcCr.FaAlCr.Pom (sheltered inshore variant)

Bedrock and boulder reef
CR.MCR.EcCr.FaAlCr.Pom

Faunal and algal crusts with Pomatoceros triqueter and sparse Alcyonium digitatum on exposed to moderately wave-exposed circalittoral rock</td>
<td>Sediment Description
Inshore area a rippled sand with a few holes, with a biofilm evident across the area.

From the inshore sand, the area gradually became a bedrock and boulder reef, with a small outcrop of rock with the brown alga Saccharina latissima and long foliose red and brown algal fronds. Where the reef became more established, only foliose red algal fronds remained, namely ?Delesseria sanguinea, before the algae reduced completely. The area then became a bedrock, boulder and cobble reef, undulating and rising to around 1 to 2.0m approx. in height at its greatest point. A cobble pebble and gravelly sand matrix evident within the recesses in places. There were small areas where a thin film of sediment was evident on the hard rock surfaces.

Fauna

Only a few flat fish were evident on the inner shore sand area.

Bedrock and boulder reef densely covered by a crust of what is believed to be a brown alga, with coralline algae and bryozoan crusts strongly present. Spirobranchus worm tubes very visible. The urchin Echinus esculentus very common across the area, along with a frequent presence of the soft coral Alcyonium digitatum. Small starfish (Asteroidea) very noticeable, probably Asterias rubens but confirmation difficult. Crossaster papposus very frequent. Cancer pagurus noticed occasionally.</td>
<td>Sand
ASTEROIDEA
PLEURONECTIFORMES
Biofilm

Algae additions to reef
Saccharina latissima
?Delesseria sanguinea
Red and brown algal turf - long

Reef
?Abietinaria abietina
Hydroid/Bryozoan mixed substrate
Alcyonium digitatum
Urticina
Metridium senile
Spirobranchus
Munida rugosa
Cancer pagurus
Gibbula
Bryozoa crust
ASTEROIDEA
Marthasterias glacialis
Crossaster papposus
Echinus esculentus
Labridae
Corallinaceae
Encrusting Brown Algae</td>
<td>Inshore sand with biofilm


Reef with algae

</td>
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</table>

Reef

Biotope SS.SSa (Section 3) Sublittoral sand and muddy sands.	**Sediment Description** Rippled sand with a few holes, becoming gradually coarser further offshore. Ripples becoming more mixed and larger in form. **Fauna** A few starfish are scattered across the area, with large pagurid crabs, a few flat fish and a few gadoid fish in places. One monkfish seen. As the sand became coarser, sand eel activity became more apparent.	DECAPODA (?*Liocarcinus*) Paguridae *Cancer pagurus* *Astropecten irregularis* ASTEROIDEA *Lophius piscatorius* Ammodytidae Gadiformes Gobiidae PLEURONECTIFORMES	

Appendix 4 – PSD results

Certificate Number:	EP/14/4578	**Fugro EMU Job Number:**	J/3/08/2610
Job Reference:	Moray Offshore Renewables Ltd - Moray Firth Benthic Ecology Characterisation (Offshore Transmission Infrastructure)		
Prepared For		**Prepared By**	
Peter Moore **Moray Offshore Renewables Ltd.** 4th floor 40 Princes Street EH2 2BY Edinburgh United Kingdom		**James Hutchinson** **Fugro EMU Limited** Trafalgar Wharf (Unit 16) Hamilton Road Portchester Portsmouth PO6 4PX United Kingdom	
Phone: +44 (0) 1315 567602 **Email:** Peter.Moore@edpr.com **Web:** www.morayoffshorerenewables.com		**Phone:** +44 (0) 2392 205500 **Email:** sediment@fugroemu.com **Web:** www.fugroemu.com	

Sampling Undertaken By:	Fugro EMU	**Sampling Date:**	24/05/2014
Date of Receipt:	26/05/2014	**Date of Analysis:**	28/05/2014 – 05/06/2014
Sample Matrix:	Marine Sediments		
Method Reference:	Particle Size Distribution by Dry Sieving – Fugro EMU MET/01 based on BS1377: 1990: Parts 1 – 2, and Fugro EMU MET/48 based on the NMBAQC PSA SOP for supporting biological data. *Particle Size Distribution by Laser Diffraction – Fugro EMU MET/50 based on BS ISO 13320: 2009.		
Test Results:	Refer to page 2 of 2		
Laboratory Comments:	**Deviating Codes:** None		
Authorised Signature:	J. R. Hutchinson		
Name:	James Hutchinson		
Position:	Sediment Laboratory Manager		
Issue Date:	06/06/2014		

- Further information on methods of analysis may be obtained from the above address
- Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
- *Indicates determinand not included in UKAS accreditation
- Test results reported relate only to those items tested
- Sub indicates subcontracted test

A UKAS TESTING LABORATORY

UKAS TESTING 1272

Fugro EMU Limited. Incorporated in England No. 3469947. Reg. Office: Fugro House, Hithercroft Road, Wallingford, Oxfordshire, OX10 9RB

FUGRO EMU LIMITED
CERTIFICATE OF ANALYSIS

Test Results: Particle Size Distribution by Dry Sieving (63000 - 1000 µm) and Laser Diffraction (< 1000 - < 0.09 µm) @ 0.5 Phi Intervals
Fugro EMU Job Number: J/3/08/2610
Job Reference: Moray Offshore Renewables Ltd - Moray Firth Benthic Ecology Characterisation (Offshore Transmission Infrastructure)

SAMPLE ID:	KPB 12	KPB 7	KPA 58	KPA 50	KPA 45	KPA 37	KPA 30	KPA 21	KPA 17	KPA 12	KPA 2
LAB ID:	12543	12544	12589	12590	12591	12592	12593	12594	12595	12596	12598
Aperture [µm]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]
63000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22400	0.00	6.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16000	0.00	5.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11200	0.00	10.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8000	0.00	6.16	0.22	0.27	0.72	0.00	0.00	0.00	0.00	0.00	0.00
5600	0.00	5.49	0.04	0.04	0.53	0.00	0.00	0.00	0.00	0.00	0.00
4000	0.00	7.33	0.26	0.17	1.01	0.00	0.00	0.00	0.00	0.00	0.00
2800	0.00	7.15	0.39	0.17	5.52	0.04	0.05	0.04	0.00	0.00	0.04
2000	0.02	7.20	0.47	0.36	11.15	0.02	0.00	0.02	0.00	0.00	0.02
1400	0.01	6.63	0.75	0.67	17.05	0.01	0.04	0.01	0.00	0.02	0.10
1000	0.04	5.19	0.93	0.72	18.99	0.04	0.02	0.03	0.06	0.04	0.28
707	0.90	2.91	0.95	0.06	15.40	0.42	0.36	0.85	0.86	0.51	0.00
500	2.77	2.53	3.05	1.85	11.90	0.27	0.71	0.73	3.07	2.00	2.58
354	6.03	2.70	11.07	10.70	7.53	0.01	0.66	1.55	6.39	4.44	17.16
250	10.58	3.75	23.15	24.35	4.07	0.97	1.09	5.94	9.82	8.12	35.28
177	15.76	4.58	28.14	29.47	2.07	8.02	4.36	14.51	12.58	13.26	31.78
125	18.92	3.96	19.78	19.78	1.16	19.15	11.47	21.88	14.12	17.93	11.91
88	16.62	2.24	7.09	6.43	0.70	25.32	18.53	21.16	13.52	18.04	0.85
63	9.74	0.86	0.64	0.42	0.37	20.56	19.58	13.24	10.50	12.57	0.00
44.19	3.46	0.46	0.00	0.01	0.19	9.96	13.83	5.31	6.51	5.77	0.00
31.25	0.98	0.60	0.30	0.52	0.16	2.44	6.66	1.75	3.55	1.95	0.00
22.10	1.23	0.79	0.74	0.90	0.19	0.65	2.87	1.47	2.37	1.35	0.00
15.63	1.95	0.90	0.53	0.62	0.22	1.53	2.49	1.89	2.36	1.89	0.00
11.05	2.19	0.99	0.28	0.39	0.24	2.14	3.14	1.92	2.64	2.20	0.00
7.81	2.12	1.06	0.26	0.42	0.24	1.98	3.34	1.74	2.73	2.17	0.00
5.52	1.95	1.01	0.34	0.52	0.22	1.64	3.00	1.59	2.55	2.04	0.00
3.91	1.66	0.82	0.34	0.51	0.18	1.41	2.44	1.41	2.13	1.82	0.00
2.76	1.22	0.56	0.26	0.39	0.13	1.16	1.82	1.09	1.56	1.43	0.00
1.95	0.75	0.33	0.04	0.25	0.02	0.81	1.22	0.71	0.99	0.95	0.00
1.38	0.42	0.18	0.00	0.01	0.00	0.49	0.75	0.42	0.58	0.56	0.00
0.98	0.27	0.12	0.00	0.00	0.00	0.33	0.54	0.28	0.40	0.37	0.00
0.69	0.24	0.11	0.00	0.00	0.00	0.30	0.51	0.25	0.36	0.32	0.00
0.49	0.17	0.08	0.00	0.00	0.00	0.26	0.42	0.20	0.29	0.25	0.00
0.35	0.00	0.00	0.00	0.00	0.00	0.07	0.11	0.00	0.07	0.01	0.00
0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
< 0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL:	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Test Results: Particle Size Distribution by Dry Sieving (63000 - 1000 µm) and Laser Diffraction (< 1000 - < 0.09 µm) @ 0.5 Phi Intervals
Fugro EMU Job Number: J/3/08/2610
Job Reference: Moray Offshore Renewables Ltd - Moray Firth Benthic Ecology Characterisation (Offshore Transmission Infrastructure)

	SAMPLE ID:	KPB 12	KPB 7	KPA 58	KPA 50	KPA 45	KPA 37	KPA 30	KPA 21	KPA 17	KPA 12	KPA 2
	LAB ID:	12543	12544	12589	12590	12591	12592	12593	12594	12595	12596	12598
TEXTURAL GROUP	SAMPLE TYPE:	Unimodal, Poorly Sorted	Polymodal, Very Poorly Sorted	Unimodal, Moderately Sorted	Unimodal, Moderately Sorted	Unimodal, Poorly Sorted	Unimodal, Poorly Sorted	Bimodal, Poorly Sorted	Unimodal, Poorly Sorted	Bimodal, Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Moderately Well Sorted
	FOLK [1954 ORIGINAL]:	Slightly Gravelly Muddy Sand	Muddy Sandy Gravel	Slightly Gravelly Sand	Slightly Gravelly Sand	Gravelly Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Muddy Sand	Slightly Gravelly Sand
	FOLK [BGS MODIFIED]:	Muddy Sand	Muddy Sandy Gravel	Slightly Gravelly Sand	Slightly Gravelly Sand	Gravelly Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand	Sand
	SEDIMENT NAME:	Slightly Very Fine Gravelly Very Coarse Silty Fine Sand	Medium Silty Sandy Medium Gravel	Slightly Very Fine Gravelly Fine Sand	Slightly Very Fine Gravelly Fine Sand	Very Fine Gravelly Very Coarse Sand	Slightly Very Fine Gravelly Very Coarse Silty Very Fine Sand	Slightly Very Fine Gravelly Very Coarse Silty Very Fine Sand	Slightly Very Fine Gravelly Very Coarse Silty Fine Sand	Slightly Very Fine Gravelly Very Coarse Silty Fine Sand	Very Coarse Silty Fine Sand	Slightly Very Fine Gravelly Medium Sand
METHOD OF MOMENTS Arithmetic [µm]	MEAN:	174.04	6376.52	326.48	303.02	1381.44	106.69	89.56	140.17	161.01	150.03	288.93
	SORTING:	151.01	7802.01	598.47	596.75	1204.09	112.55	123.39	138.93	156.88	134.64	139.66
	SKEWNESS:	2.30	1.39	10.60	12.12	3.14	13.74	12.78	8.20	1.87	2.22	7.43
	KURTOSIS:	15.85	3.91	143.97	174.83	19.04	337.04	295.16	152.75	8.56	11.96	131.02
METHOD OF MOMENTS Geometric [µm]	MEAN:	104.50	1715.59	223.71	207.20	963.03	72.42	50.87	90.60	84.27	88.21	264.43
	SORTING:	3.53	9.00	2.22	2.34	2.65	2.95	3.51	3.13	4.06	3.61	1.45
	SKEWNESS:	-1.47	-1.01	-0.83	-1.56	-1.76	-1.85	-1.19	-1.64	-1.12	-1.41	0.46
	KURTOSIS:	5.18	3.62	11.18	12.09	9.80	7.14	4.49	6.29	3.98	5.00	4.73
METHOD OF MOMENTS Logarithmic [Phi]	MEAN:	3.26	-0.78	2.16	2.27	0.05	3.79	4.30	3.46	3.57	3.50	1.92
	SORTING:	1.82	3.17	1.15	1.23	1.41	1.56	1.81	1.65	2.02	1.85	0.53
	SKEWNESS:	1.47	1.01	0.83	1.56	1.76	1.85	1.19	1.64	1.12	1.41	-0.46
	KURTOSIS:	5.18	3.62	11.18	12.09	9.80	7.14	4.49	6.29	3.98	5.00	4.73
FOLK AND WARD METHOD [µm]	MEAN:	123.86	1943.49	226.43	218.43	1032.70	87.62	50.66	105.85	87.60	99.86	264.88
	SORTING:	3.04	9.10	1.72	1.64	2.25	2.37	3.29	2.63	3.96	3.19	1.45
	SKEWNESS:	-0.31	-0.32	0.06	-0.05	-0.15	-0.35	-0.45	-0.34	-0.35	-0.33	0.00
	KURTOSIS:	1.70	0.97	1.13	1.06	1.09	1.93	1.45	1.81	1.30	1.70	0.98
FOLK AND WARD METHOD [Phi]	MEAN:	3.01	-0.96	2.14	2.19	-0.05	3.51	4.30	3.24	3.51	3.32	1.92
	SORTING:	1.60	3.19	0.78	0.71	1.17	1.24	1.72	1.39	1.99	1.67	0.54
	SKEWNESS:	0.31	0.32	-0.06	0.05	0.15	0.35	0.45	0.34	0.35	0.33	0.00
	KURTOSIS:	1.70	0.97	1.13	1.06	1.09	1.93	1.45	1.81	1.30	1.70	0.98
FOLK AND WARD METHOD [Description]	MEAN:	Very Fine Sand	Very Coarse Sand	Fine Sand	Fine Sand	Very Coarse Sand	Very Fine Sand	Very Coarse Silt	Very Fine Sand	Very Fine Sand	Very Fine Sand	Medium Sand
	SORTING:	Poorly Sorted	Very Poorly Sorted	Moderately Sorted	Moderately Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Moderately Well Sorted
	SKEWNESS:	Very Fine Skewed	Very Fine Skewed	Symmetrical	Symmetrical	Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Symmetrical
	KURTOSIS:	Very Leptokurtic	Mesokurtic	Leptokurtic	Mesokurtic	Mesokurtic	Very Leptokurtic	Leptokurtic	Very Leptokurtic	Leptokurtic	Very Leptokurtic	Mesokurtic
	MODE 1 [µm]:	150.89	13600.00	213.39	213.39	1200.00	106.69	75.44	150.89	150.89	106.69	301.78
	MODE 2 [µm]:	0.00	4800.00	0.00	0.00	0.00	0.00	9.43	0.00	9.43	0.00	0.00
	MODE 3 [µm]:	0.00	2400.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MODE 1 [Phi]:	2.75	-3.74	2.25	2.25	-0.24	3.25	3.75	2.75	2.75	3.25	1.75
	MODE 2 [Phi]:	0.00	-2.24	0.00	0.00	0.00	0.00	6.75	0.00	6.75	0.00	0.00
	MODE 3 [Phi]:	0.00	-1.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	D10 [µm]:	13.34	105.06	120.10	115.98	347.57	14.19	7.12	16.79	8.96	11.19	163.13
	D50 [µm]:	137.06	2724.42	224.50	220.60	1091.91	93.71	70.57	116.24	115.47	116.44	263.78
	D90 [µm]:	350.91	18475.96	455.84	415.88	2618.21	176.15	162.86	245.12	361.09	311.10	434.27
	(D90 / D10) [µm]:	26.30	175.87	3.80	3.59	7.53	12.41	22.88	14.60	40.31	27.81	2.66
	(D90 - D10) [µm]:	337.57	18370.90	335.74	299.91	2270.65	161.95	155.74	228.33	352.14	299.92	271.15
	(D75 / D25) [µm]:	2.88	23.55	1.99	1.93	2.85	2.16	3.15	2.43	4.36	2.93	1.67
	(D75 - D25) [µm]:	147.25	9762.26	158.68	148.04	1143.55	72.13	75.90	101.95	168.82	127.22	135.18
	D10 [Phi]:	1.51	-4.21	1.13	1.27	-1.39	2.51	2.62	2.03	1.47	1.68	1.20
	D50 [Phi]:	2.87	-1.45	2.16	2.18	-0.13	3.42	3.82	3.10	3.11	3.10	1.92
	D90 [Phi]:	6.23	3.25	3.06	3.11	1.52	6.14	7.13	5.90	6.80	6.48	2.62
	(D90 / D10) [Phi]:	4.12	-0.77	2.70	2.46	-1.10	2.45	2.72	2.91	4.63	3.85	2.17
	(D90 - D10) [Phi]:	4.72	7.46	1.92	1.84	2.91	3.63	4.52	3.87	5.33	4.80	1.41
	(D75 / D25) [Phi]:	1.71	-0.36	1.60	1.56	-0.85	1.38	1.52	1.51	1.97	1.65	1.47
	(D75 - D25) [Phi]:	1.52	4.56	0.99	0.95	1.51	1.11	1.66	1.28	2.12	1.55	0.74
	% GRAVEL [63000 - 2000 µm]:	0.02	56.62	1.37	1.01	18.93	0.06	0.05	0.06	0.00	0.00	0.06
	% SAND [< 2000 - 63 µm]:	81.37	35.37	95.54	94.45	79.26	74.77	56.81	79.90	70.92	76.91	99.94
	% MUD [< 63 µm]:	18.61	8.02	3.09	4.54	1.82	25.17	43.14	20.03	29.08	23.09	0.00
	% V COARSE GRAVEL:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	% COARSE GRAVEL:	0.00	12.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	% MEDIUM GRAVEL:	0.00	17.03	0.22	0.27	0.72	0.00	0.00	0.00	0.00	0.00	0.00
	% FINE GRAVEL:	0.00	12.82	0.30	0.21	1.54	0.00	0.00	0.00	0.00	0.00	0.00
	% V FINE GRAVEL:	0.02	14.36	0.85	0.53	16.67	0.06	0.05	0.06	0.00	0.00	0.06
	% V COARSE SAND:	0.05	11.81	1.67	1.39	36.04	0.05	0.06	0.04	0.07	0.05	0.38
	% COARSE SAND:	3.68	5.45	4.00	1.91	27.30	0.70	1.07	1.58	3.93	2.51	2.58
	% MEDIUM SAND:	16.61	6.45	34.22	35.05	11.61	0.98	1.75	7.49	16.21	12.55	52.44
	% FINE SAND:	34.68	8.54	47.92	49.24	3.23	27.17	15.82	36.39	26.69	31.19	43.68
	% V FINE SAND:	26.36	3.11	7.73	6.85	1.08	45.88	38.11	34.40	24.01	30.61	0.85
	% V COARSE SILT:	4.44	1.06	0.30	0.53	0.36	12.40	20.49	7.06	10.05	7.73	0.00
	% COARSE SILT:	3.18	1.69	1.27	1.52	0.42	2.18	5.36	3.36	4.73	3.24	0.00
	% MEDIUM SILT:	4.31	2.05	0.54	0.81	0.49	4.12	6.48	3.66	5.37	4.38	0.00
	% FINE SILT:	3.62	1.83	0.69	1.04	0.41	3.06	5.43	3.00	4.68	3.86	0.00
	% V FINE SILT:	1.98	0.89	0.29	0.64	0.15	1.97	3.04	1.81	2.55	2.38	0.00
	% CLAY:	1.10	0.50	0.00	0.01	0.00	1.45	2.34	1.15	1.70	1.51	0.00

Appendix 5 – Sediment chemistry results

Cefas (2003) guideline values

	Existing AL 1	Existing AL 2	Revised AL1	Revised AL2
Arsenic (As)	20	50-100	20	70
Cadmium (Cd)	0.4	2	0.4	4
Chromium (Cr)	40	400	50	370
Copper (Cu)	40	400	30	300
Mercury (Hg)	0.3	3	0.25	1.5
Nickel (Ni)	20	200	30	150
Lead (Pb)	50	500	50	400
Zinc (Zn)	130	800	130	600
Tributyltin (TBT,DBT,MBT)	0.1	1	0.1	0.5
Polychlorinated Biphenyls (PCBs)	0.02	0.2	0.02	0.18
Polyaromatic Hydrocarbons				
Acenaphthene			0.1	
Acenaphthylene			0.1	
Anthracene			0.1	
Fluorene			0.1	
Naphthalene			0.1	
Phenanthrene			0.1	
Benzo[a]anthracene			0.1	
Benzo[b]fluoranthene			0.1	
Benzo[k]fluoranthene			0.1	
Benzo[g]perylene			0.1	
Benzo[a]pyrene			0.1	
Benzo[g,h,i]perylene			0.1	
Dibenzo[a,h]anthracene			0.01	
Chrysene			0.1	
Fluoranthene			0.1	
Pyrene			0.1	
Indeno(1,2,3cd)pyrene			0.1	
Total hydrocarbons	100		100	

Note: All results presented as mg.kg-1 (ppm) dry weight

OSPAR CSEMP metal guideline values taken from:
http://www.bodc.ac.uk/projects/uk/merman/assessments_and_data_access/csemp/help/assessment_criteria/sediment/metals.html

	BAC	ERL
Arsenic	25	8.2
Cadmium	0.31	1.2
Chromium	81	81
Copper	27	34
Mercury	0.07	0.15
Nickel	36	21
Lead	38	47
Zinc	122	150

Notes:
- all concentrations are expressed as mg kg-1> dw
- BACs are normalised to 5% aluminium
- for arsenic and nickel, the ERLs are below the OSPAR Background Concentrations of 15 and 30 mg/kg-1 respectively; concentrations are only assessed against the BAC
- for chromium, the ERL equals the BAC; concentrations are only assessed against the ERL

OSPAR CSEMP PAH guideline values taken from:
http://www.bodc.ac.uk/projects/uk/merman/assessments_and_data_access/csemp/help/assessment_criteria/sediment/polycyclic_aromatic_hydrocarbons.html

	BAC	ERL
Naphthalene	8	160
C1-naphthalene	-	155
C2-naphthalene	-	150
Phenanthrene	32	240
C1-phenanthrene	-	170
C2-phenanthrene	-	200
Anthracene	5	85
Dibenzothiophene	-	190
C1-dibenzothiophene	-	85
Fluoranthene	39	600
Pyrene	24	665
Benz[a]anthracene	16	261
Chrysene (Triphenylene)	20	384
Benzo[a]pyrene	30	430
Benzo[ghi]perylene	80	85
Indeno[123-cd]pyrene	103	240

Notes

- all concentrations are expressed as µg kg-1 dw
- BACs are normalised to 2.5% organic carbon in all subregions
- the ERL for C2-naphthalene is the sum of the ERLs for 1-methyl naphthalene and 2-methyl naphthalene

Canadian (CCME 2001) guideline values:

Metals	Units	ISQG / TEL	PEL
Arsenic	$mg.kg^{-1}$	7.24	41.6
Cadmium	$mg.kg^{-1}$	0.7	4.2
Chromium	$mg.kg^{-1}$	52.3	160
Copper	$mg.kg^{-1}$	18.7	108
Lead	$mg.kg^{-1}$	30.2	112
Mercury	$mg.kg^{-1}$	0.13	0.7
Zinc	$mg.kg^{-1}$	124	271
PAH	**Units**	**ISQG / TEL**	**PEL**
2-Methylnaphthalene	$\mu g.kg^{-1}$	20.2	201
Acenaphthene	$\mu g.kg^{-1}$	6.71	88.9
Acenaphthylene	$\mu g.kg^{-1}$	5.87	128
Anthracene	$\mu g.kg^{-1}$	46.9	245
Benz(a)anthracene	$\mu g.kg^{-1}$	74.8	693
Benzo(a)pyrene	$\mu g.kg^{-1}$	88.8	763
Chrysene	$\mu g.kg^{-1}$	108	846
Dibenz(a,h)anthracene	$\mu g.kg^{-1}$	6.22	135
Fluoranthene	$\mu g.kg^{-1}$	113	1494
Fluorene	$\mu g.kg^{-1}$	21.2	144
Naphthalene	$\mu g.kg^{-1}$	34.6	391
Phenanthrene	$\mu g.kg^{-1}$	86.7	544
Pyrene	$mg.kg^{-1}$	153	1398

Analytical Results

National Laboratory Service

Analytical Report

Partial Reports - results awaited - awaiting LSM approval

Report ID - 20065720 - 1

UKAS TESTING 0754

Batch description: J/3/08/2610 - Moray Sediment Analysis

Reported on: 11-Jun-2014

James Hutchinson
Fugro EMU Ltd
Trafalgar Wharf - Unit 16
Hamilton Road
Portchester
Porstmouth
PO6 4PX

Dear James

Please find attached the results for the batch of 11 samples described below.

Samples Registered on:	28-May-2014
Analysis Started on:	29-May-2014
Analysis Completed on:	11-Jun-2014
Results for Batch Number	20065720
Your Purchase Order Number:	E42027

You will be invoiced shortly by our accounts department.

If we can be of further assistance then please do not hesitate to contact us.

Yours sincerely

William Fardon
Customer Services Team Manager
Tel: (0113) 231 2177
nls@environment-agency.gov.uk

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation. Details of analytical procedures and performance data are available on request. The date of sample analysis is available on request.

The Environment Agency carries out analytical work to high standards and within the scope of its UKAS accreditation, but has no knowledge of whether the circumstances or the validity of the procedures used to obtain the samples provided to the laboratory were representative of the need for which the information was required.
The Environment Agency and/or its staff does not therefore accept any liability for the consequences of any acts or omissions made on the basis of the analysis or advice or interpretation provided.

National Laboratory Service

Analytical Report

Partial Reports - results awaited - awaiting LSM approval

Report ID - 20065720 - 1

UKAS TESTING 0754

Batch description: J/3/08/2610 - Moray Sediment Analysis

Reported on: 11-Jun-2014

Client: Fugro EMU Ltd

Project: P Moray Sediment

Sample Point Name: CC Fugro EMU Ltd

Folder No: 002801373

Sampled on: 24-May-14 @ (Time not supplied)

Comments: KPA58 (LR- 12599) - 52.0m

Quote No: 11244

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	0.502	mg/kg		0.05	UKAS	LE	402
Mercury : Dry Wt	0.00352	mg/kg		0.002	UKAS	LE	1082
Aluminium, HF Digest : Dry Wt	16700	mg/kg		50	UKAS	LE	756
Barium, HF Digest : Dry Wt	259	mg/kg		20	None	LE	756
Arsenic, HF Digest : Dry Wt	5.46	mg/kg		0.4	UKAS	LE	341
Cadmium, HF Digest : Dry Wt	0.0560	mg/kg		0.03	UKAS	LE	341
Chromium, HF Digest : Dry Wt	25.0	mg/kg		3	UKAS	LE	341
Copper, HF Digest : Dry Wt	3.51	mg/kg		1	UKAS	LE	341
Lead, HF Digest : Dry Wt	9.62	mg/kg		3	UKAS	LE	341
Nickel, HF Digest : Dry Wt	4.19	mg/kg		1	UKAS	LE	341
Tin, HF Digest : Dry Wt	0.806	mg/kg		0.5	None	LE	341
Zinc : HF Digest : Dry Wt	10.2	mg/kg		5	UKAS	LE	341
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Diphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	None	LE	897
Tetrabutyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Triphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Dry Solids @ 30°C	71.7	%		0.5	None	LE	1130

Analytical Report

Partial Reports - results awaited - awaiting LSM approval

Report ID - 20065720 - 1

UKAS TESTING 0754

Batch description: J/3/08/2610 - Moray Sediment Analysis

Reported on: 11-Jun-2014

Client:	Fugro EMU Ltd	Project:	P Moray Sediment
		Sample Point Name:	CC Fugro EMU Ltd
Folder No:	002801374	Sampled on:	24-May-14 @ (Time not supplied)
Comments:	KPA50 (LR- 12600) - 51.2m		
Quote No:	11244	Matrix:	Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	0.436	mg/kg		0.05	UKAS	LE	402
Mercury : Dry Wt	0.00381	mg/kg		0.002	UKAS	LE	1082
Aluminium, HF Digest : Dry Wt	19200	mg/kg		50	UKAS	LE	756
Barium, HF Digest : Dry Wt	257	mg/kg		20	None	LE	756
Arsenic, HF Digest : Dry Wt	3.20	mg/kg		0.4	UKAS	LE	341
Cadmium, HF Digest : Dry Wt	0.0420	mg/kg		0.03	UKAS	LE	341
Chromium, HF Digest : Dry Wt	12.5	mg/kg		3	UKAS	LE	341
Copper, HF Digest : Dry Wt	2.52	mg/kg		1	UKAS	LE	341
Lead, HF Digest : Dry Wt	7.89	mg/kg		3	UKAS	LE	341
Nickel, HF Digest : Dry Wt	3.70	mg/kg		1	UKAS	LE	341
Tin, HF Digest : Dry Wt	0.553	mg/kg		0.5	None	LE	341
Zinc : HF Digest : Dry Wt	8.40	mg/kg		5	UKAS	LE	341
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Diphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	None	LE	897
Tetrabutyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Triphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Dry Solids @ 30°C	75.2	%		0.5	None	LE	1130

Analytical Report

Partial Reports - results awaited - awaiting LSM approval

Report ID - 20065720 - 1

UKAS TESTING 0754

Batch description: J/3/08/2610 - Moray Sediment Analysis

Reported on: 11-Jun-2014

Client: Fugro EMU Ltd

Project: P Moray Sediment

Sample Point Name: CC Fugro EMU Ltd

Folder No: 002801375

Sampled on: 24-May-14 @ (Time not supplied)

Comments: KPA45 (LR- 12601) - 54.8m

Quote No: 11244

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	0.801	mg/kg		0.05	UKAS	LE	402
Mercury : Dry Wt	0.00538	mg/kg		0.002	UKAS	LE	1082
Aluminium, HF Digest : Dry Wt	6770	mg/kg		50	UKAS	LE	756
Barium, HF Digest : Dry Wt	115	mg/kg		20	None	LE	756
Arsenic, HF Digest : Dry Wt	24.6	mg/kg		0.4	UKAS	LE	341
Cadmium, HF Digest : Dry Wt	0.0380	mg/kg		0.03	UKAS	LE	341
Chromium, HF Digest : Dry Wt	10.2	mg/kg		3	UKAS	LE	341
Copper, HF Digest : Dry Wt	2.05	mg/kg		1	UKAS	LE	341
Lead, HF Digest : Dry Wt	8.86	mg/kg		3	UKAS	LE	341
Nickel, HF Digest : Dry Wt	3.64	mg/kg		1	UKAS	LE	341
Tin, HF Digest : Dry Wt	<0.5	mg/kg		0.5	None	LE	341
Zinc : HF Digest : Dry Wt	10.0	mg/kg		5	UKAS	LE	341
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg		3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation					
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg		3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation					
Diphenyl Tin : Dry Wt as Cation	<2	ug/kg		2	None	LE	897
Tetrabutyl Tin : Dry Wt as Cation	<2	ug/kg		2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg		3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation					
Triphenyl Tin : Dry Wt as Cation	<2	ug/kg		2	UKAS	LE	897
Dry Solids @ 30°C	83.9	%		0.5	None	LE	1130

Analytical Report

Partial Reports - results awaited - awaiting LSM approval

Report ID - 20065720 - 1

UKAS TESTING 0754

Batch description: J/3/08/2610 - Moray Sediment Analysis

Reported on: 11-Jun-2014

Client:	Fugro EMU Ltd	Project:	P Moray Sediment
		Sample Point Name:	CC Fugro EMU Ltd
Folder No:	002801376	Sampled on:	24-May-14 @ (Time not supplied)
Comments:	KPA37 (LR- 12602) - 70.0m		
Quote No:	11244	Matrix:	Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	1.63	mg/kg		0.05	UKAS	LE	402
Mercury : Dry Wt	0.0113	mg/kg		0.002	UKAS	LE	1082
Aluminium, HF Digest : Dry Wt	21400	mg/kg		50	UKAS	LE	756
Barium, HF Digest : Dry Wt	308	mg/kg		20	None	LE	756
Arsenic, HF Digest : Dry Wt	4.07	mg/kg		0.4	UKAS	LE	341
Cadmium, HF Digest : Dry Wt	0.171	mg/kg		0.03	UKAS	LE	341
Chromium, HF Digest : Dry Wt	67.1	mg/kg		3	UKAS	LE	341
Copper, HF Digest : Dry Wt	6.36	mg/kg		1	UKAS	LE	341
Lead, HF Digest : Dry Wt	9.04	mg/kg		3	UKAS	LE	341
Nickel, HF Digest : Dry Wt	14.6	mg/kg		1	UKAS	LE	341
Tin, HF Digest : Dry Wt	1.20	mg/kg		0.5	None	LE	341
Zinc : HF Digest : Dry Wt	26.5	mg/kg		5	UKAS	LE	341
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Diphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	None	LE	897
Tetrabutyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Triphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Dry Solids @ 30°C	67.2	%		0.5	None	LE	1130

Analytical Report

Partial Reports - results awaited - awaiting LSM approval

Report ID - 20065720 - 1

UKAS TESTING 0754

Batch description: J/3/08/2610 - Moray Sediment Analysis

Reported on: 11-Jun-2014

Client: Fugro EMU Ltd
Project: P Moray Sediment
Sample Point Name: CC Fugro EMU Ltd
Folder No: 002801377
Sampled on: 24-May-14 @ (Time not supplied)
Comments: KPA30 (LR- 12603) - 87.1m
Quote No: 11244
Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	2.63	mg/kg		0.05	UKAS	LE	402
Mercury : Dry Wt	0.0134	mg/kg		0.002	UKAS	LE	1082
Aluminium, HF Digest : Dry Wt	29800	mg/kg		50	UKAS	LE	756
Barium, HF Digest : Dry Wt	320	mg/kg		20	None	LE	756
Arsenic, HF Digest : Dry Wt	4.90	mg/kg		0.4	UKAS	LE	341
Cadmium, HF Digest : Dry Wt	0.141	mg/kg		0.03	UKAS	LE	341
Chromium, HF Digest : Dry Wt	70.7	mg/kg		3	UKAS	LE	341
Copper, HF Digest : Dry Wt	6.01	mg/kg		1	UKAS	LE	341
Lead, HF Digest : Dry Wt	9.99	mg/kg		3	UKAS	LE	341
Nickel, HF Digest : Dry Wt	15.6	mg/kg		1	UKAS	LE	341
Tin, HF Digest : Dry Wt	1.25	mg/kg		0.5	None	LE	341
Zinc : HF Digest : Dry Wt	28.7	mg/kg		5	UKAS	LE	341
Dibutyl Tin : Dry Wt as Cation	<5	ug/kg		3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation					
Dioctyl Tin : Dry Wt as Cation	<5	ug/kg		3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation					
Diphenyl Tin : Dry Wt as Cation	<3	ug/kg		2	None	LE	897
		ELEVATED_MRV : Dry weight calculation					
Tetrabutyl Tin : Dry Wt as Cation	<3	ug/kg		2	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation					
Tributyl Tin : Dry Wt as Cation	<5	ug/kg		3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation					
Triphenyl Tin : Dry Wt as Cation	<3	ug/kg		2	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation					
Dry Solids @ 30°C	63.6	%		0.5	None	LE	1130

National Laboratory Service

Analytical Report

Partial Reports - results awaited - awaiting LSM approval

Report ID - 20065720 - 1

UKAS TESTING 0754

Batch description: J/3/08/2610 - Moray Sediment Analysis

Reported on: 11-Jun-2014

Client:	Fugro EMU Ltd	Project:	P Moray Sediment
		Sample Point Name:	CC Fugro EMU Ltd
Folder No:	002801378	Sampled on:	24-May-14 @ (Time not supplied)
Comments:	KPA21 (LR- 12604) - 75.1m		
Quote No:	11244	Matrix:	Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	1.52	mg/kg		0.05	UKAS	LE	402
Mercury : Dry Wt	0.0113	mg/kg		0.002	UKAS	LE	1082
Aluminium, HF Digest : Dry Wt	31000	mg/kg		50	UKAS	LE	756
Barium, HF Digest : Dry Wt	347	mg/kg		20	None	LE	756
Arsenic, HF Digest : Dry Wt	4.75	mg/kg		0.4	UKAS	LE	341
Cadmium, HF Digest : Dry Wt	0.140	mg/kg		0.03	UKAS	LE	341
Chromium, HF Digest : Dry Wt	53.6	mg/kg		3	UKAS	LE	341
Copper, HF Digest : Dry Wt	6.28	mg/kg		1	UKAS	LE	341
Lead, HF Digest : Dry Wt	10.1	mg/kg		3	UKAS	LE	341
Nickel, HF Digest : Dry Wt	14.7	mg/kg		1	UKAS	LE	341
Tin, HF Digest : Dry Wt	1.28	mg/kg		0.5	None	LE	341
Zinc : HF Digest : Dry Wt	28.5	mg/kg		5	UKAS	LE	341
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Diphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	None	LE	897
Tetrabutyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Triphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Dry Solids @ 30°C	71.9	%		0.5	None	LE	1130

National Laboratory Service

Analytical Report

Partial Reports - results awaited - awaiting LSM approval

Report ID - 20065720 - 1

UKAS TESTING 0754

Batch description: J/3/08/2610 - Moray Sediment Analysis

Reported on: 11-Jun-2014

Client: Fugro EMU Ltd
Project: P Moray Sediment
Sample Point Name: CC Fugro EMU Ltd
Folder No: 002801379
Sampled on: 24-May-14 @ (Time not supplied)
Comments: KPA17 (LR- 12605) - 84.3m
Quote No: 11244
Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	2.36	mg/kg		0.05	UKAS	LE	402
Mercury : Dry Wt	0.0165	mg/kg		0.002	UKAS	LE	1082
Aluminium, HF Digest : Dry Wt	13700	mg/kg		50	UKAS	LE	756
Barium, HF Digest : Dry Wt	339	mg/kg		20	None	LE	756
Arsenic, HF Digest : Dry Wt	4.91	mg/kg		0.4	UKAS	LE	341
Cadmium, HF Digest : Dry Wt	0.132	mg/kg		0.03	UKAS	LE	341
Chromium, HF Digest : Dry Wt	46.8	mg/kg		3	UKAS	LE	341
Copper, HF Digest : Dry Wt	6.67	mg/kg		1	UKAS	LE	341
Lead, HF Digest : Dry Wt	10.8	mg/kg		3	UKAS	LE	341
Nickel, HF Digest : Dry Wt	15.5	mg/kg		1	UKAS	LE	341
Tin, HF Digest : Dry Wt	1.24	mg/kg		0.5	None	LE	341
Zinc : HF Digest : Dry Wt	31.3	mg/kg		5	UKAS	LE	341
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Diphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	None	LE	897
Tetrabutyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Triphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Dry Solids @ 30°C	69.6	%		0.5	None	LE	1130

National Laboratory Service

Analytical Report

Partial Reports - results awaited - awaiting LSM approval

Report ID - 20065720 - 1

UKAS TESTING 0754

Batch description: J/3/08/2610 - Moray Sediment Analysis

Reported on: 11-Jun-2014

Client: Fugro EMU Ltd

Project: P Moray Sediment

Sample Point Name: CC Fugro EMU Ltd

Folder No: 002801380

Sampled on: 24-May-14 @ (Time not supplied)

Comments: KPA12 (LR- 12606) - 94.0m

Quote No: 11244

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	1.87	mg/kg		0.05	UKAS	LE	402
Mercury : Dry Wt	0.0184	mg/kg		0.002	UKAS	LE	1082
Aluminium, HF Digest : Dry Wt	15600	mg/kg		50	UKAS	LE	756
Barium, HF Digest : Dry Wt	419	mg/kg		20	None	LE	756
Arsenic, HF Digest : Dry Wt	5.94	mg/kg		0.4	UKAS	LE	341
Cadmium, HF Digest : Dry Wt	0.148	mg/kg		0.03	UKAS	LE	341
Chromium, HF Digest : Dry Wt	58.8	mg/kg		3	UKAS	LE	341
Copper, HF Digest : Dry Wt	7.40	mg/kg		1	UKAS	LE	341
Lead, HF Digest : Dry Wt	12.2	mg/kg		3	UKAS	LE	341
Nickel, HF Digest : Dry Wt	17.2	mg/kg		1	UKAS	LE	341
Tin, HF Digest : Dry Wt	1.38	mg/kg		0.5	None	LE	341
Zinc : HF Digest : Dry Wt	33.4	mg/kg		5	UKAS	LE	341
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Diphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	None	LE	897
Tetrabutyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Triphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Dry Solids @ 30°C	69.3	%		0.5	None	LE	1130

Analytical Report

Partial Reports - results awaited - awaiting LSM approval

Report ID - 20065720 - 1

UKAS TESTING 0754

Batch description: J/3/08/2610 - Moray Sediment Analysis

Reported on: 11-Jun-2014

Client:	Fugro EMU Ltd	Project:	P Moray Sediment
		Sample Point Name:	CC Fugro EMU Ltd
Folder No:	002801381	Sampled on:	24-May-14 @ (Time not supplied)
Comments:	KPA2 (LR- 12608) - 86.6m		
Quote No:	11244	Matrix:	Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	1.67	mg/kg		0.05	UKAS	LE	402
Mercury : Dry Wt	0.0230	mg/kg		0.002	UKAS	LE	1082
Aluminium, HF Digest : Dry Wt	16100	mg/kg		50	UKAS	LE	756
Barium, HF Digest : Dry Wt	434	mg/kg		20	None	LE	756
Arsenic, HF Digest : Dry Wt	6.07	mg/kg		0.4	UKAS	LE	341
Cadmium, HF Digest : Dry Wt	0.149	mg/kg		0.03	UKAS	LE	341
Chromium, HF Digest : Dry Wt	55.0	mg/kg		3	UKAS	LE	341
Copper, HF Digest : Dry Wt	7.82	mg/kg		1	UKAS	LE	341
Lead, HF Digest : Dry Wt	13.5	mg/kg		3	UKAS	LE	341
Nickel, HF Digest : Dry Wt	16.1	mg/kg		1	UKAS	LE	341
Tin, HF Digest : Dry Wt	1.62	mg/kg		0.5	None	LE	341
Zinc : HF Digest : Dry Wt	36.2	mg/kg		5	UKAS	LE	341
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Diphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	None	LE	897
Tetrabutyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Triphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Dry Solids @ 30°C	70.6	%		0.5	None	LE	1130

Analytical Report

Partial Reports - results awaited - awaiting LSM approval

Report ID - 20065720 - 1

UKAS TESTING 0754

Batch description: J/3/08/2610 - Moray Sediment Analysis

Reported on: 11-Jun-2014

Client: Fugro EMU Ltd

Project: P Moray Sediment

Sample Point Name: CC Fugro EMU Ltd

Folder No: 002801382

Sampled on: 24-May-14 @ (Time not supplied)

Comments: KPB12 (LR- 12648) - 37.4m

Quote No: 11244

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	3.21	mg/kg		0.05	UKAS	LE	402
Mercury : Dry Wt	0.0235	mg/kg		0.002	UKAS	LE	1082
Aluminium, HF Digest : Dry Wt	37300	mg/kg		50	UKAS	LE	756
Barium, HF Digest : Dry Wt	436	mg/kg		20	None	LE	756
Arsenic, HF Digest : Dry Wt	11.2	mg/kg		0.4	UKAS	LE	341
Cadmium, HF Digest : Dry Wt	0.151	mg/kg		0.03	UKAS	LE	341
Chromium, HF Digest : Dry Wt	52.7	mg/kg		3	UKAS	LE	341
Copper, HF Digest : Dry Wt	10.6	mg/kg		1	UKAS	LE	341
Lead, HF Digest : Dry Wt	17.3	mg/kg		3	UKAS	LE	341
Nickel, HF Digest : Dry Wt	19.7	mg/kg		1	UKAS	LE	341
Tin, HF Digest : Dry Wt	1.93	mg/kg		0.5	None	LE	341
Zinc : HF Digest : Dry Wt	48.2	mg/kg		5	UKAS	LE	341
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Diphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	None	LE	897
Tetrabutyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Triphenyl Tin : Dry Wt as Cation	<3	ug/kg ELEVATED_MRV : Dry weight calculation		2	UKAS	LE	897
Dry Solids @ 30°C	76.0	%		0.5	None	LE	1130

National Laboratory Service

Analytical Report

Partial Reports - results awaited - awaiting LSM approval

Report ID - 20065720 - 1

0754

Batch description: J/3/08/2610 - Moray Sediment Analysis

Reported on: 11-Jun-2014

Client: Fugro EMU Ltd
Folder No: 002801383
Comments: KPB7 (LR- 12649) - 20.0m
Quote No: 11244

Project: P Moray Sediment
Sample Point Name: CC Fugro EMU Ltd
Sampled on: 24-May-14 @ (Time not supplied)
Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	0.140	mg/kg		0.05	UKAS	LE	402
Mercury : Dry Wt	<0.002	mg/kg		0.002	UKAS	LE	1082
Aluminium, HF Digest : Dry Wt	19600	mg/kg		50	UKAS	LE	756
Barium, HF Digest : Dry Wt	270	mg/kg		20	None	LE	756
Arsenic, HF Digest : Dry Wt	4.87	mg/kg		0.4	UKAS	LE	341
Cadmium, HF Digest : Dry Wt	0.0700	mg/kg		0.03	UKAS	LE	341
Chromium, HF Digest : Dry Wt	11.4	mg/kg		3	UKAS	LE	341
Copper, HF Digest : Dry Wt	2.04	mg/kg		1	UKAS	LE	341
Lead, HF Digest : Dry Wt	6.65	mg/kg		3	UKAS	LE	341
Nickel, HF Digest : Dry Wt	3.30	mg/kg		1	UKAS	LE	341
Tin, HF Digest : Dry Wt	0.740	mg/kg		0.5	None	LE	341
Zinc : HF Digest : Dry Wt	13.6	mg/kg		5	UKAS	LE	341
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Diphenyl Tin : Dry Wt as Cation	<2	ug/kg		2	None	LE	897
Tetrabutyl Tin : Dry Wt as Cation	<2	ug/kg		2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg ELEVATED_MRV : Dry weight calculation		3	UKAS	LE	897
Triphenyl Tin : Dry Wt as Cation	<2	ug/kg		2	UKAS	LE	897
Dry Solids @ 30°C	78.0	%		0.5	None	LE	1130

Method Description Summary for all samples in batch Number 20065720

341	LL ME ICPMS 12.1 & 12.4 - Metals - HF Digest Open Vessel Hotplate Digest, determined by ICPMS, sieved to <63um
402	NLS I UVF 10.2 - HCs - methanol digested; pentane xch; by UV fluorescence spectrometry
756	LL ME ICPOES 22.1 & 22.2 - Metals - Open Vessel Hotplate HF digest, determined by ICPOES, sieved to <63um
897	LE O Organotins (GCMS) 01 - acetic acid/methanol extracted; derivatised; determined GCMS (SIM); from "as received" sample
1082	LL ME Hg 10.8 - Mercury - microwave aqua regia digested; acidic SnCl2 reduced; determined by CV-AFS, sieved to <63um.
1130	LE P Soil Preparation 01: The sample is air-dried at <30ºC in a controlled environment until a constant weight it achieved.

S.M

Steve Moss
Laboratory Site Manager

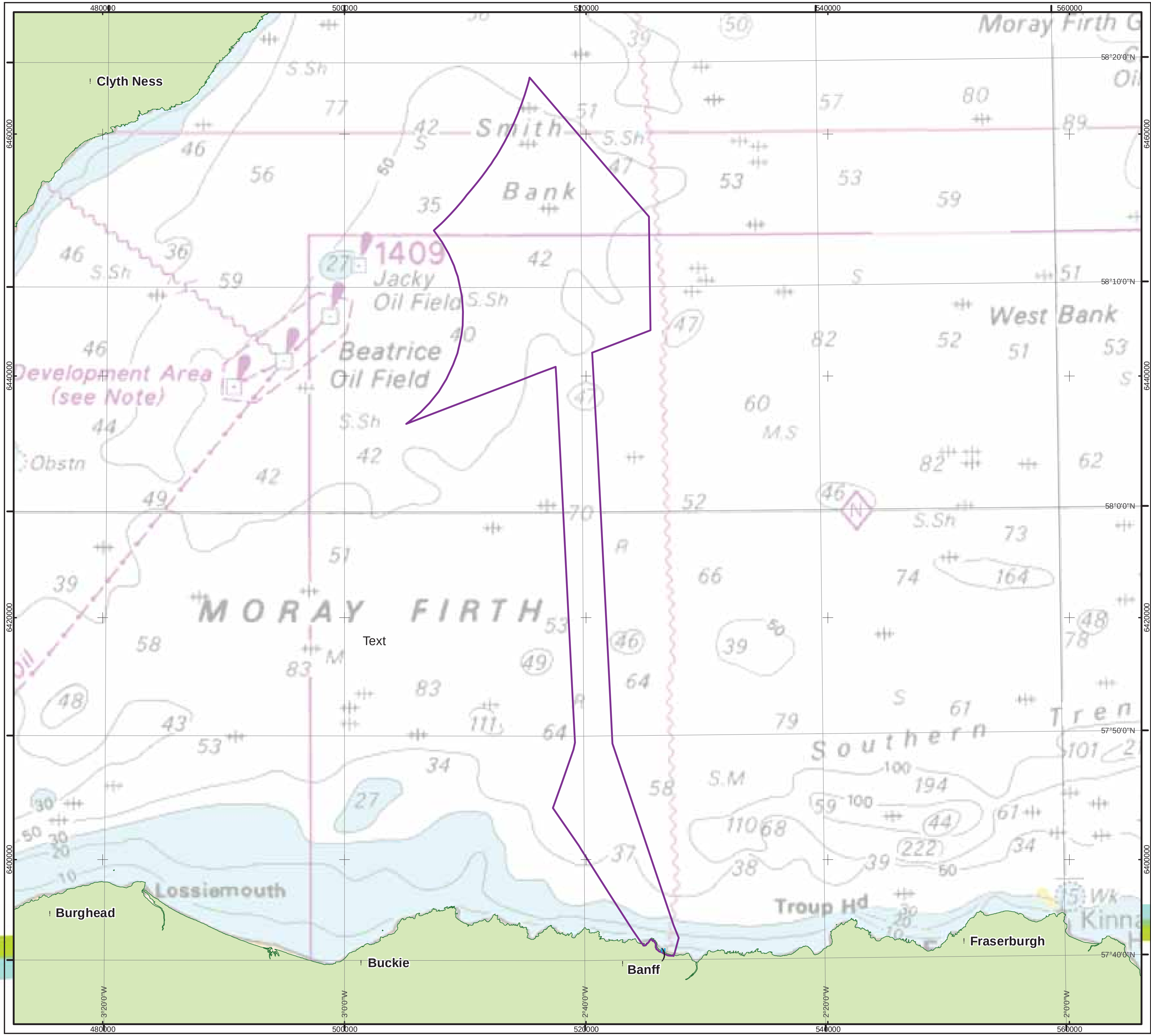
All reporting limits quoted are those achievable for clean samples of the relevant matrix. No allowance is made for instances when dilutions are necessary owing to the nature of the sample or insufficient volume of the sample being available. In these cases higher reporting limits may be **00:00:00**quoted and will be above the MRV.
Solid sample results are determined on a "dried" sample fraction except for parameters where the method description identifies that "as received" sample was used.

The analysis start date specified is the date of the first test, dates for other analysis are available on request.

Please note all samples will be retained for 10 working days for aqueous samples and 30 working days for solid samples after reporting unless otherwise agreed with Customer Services
Key to Accreditation: UKAS = Methodology accredited to ISO/IEC 17025:2005, MCertS = Methodology accredited to MCertS Performance Standard for testing of soils, none = Methodology not accredited
Key to Lab ID: LE = Leeds, NM = Nottingham, SX = Starcross, SC = Sub-Contracted outside NLS, FI = Field Data - outside NLS, NLS = Calculated
Any subsequent version of this report denoted with a higher version number will supersede this and any previous versions

END OF TEST REPORT

Chart Appendix



Moray Offshore Renewables Ltd

KEY

Modified OfTI

Cable Route Landing Site

Horizontal Scale: 1:300,000 A3 Chart

0 5,000 10,000 Metres

Geodetic Parameters: WGS84 UTM Zone 30N

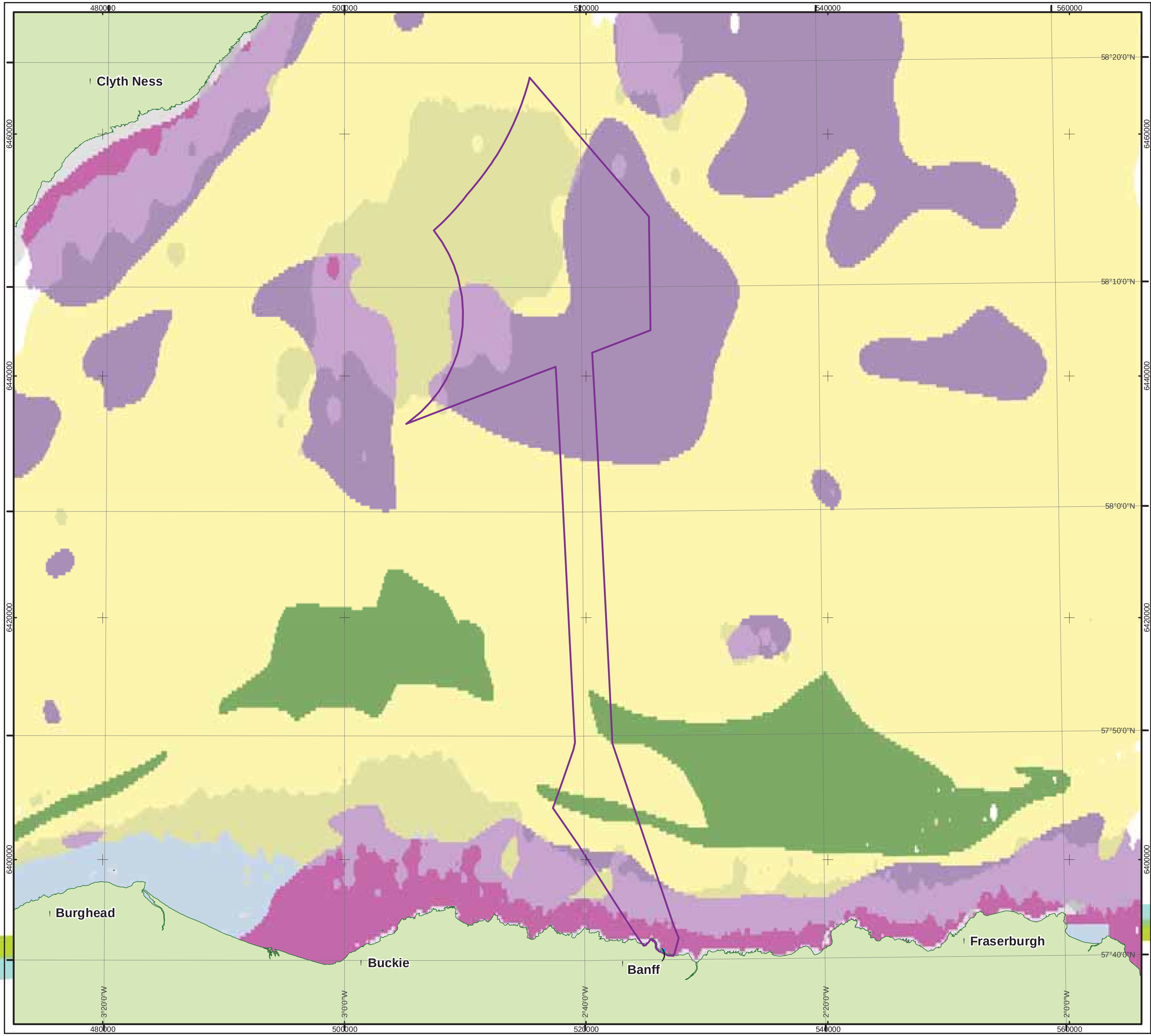
Produced: IMR
Reviewed: ES
Approved: CR

Date: 13/06/2014 Revision: A

REF: 8460001-PSO0131-EMU-MAP-005

Figure 1.1
Location Plot

Moray Offshore Renewables Ltd



Moray Offshore Renewables Ltd

KEY

- Modified OfTI
- Cable Route Landing Site

Potential EUNIS Habitats

- Circalittoral Coarse Sediment
- Infralittoral Coarse Sediment
- Deep Circalittoral Coarse Sediment
- Deep Circalittoral Sand
- Circalittoral Fine Sand or Circalittoral Muddy Sand
- Infralittoral Fine Sand or Infralittoral Muddy Sand
- Circalittoral Sandy Mud or Circalittoral Fine Mud
- Deep Circalittoral Mud
- Low Energy Circalittoral Rock
- Low Energy Infralittoral Rock

Horizontal Scale: 1:300,000 A3 Chart

0 5,000 10,000 Metres

Geodetic Parameters: WGS84 UTM Zone 30N

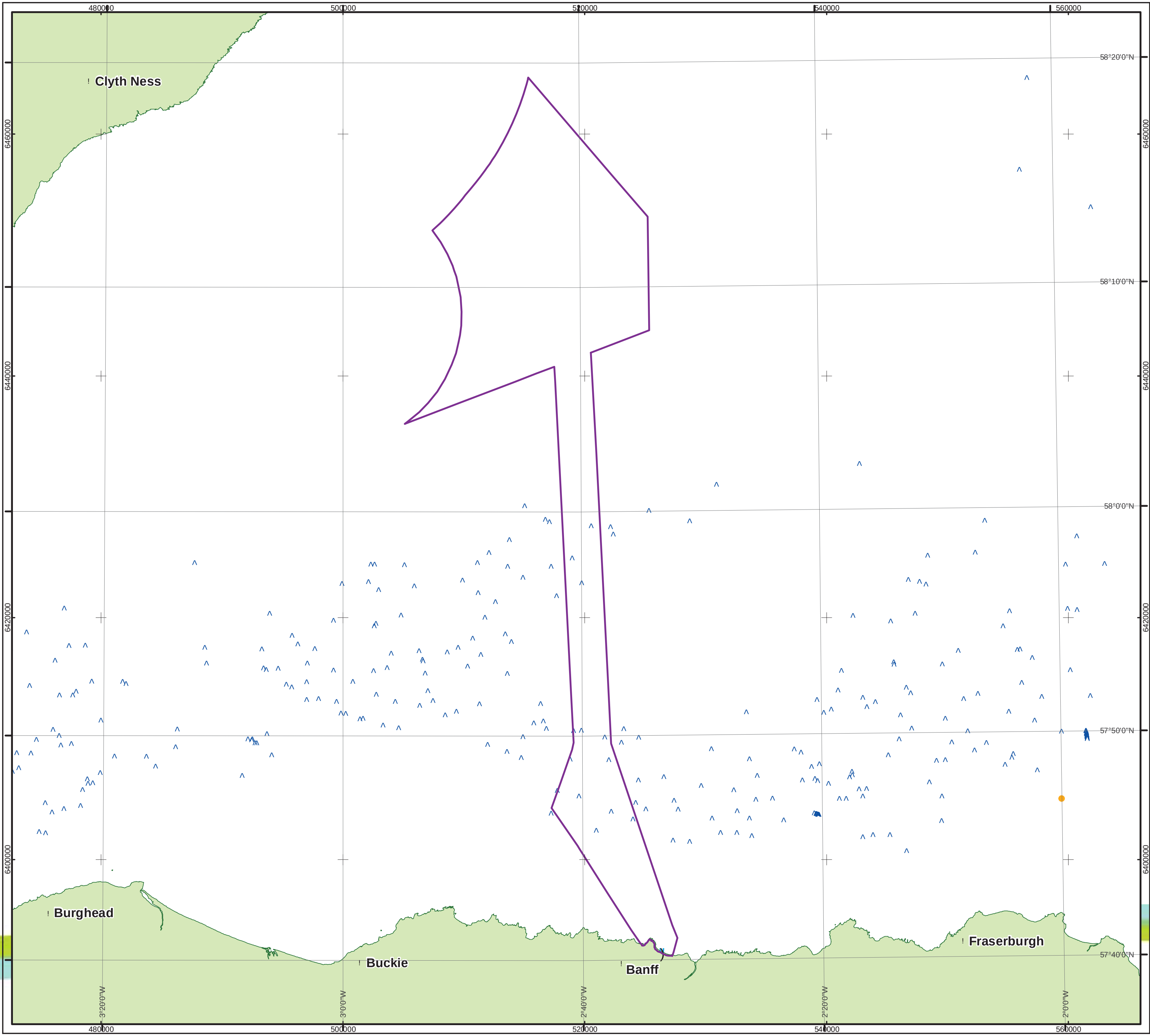
Produced: IMR
Reviewed: ES
Approved: CR

Date: 13/06/2014 Revision: A

REF: 8460001-PSO0131-EMU-MAP-006

Figure 1.2
Potential MESH Habitats

Moray Offshore Renewables Ltd



edp renewables
REPSOL

Moray Offshore Renewables Ltd

KEY

Modified OfTI

Cable Route Landing Site

OSPAR Habitats 2014

Lophelia pertusa Reefs

Sea-pen and Burrowing Megafauna Communities

Horizontal Scale: 1:300,000 A3 Chart

0 5,000 10,000 Metres

Geodetic Parameters: WGS84 UTM Zone 30N

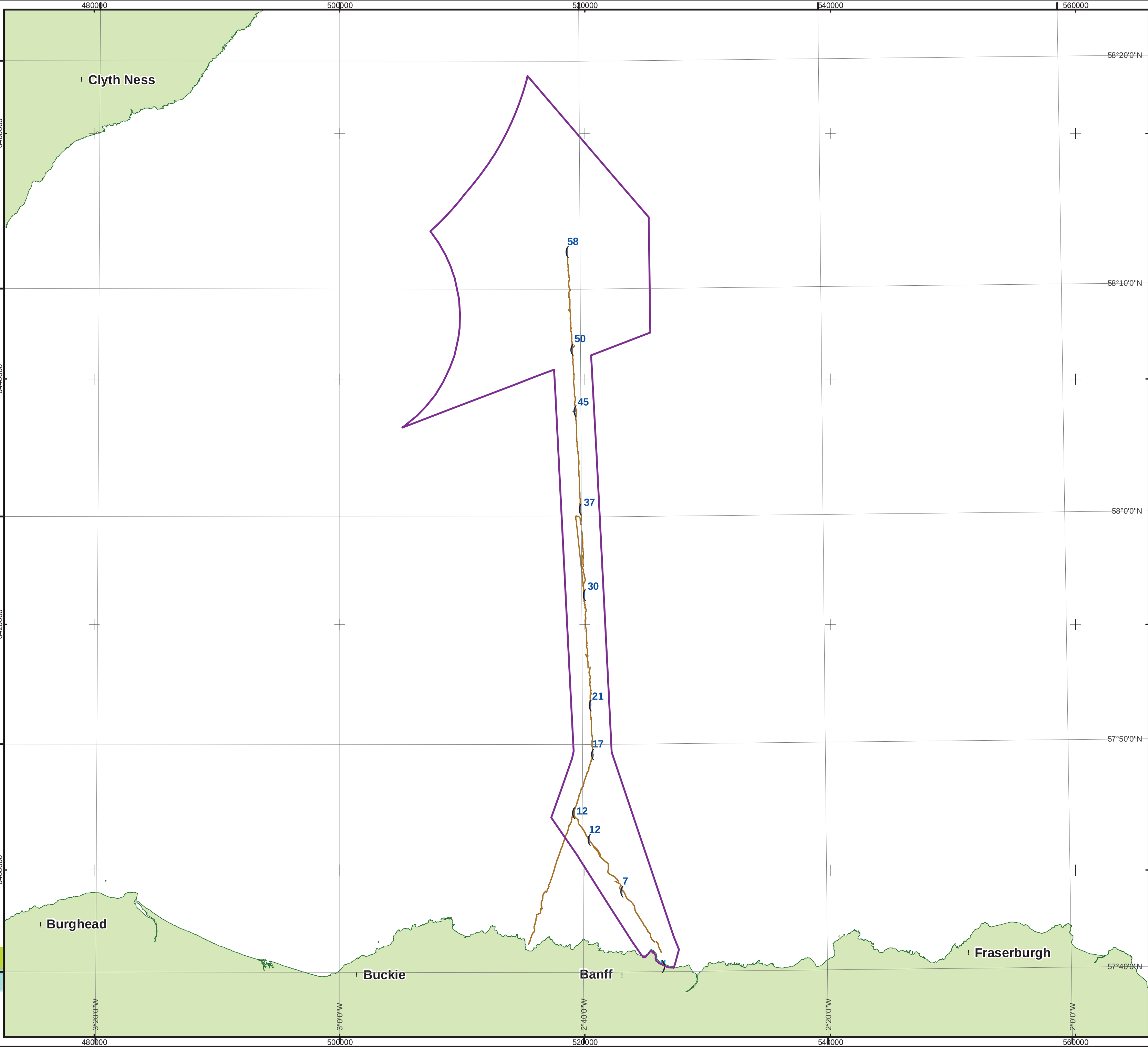
Produced: IMR
Reviewed: ES
Approved: CR

Date: 13/06/2014 Revision: A

REF: 8460001-PSO0131-EMU-MAP-007

Figure 1.4
OSPAR Habitats

Moray Offshore Renewables Ltd



edp renewables

REPSOL

Moray Offshore Renewables Ltd

KEY

Modified OfTI

Cable Route Landing Site

Benthic Sampling Array

Grab Site

Video Transect

Horizontal Scale: 1:300,000 A3 Chart

0 5,000 10,000 Metres

Geodetic Parameters: WGS84 UTM Zone 30N

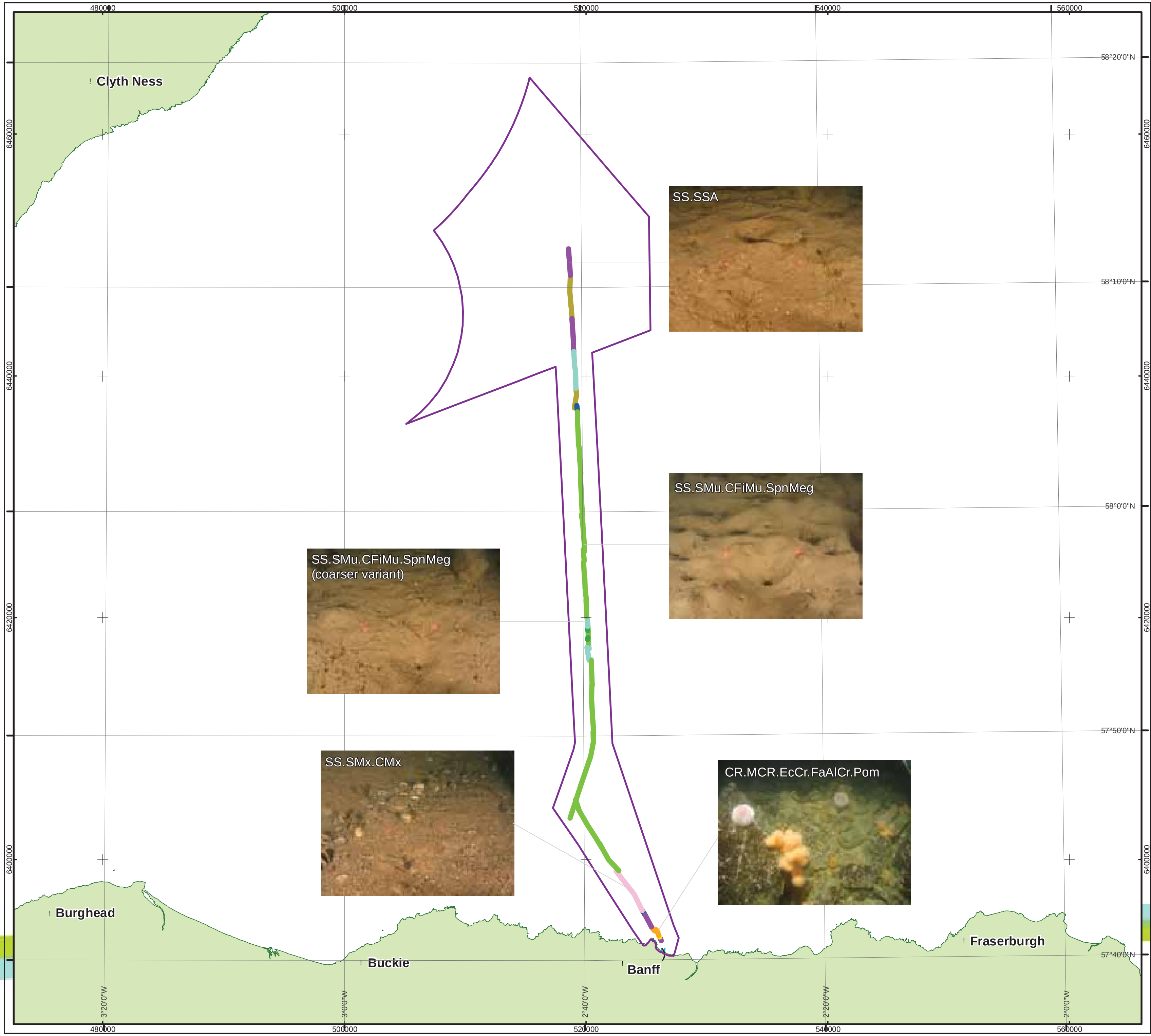
Produced: IMR
Reviewed: ES
Approved: CR

Date: 13/06/2014 Revision: A

REF: 8460001-PSO0131-EMU-MAP-008

Figure 2.1
Benthic Sampling Array

Moray Offshore
Renewables Ltd



Moray Offshore Renewables Ltd

KEY

- Modified OfTI
- Cable Route Landing Site

Biotopes

- CR.MCR.EcCr.FaAlCr.Pom
- CR.MCR.EcCr.FaAlCr.Pom (sheltered shore variant)
- SS.SMu.CFiMu.SpnMeg
- SS.SMu.CFiMu.SpnMeg (coarser variant)
- SS.SMu.CFiMu.SpnMeg with SS.SMx.CMx
- SS.SMx.CMx
- SS.SMx.CMx (with SSA)
- SS.SSA
- SS.SSA with areas of SS.SMx.CMx

Horizontal Scale: 1:300,000 A3 Chart

0 5,000 10,000 Metres

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: IMR
Reviewed: ES
Approved: CR

Date: 13/06/2014 Revision: A

REF: 8460001-PSO0131-EMU-MAP-009

Figure 3.1
Biotopes

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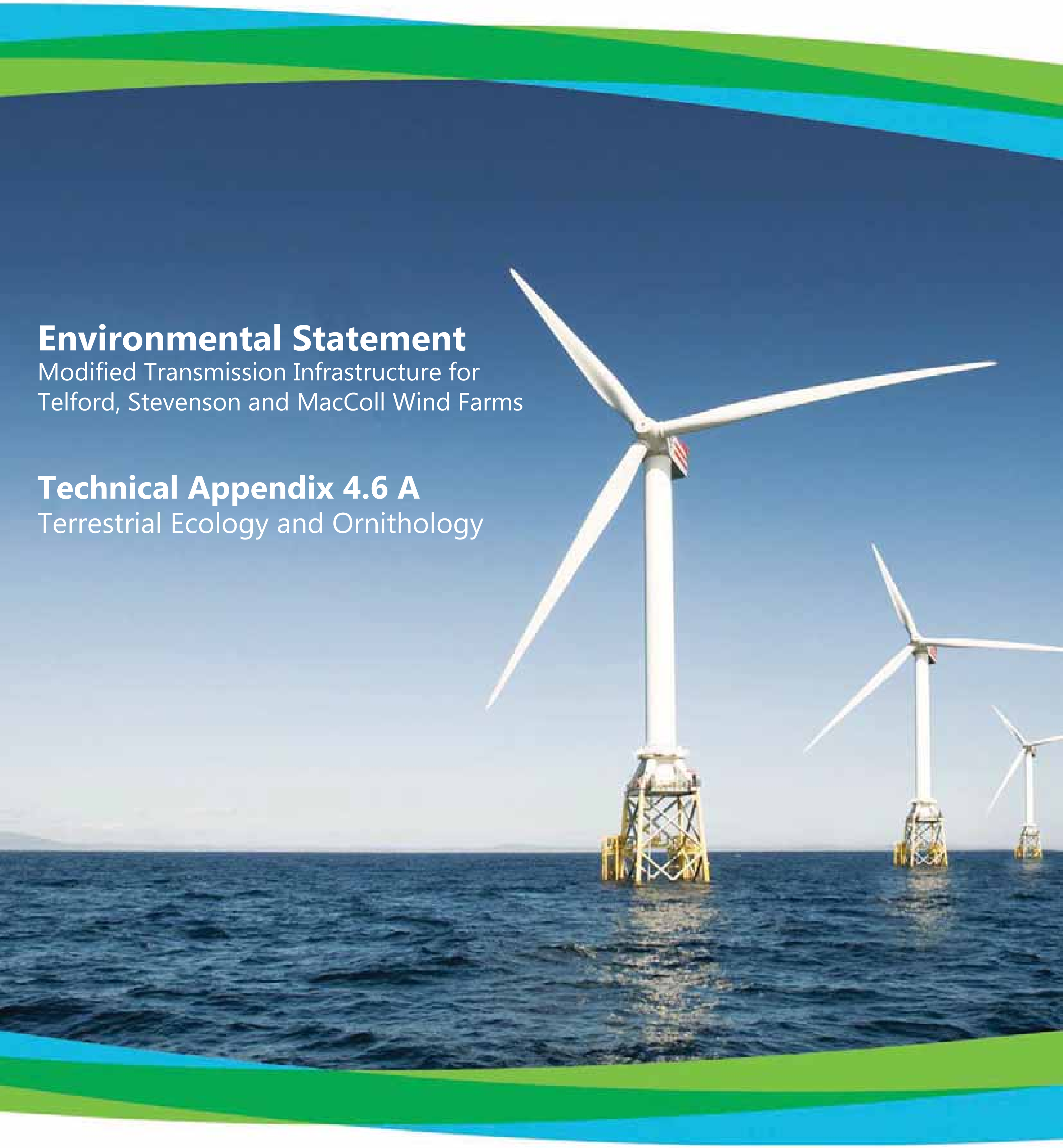
moray offshore renewables ltd

Developing Wind Energy In The Outer Moray Firth



Environmental Statement

Modified Transmission Infrastructure for
Telford, Stevenson and MacColl Wind Farms

Technical Appendix 4.6 A

Terrestrial Ecology and Ornithology

edp renewables

This document was produced by RPS on behalf of Moray Offshore Renewables Ltd

RPS

Document Owner		**RPS**			
Document Status		**Final**			
File Name		**Terrestrial Ecology and Ornithology Technical Appendix**			
Revision	**Date**	**Description**	**Originated By**	**Checked By**	**Approved By**
A1	14/06/2014	For Review	Tony Marshall / Stephen Lockwood	Martin Scott / Julia Ferguson	
A2	20/06/2014	For Review	Stephen Lockwood	Julia Ferguson	
A3	23/06/2014	Final	Stephen Lockwood		Peter Moore

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Table of Contents

1. Introduction

This Technical Appendix (TA) describes the terrestrial ecology and ornithology baseline conditions derived from desk studies and contemporary field surveys (2014) specifically associated with modified Onshore Transmission Infrastructure (OnTI) elements of the Telford, Stevenson and MacColl Offshore Wind Farms and Transmission Infrastructure Environmental Statement (ES). The following information is incorporated within this document:

- Baseline field survey methodology for winter walkover, breeding bird and coast line bird surveys;
- Baseline field survey methodology for Phase 1 Habitat, protected species, and bat roost and habitat suitability surveys,
- Baseline desk study results from Seabird 2000, British Trust for Ornithology (BTO) Wetland Bird Survey (WeBS), the North East Scotland Biological Record Centre (NESBReC), the Northeast Local Biodiversity Action Plan (NE LBAP) and the National Biodiversity Network (NBN);
- Baseline field survey results from winter walk over, breeding bird and coast line surveys of the modified OnTI; and,
- Baseline field survey results from Phase 1 Habitat surveys, protected species surveys, and bat roost and habitat suitability surveys of the modified OnTI.

Survey results detailing badger (*Meles meles*) sett locations are included within a separate Confidential Annex to the ES. All surveys and consultations have been guided by recognised best practice and through consultation with Scottish Natural Heritage (SNH) to ensure a comprehensive baseline is collated. A summarised account of all information included within this TA is provided in Chapter 4.6 –Modified Transmission Infrastructure ES.

2. Background

The potential route options of the modified OnTI cable route corridor can be seen in Figure 4.6-1. Route Option 1a (received 14.04.14) is the option surveyed for the purposes of this submission and includes the landfall location at Boyndie Bay (Inverboyndie), (NGR NJ 668647) approximately 1 km to the west of Banff. Refined Route Option 1b shown (Figure 4.6-1), is the newly proposed route (as of 27.05.14). This route has not yet been fully surveyed for ecology or ornithology receptors, however overlap exists between the two proposed corridors and the much of the route has been surveyed. An update to the baseline interests will be undertaken through June and July 2014, however given the generic nature of the habitat throughout the wider area, assessments made using the data collected are deemed to be valid between Route Options 1a and 1b.

Figure 4.6-1 also shows a previous iteration of the cable route running to the north of Route Options 1a and 1b which was surveyed through the 2013/14 winter period for birds of conservation concern and for areas suitable for feeding and/or roosting. This data, although not now associated with the proposed route options, gives an additional sub-set of information to assist as an overview of the area for the potential impacts associated with the development.

The onshore export cable will run in an approximately south-easterly direction, to link with an as yet unconstructed substation near New Deer, which will connect into a second adjacent substation. Route Option 1a covered approximately 28 km, whilst Option 1b covers approximately 33 km.

Areas crossed by the proposed modified OnTI are typical of the wider landscape, with the majority of the route traversing open farmland including a mixture of arable and pastoral fields. Scattered pockets of broadleaved and coniferous woodland are present along both route options, however, the proposed corridors have sought to minimise the impact to such habitats by deviating around these areas wherever practicable.

All the route options surveyed cross a number of watercourses, the majority of which are minor streams and tributaries draining the wider landscape. Only one major watercourse is required to be 'crossed' along the length of all route options; the River Deveron which, although is not designated within either EU or UK legislation, is known to contain populations of both salmon and sea-trout and is recognised as an important spawning ground for both species.

2.1 Conservation Designations

Eight conservation designations accompany species and habitat records throughout this report:

Habitats Directive

European Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive') was adopted in 1992 in response to the Bern Convention. This Directive is transposed into UK law by the Conservation of Habitats and Species Regulations 2010 (together with the Conservation (Natural Habitats, &c.) Regulations 1994). The Directive requires Member States to maintain habitats listed on Annex I at a favourable conservation status through the creation of a network of Special Areas of Conservation (SACs).

Birds Directive

The European Union meets its obligations for birds through Directive 2009/147/EC (the 'Birds Directive') on the conservation of wild birds (codified version of the European Council Directive 79/409/EEC as amended). This legislation was adopted in 1979 in response to increasing concern about declines in Europe's wild birds. The Directive emphasises the protection of habitat for endangered and migratory birds listed on Annex I through the creation of a network of Special Protection Areas (SPAs).

Conservation of Habitats and Species Regulations 2010

In Scotland, the Conservation of Habitats and Species Regulations 2010 (together with the Conservation (Natural Habitats, &c.) Regulations 1994) transpose the Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) into UK law. The Regulations protect European sites and European protected species (EPS). The Regulations make it an offence (subject to exceptions) to deliberately capture, kill, disturb, or trade in rare and endangered animals listed on Schedule 2.

Wildlife and Countryside Act 1981

The Wildlife and Countryside Act 1981 consolidates existing national legislation to implement the Bern Convention and Birds Directive in the UK. The Act received royal assent in 1981. It protects native species, controls the release of non-native species, enhances the protection of Sites of Special Scientific Interest (SSSIs) and builds upon rights of way rules. Special penalties are available for offences related to rare and endangered birds, listed on Schedule 1, and animals, listed on Schedule 5.

Birds of Conservation Concern

The population status of UK birds is reviewed every five years to provide an up-to-date assessment of conservation priorities. The 2009 review of Birds of Conservation Concern (BoCCs) (Eaton et al., 2009) allocated 246 species onto red, amber or green lists. Seven quantitative criteria were used to assess population status: global conservation status, recent decline, historical decline, European conservation status, rare breeders, localised species and international importance.

Protection of Badgers Act 1992

Badgers are protected by the Protection of Badgers Act 1992, which consolidates previous legislation. Under the Act, it is an offence to kill, injure or take a badger; dig for a badger; cruelly ill-treat a badger; possess or control a dead or live badger; damage or destroy a badger sett (obstruct access, cause a dog to enter the sett, or disturb a badger while it is occupying the sett). Licenses to undertake some actions can be issued from SNH if justified.

Scottish Biodiversity List

The Scottish Biodiversity List (SBL), published in 2005, is a list of flora, fauna and habitats which Scottish Ministers consider to be important for Scottish biodiversity conservation. The list was developed by a partnership of organisations, specifically, the Scottish Biodiversity Forum as well as the Scottish public. The criteria required for inclusion on the SBL include scientific as well as a social criterion of culturally important species and habitats based on a survey of the Scottish public. The list now includes all species previously included within the UK Biodiversity Action Plan (UK BAP) for Scotland, which UK wide has been superseded by the UK Post-2010 Biodiversity Framework (2012). The SBL supports Scotland's Biodiversity Strategy in relation to the wider aims of the current UK framework.

Northeast Local Biodiversity Action Plan Priority Habitats and Species

The NE LBAP aims to protect and enhance local biodiversity across Aberdeen, Aberdeenshire and Moray. Formed in 1996, it is a partnership of statutory and voluntary agencies and individuals. The NE LBAP develops Local Action Plans which set out measures to conserve priority habitats and species. Once published, plans are implemented and periodically reviewed.

3. Baseline Survey Methodology

3.1 Baseline Field Survey Management

Baseline field surveys were carried out from November 2013 to March 2014 for wintering birds on an initial indicative route option to the north of Route Option 1a and 1b (Figure 4.6-1). Surveys for breeding birds are currently on-going along the refined Route Option 1b and at the coastal landfall location at Inverboyndie, increasing the baseline data for the OnTI. Surveys assessing the terrestrial ecology were undertaken throughout May 2014, quantifying the use of the area by protected mammals, mapping habitats and assessing their potential to support bats.

The 'ecology survey area' for all work completed was defined as a 550 m wide band including a construction corridor and suitable buffer surrounding this. The total area surveyed equated to 13.5 km^2 of a total available survey area of 18.3 km^2; restricted access by a number of landowners during the survey period limited the total area able to be assessed in the field. Updates to these restricted areas and the baseline survey information will be included within the report to be submitted in summer 2014.

All data collected throughout the course of the field surveys was entered into relevant databases, digitised using ArcGIS Geographical Information Systems (GIS) software, where applicable, and quality assured using RPS in house audit systems.

3.2 SNH Guidance on Determining an Ecological Baseline

Consultation with SNH was conducted via a Scoping Report issued in April 2014, and a meeting on 9 May 2014 to discuss survey and assessment methodology and timescales for both ecology and ornithology. Following this consultation process, SNH issued the following advice on 23 May 2014:

- Adequate detail of the cable laying technique(s) should be provided so that potential impacts to sensitive species and habitats during the construction phase can be assessed;
- The route is not expected to impinge on any designated ornithological sites;
- Omission of winter bird surveys is acceptable given that the timeline for construction specifies that the winter months will be avoided;
- Additional breeding bird surveys should be carried out immediately prior to construction to identify nesting attempts, particularly those of Schedule 1 species;
- SNH are content with the proposed list of protected species surveys outlined in section 5.2.6 of the scoping report;
- In addition to the scoping response received following submission of the scoping report, SNH confirmed at the meeting in May that great crested newt survey work was not required;
- Relevant District Salmon Fishery Boards should be consulted regarding potential impacts to salmonids and other fish species at river crossings;
- Surveys for freshwater pearl mussels are not required provided adequate sediment management and pollution prevention plans are in place;
- SNH support the proposal to undertake Phase 1 surveys along the cable corridor route and buffer with the understanding that follow up National Vegetation Classification (NVC) work for important areas may be required. As set out in the scoping report, they also advise that this is also used to identify where protected species survey work is appropriate; and,
- Protected species pre-construction survey work revisiting the project footprint should be undertaken to ascertain any changes in the degree of wildlife activity as this could have implications for the level of mitigation required.

During the course of the May 2014 meeting SNH were informed of the timelines for submission and it was outlined that all surveys would not be completed by these dates; this is particularly the case for breeding bird surveys along the modified OnTI including the landfall location. SNH accepted that a report submitted following the initial ES submission would be appropriate for further detail of the findings of these surveys.

3.3 Baseline Desk Studies

The following organisations and data sources were contacted for relevant historical and contemporary species and habitat records:

- Joint Nature Conservation Committee (JNCC).
- BTO;
- North East Scotland Raptor Study Group (NESRSG);
- Royal Society for the Protection of Birds (RSPB);
- Deveron, Bogie and Isla Rivers Charitable Trust;
- District Salmon Fisheries Boards;
- NESBReC;
- Scottish Wildlife Trust (SWT);
- North East Scotland Bat Group;
- Saving Scotland's Red Squirrels (SSRS); and
- Botanical Society of Britain and Ireland (BSBI).

3.4 Field Survey Methodology

Winter Bird Surveys:

A total of three winter walkover survey visits were undertaken of the proposed substation location and wider area in November 2013 and February and March 2014, coupled with a single walkover survey of the original indicative route option in March 2014. Surveys sought to identify species of conservation concern and habitat which might be utilised by such species for foraging and/or through the winter period. Although this information has now been deemed by SNH as not required, it still provides useful additional background regarding the use of the area by such species.

Breeding Bird Surveys

At the time of writing, a single breeding bird survey visit had been completed. Two further surveys will be carried out in June and July 2014, with the results of these surveys being included in the report to be submitted in Summer 2014. The surveys have been (and will be) undertaken according to the Common Bird Census (CBC) methodology (Gilbert *et al*., 1998; Marchant, 1983). Surveys are carried out during periods of good weather (i.e. good visibility, no persistent rain or fog, avoiding excessive heat or cold or wind speeds exceeding Beaufort Force 4) from one hour before dawn to six hours after dawn. The location and behaviour of all birds are recorded directly onto 1:10,000 scale Ordnance Survey (OS) maps using standard BTO notation.

All records of birds are digitised using ArcGIS software and territory analysis will be carried out on completion of all surveys. Birds are assumed to be holding territory if one or more of the following behaviours are observed:

- Displaying or singing;
- Presence of a nest, eggs or young (including newly-fledged birds);

- Agitated behaviour, specifically, alarm calls or distraction display; and/or
- A territorial dispute.

In the absence of any of these behaviours, a pair observed together in suitable habitat is also considered to be holding a territory. Other records are considered to be non-breeding birds.

Coastal Bird Surveys

Coastal bird surveys were undertaken at the two locations (Inverboyndie and Sandend) investigated as potential point of landfall for Offshore Transmission Infrastructure (OfTI(+)) cables originating from the three consented wind farms. A landfall location has now been selected at Inberboyndie but the results of both survey locations have been reported here for context. A total of three survey visits are proposed to each location between May and July 2014. To date only the May surveys have been completed.

The survey area at each location includes the working corridor of the proposed cable route plus an additional 1 km buffer stretching east and west along the coast lines. The coast lines were buffered to a distance of 500 m offshore to include birds on the water or in flight above the sea, visible from land. Surveyors walked the coast within the survey area from west to east, mapping all waterbird species (defined by the BTO as all divers, grebes, cormorants, herons, wildfowl, waders, gulls and terns) on a 1:5,000 scale OS map which had a north-south grid of 250 x 250 m cells placed across it to improve accuracy. Standard BTO codes were used in recording birds, with notes of behaviour also made (e.g. roosting, loafing, foraging etc.).

Surveys were undertaken simultaneously at both locations to reduce the impact of confounding factors (e.g. weather conditions and tidal state) causing any potential bias in results.

Surveys were timed to be carried out across the survey programme at different times of the tidal cycle to ensure that all species and activities were captured. Surveys were timed as such:

- One survey commencing two hours prior to high tide;
- One survey commencing two hours prior to slack tide; and,
- One survey commencing two hours prior to low tide.

Phase 1 Habitat Surveys

Surveys of the modified OnTI were carried out across May 2014 with the purpose of defining Phase 1 Habitat type and extent across the 18.4 km^2 of the available ecology survey area. Surveys followed the standard JNCC (2010) guidelines.

The Phase 1 Habitat classification and associated field survey technique provides a relatively rapid system of recording semi-natural vegetation and other wildlife habitats. Each habitat type is defined by way of a brief description and is allocated a specific name, alpha-numeric code and unique mapping colour. The system has been widely used and continues to act as the standard technique for habitat survey across the UK.

The ecology survey area was walked, habitats were inspected and delineated directly onto 1:10,000 Ordnance Survey maps using standard alpha-numeric notation. Target notes (TNs) were made to highlight features of interest or any aspect too small to be mapped; these were supported by photos and GPS (Global Positioning System) coordinates. Target notes are referred to throughout the text and in figures by a sequential number prefixed with TN, e.g. TN18. Where designated conservation sites, areas of high biodiversity or peat in the superficial geology were encountered, these were mapped to National Vegetation Classification (NVC) level (Rodwell, 1991-2006; Rodwell, 2006)

Protected Species Surveys

Surveys were carried out across the OnTI throughout May 2014 in periods of suitable weather where heavy rainfall would not limit the quantity of field signs present across the survey area for each species.

Field evidence of the following protected species was searched for across the 18.4 km^2 of the accessible ecology survey area:

- Otter (*Lutra lutra*);
- Badger (*Meles meles*);
- Red squirrel (*Sciurus vulgaris*);
- Water vole (*Arvicola amphibious*);
- Pine marten (*Martes martes*); and
- Wild cat (Felis silvestris).

Otter

All safely accessible watercourses in the ecology survey area were searched for field evidence of otter. Evidence was recorded directly onto 1:10,000 Ordnance Survey maps. Photos and GPS coordinates were taken to support recordings made on maps. Otter field evidence recorded is as described by Bang and Dahlstrøm (2001) and SNH (2008):

- **Holts**: these are underground features where otters live. They can be tunnels within bank sides, underneath root plates or boulder piles, and even man-made structures such as disused drains. Holts are used by otters to rest during the day and are the usual site of natal or breeding sites. Otters may use holts permanently or temporarily;
- **Couches**: these are above-ground resting sites. They may be partly sheltered or fully exposed. Couches may be regularly used, especially in reedbeds and on in-stream islands. They have been known to be used as natal and breeding sites. Couches can be very difficult to identify, sometimes consisting of no more than an area of flattened grass or earth, and are best identified by the presence of other field evidence (e.g. spraints). Where rocks or rock armour are used as couches, these can be almost impossible to identify without observing the otter in-situ;
- **Feeding evidence**: the remains of prey items may be found at preferred feeding stations. Remains of fish, crabs or skinned amphibians can indicate the presence of otter;
- **Spraints**: otter faeces can be used to mark territories, often on in-stream boulders. They can be present within or outside the entrances of holts and couches. Spraints have a characteristic smell and often contain fish remains;
- **Prints**: otters have characteristic footprints that can be found in soft ground and muddy areas;
- **Paths**: these are terrestrial routes that otters take when moving between resting sites and watercourses, or at high flow conditions when they will travel along bank sides in preference to swimming; and
- **Slides and play areas**: slides are typically worn areas on steep slopes where otters slide on their bellies, often found between holts/couches and watercourses. Play areas are used by juvenile otters in play, and are often evident by trampled vegetation and the presence of slides. These are often positioned in sheltered areas adjacent to the natal holt.

Badger

All suitable habitat in the ecology survey area was searched for field evidence of badger. Evidence was recorded directly onto 1:10,000 Ordnance Survey maps. Photos and GPS coordinates were taken to support any recordings made. Badger field evidence recorded is as described by Neal and Cheeseman (1996), Bang and Dahlstrøm (2001) and SNH (2001):

- **Setts**: entrances are typically wider than they are tall with a flattened bottom. Widths vary dependent on use, however are on average approximate 30 cm. The number of entrances to a sett is dependent on the underground size amount of use a sett receives. Numbers of entrances can be used to classify the type of sett at a particular location;
- **Spoil heaps**: these are heaps of earth excavated by badgers. Material is often coarse due to badgers' large paws and claws, and heaps may contain scratched rocks, badger remains or hairs. Spoil heaps outside entrances of a well-established sett can be very large, and often have a well-defined furrow or groove from sett entrance to spoil heap;
- **Foraging signs**: badgers often dig 'snuffle holes' for worms or soil-dwelling grubs. These are typically conical in shape, 10-15 cm across, with material dug out on more than one side. Badgers also occasionally dig up wasps' and bees' nests in late summer;
- **Latrines**: these are small pits similar to snuffle holes which contain badger faeces. Faeces can be soft and muddy in appearance, or contain wing cases of insects, husks of grain or stones/pips of berries. Latrines are often, though not always, found close to setts and can comprise one to more than a dozen pits. Importantly, they are also used as territorial boundary markers;
- **Prints**: badger prints are very distinctive, with a broad, kidney-shaped pad and five toes lined up at the front. Fore prints (4.5-6.5 cm across) are larger than hind prints (4.0-5.0 cm across), and the imprints of claw ends are further away from the toes on fore prints as the claws are much longer;
- **Runs**: well-used badger runs are often very conspicuous. Runs typically link between sett entrances, or lead away from a sett towards foraging grounds or other setts. They can also be found well away from setts, often where badgers cross roads or go through gaps beneath fences;
- **Scratching posts**: setts often have one or more scratching posts nearby, the bark on the trees will be scored, shredded or completely removed up to a height of 1 m; and
- **Hair**: these are white or whitish with a black band towards the tip. They are 7-10 cm long, the black band is 1-2 cm and the white tip is about 1 cm, they are quite coarse and oval in cross-section. Hairs are often found stuck in brambles or barbed wire fences.

Red Squirrel

All suitable habitat in the ecology survey area was searched for field evidence of red squirrels. Evidence was recorded directly onto 1:10,000 Ordnance Survey maps. Photos and GPS coordinates were taken to support recordings made on maps. Red squirrel field signs are described in Gurnell *et al.* (2009) and evidence includes:

- **Feed signs** – Pine cones stripped of all seed leaving the remaining core;
- **Feeding stations** – Often stumps in forestry or open areas where a collection of stripped cones are present; and,
- **Dreys** – round ball / nest like structures, usually c.30 cm in diameter situated close to the stem / truck of a tree. Note, there is no discernable difference between red and grey squirrel dreys.

Sightings of individuals is the most reliable determinate of species presence.

Watervole

All suitable habitat in the ecology survey area was searched for field evidence of water vole. Evidence was recorded directly onto 1:10,000 Ordnance Survey maps. Photos and GPS coordinates were taken to support recordings made on maps. Water vole field evidence includes:

- **Burrows:** these are wider than they are tall, 4-8 cm across and usually surrounded by characteristic grazed 'lawns'. There may be droppings near burrow entrances, but no spoil heaps;
- **Feeding stations:** these are often located along runs or haul-out platforms at the water's edge. At the base of vegetation, they consist of neatly clipped stems of grass, sedge or rush up to 10cm long with grooved teeth marks at the cut ends;
- **Latrines:** these are typically found at prominent points along watercourses such as flat stones or bare earth. They contain lozenge-shaped droppings, approximately 8-12 mm long and 4-5 mm wide. Fresh droppings are greenish, changing to black when older;
- **Prints:** these are star-shaped, although hard to tell apart from prints of brown rat; and,
- **Runs:** these usually occur within 3 m of a watercourse. They are low tunnels pushed through vegetation, 5-9 cm across and branching, linking the watercourse with feeding areas and burrow entrances.

Pine Marten

All suitable habitat in the ecology survey area was searched for field evidence of pine marten. Evidence was recorded directly onto 1:10,000 Ordnance Survey maps. Photos and GPS coordinates were taken to support recordings made on maps. Pine marten field evidence includes:

- **Scats:** these vary greatly depending on diet but tend to be dark in colour with a coiled or twisted appearance. They are usually 4-12 cm long and 0.8-1.8 cm in diameter. Scats are reported to have a fruity smell often likened to parma violets. Pine marten use scats to mark territory and will often leave scats inside or close to dens;
- **Dens:** tend to be found in well wooded areas with lots of cover. Dens can be found in a variety of locations including elevated tree hollows, under fallen trees in the root ball and in rocky cairns; and,
- **Prints:** pine marten have 5 toes though often only 4 will show in the imprint. Paw imprints are between 40 and 65 mm in diameter.

Wildcat

All suitable habitat in the ecology survey area was searched for field evidence of wildcat. Evidence was recorded directly onto 1:10,000 Ordnance Survey maps. Photos and GPS coordinates were taken to support recordings made on maps. Wild cat field evidence includes:

- **Scats:** usually black or dark brownish-green when fresh, become a dry, light green-grey with age. Roughly cylindrical in shape, 15 mm diameter and 40-80 mm long, but may be formless depending on diet. Wildcat scats can be difficult to separate from those of domestic cats;
- **Claw marks:** left on trees to act as territory markers. Similar scratch marks are also left by badgers and domestic cats;
- **Paw prints:** again, similar to those of domestic cats. Footprint has 4 toes, a 3-lobed main pad and no claw marks as these will be retracted when walking; and
- **Dens:** wildcats den in a variety of locations including hollow trees, rock crevices, rabbit burrows, disused badger setts or fox earths.

Bat Roost and Habitat Suitability Survey

This survey was carried through May 2014 in conjunction with the Phase 1 Habitat survey covering the 18.4 km^2 of the ecology survey area. As surveyors walked the ecology survey area recording Phase 1 Habitats, habitats were also considered for their potential suitability to support roosting, foraging or commuting bats. Surveyors categorised habitats to be of high, medium or low suitability based on roosting, foraging or commuting suitability criteria (Table 1). Thus, potential bat roosts (buildings, bridges, mature trees), commuting routes (linear features such as hedgerows and lines of trees) and foraging habitat (water bodies, marshy grassland, cow fields) were classed to be of low, medium or high value. Photos, target notes and GPS coordinates were taken to support recordings made on maps.

Habitat suitability was digitised using ArcGIS software and overlain onto aerial imagery. Interpretation notes were made based on the target notes and habitat suitability. A future, targeted baseline field survey for bats was then recommended should these habitats be affected by the OnTI construction works.

Table 1. Bat habitat suitability criteria

Potential habitat suitability	Roosting habitat	Foraging habitat	Commuting habitat
High	Woodlands: any trees with roost potential – cracks, crevices and other gaps. Diverse choice of roosts. Caves, tunnels, mines and ice houses with humid atmospheres and sheltered, stable temperature conditions. Low disturbance.	High insect abundance. Native woodland, trees and hedgerows offering abundant shelter and diverse edge habitat. Slow flowing or still freshwater features with sheltered, vegetated edges. Low disturbance from lighting, pollutants and human activity. Pasture fields with cows.	Continuous, unbroken linear features (with little or no artificial lighting present) providing shelter and/or foraging opportunities and connectivity with other landscape features including roosting and foraging habitat. Includes treelines, woodland edge, hedgerows, waterways, walls, woodland tracks, road and drainage networks and buildings.
Medium	Roost sites and access points in cracks, crevices and gaps present, but not ideal due to size, disturbance, exposure.	Moderate insect abundance. Native woodland, trees and hedgerows offering some shelter and edge habitat. Fast flowing freshwater features offering some sheltered edges.	Partly discontinuous features offering some shelter and/or foraging opportunities. Continuous features with some form of artificial lighting.
Low	No suitable roost sites or access points visible. Less than one tree in 100 has roost potential due to age or species. High disturbance. Direct lighting on features.	Coniferous woodland, improved agriculture and built-up areas with low plant diversity and/or insect abundance. Lack of shelter, poorly connected to roost sites and commuting routes. High disturbance levels from lighting, pollutants and human activity.	Discontinuous features offering no shelter and/or isolated from potential roosting and/or foraging areas. Abundant artificial lighting.

Field Survey Limitations

The timing of submission of this document has not allowed for a full suite of surveys to be completed in relation to the ornithological interests of the modified OnTI. Similarly, access restrictions at the time of the surveys (April / May 2014) has meant that 6.1 km^2 of Route Option 1a was unable to be included within both ecology and ornithology surveys.

The data presented within this document has assessed proposed Route Options 1a. Refinement of the modified OnTI route to Route Option 1b occurred during the survey period, and consequently some sections of the finalised Route Option 1b have not been directly assessed in this report, However, for the purposes of this document and the assessments made within the ES Chapter, despite data for the modified OnTI being incomplete, given the largely homogenous nature of the majority of the landscape through which the assessed options pass, this is not deemed to affect the robustness of any assessment made. Habitats surveyed to date are typical of the wider landscape. This is of particular importance for the breeding bird surveys as, although data collected and presented for the first breeding bird survey visit (April / May 2014) might not assess the refined Route Option 1b it will provide an assessment of the species present in the area which may be affected by the development. Given that construction is not proposed to commence until 2016, and that SNH have requested that a full suite of surveys be conducted prior to construction commencing, all data collected in 2014, whether along the finalised route or in proximity to it, is suitable for assessing possible effects to all species of conservation concern throughout the area.

4. Baseline Survey Results

4.1 Desk Study Results

Coastal Birds Results

Seabird 2000

Seabird 2000 is a complete census of the entire breeding seabird population of Great Britain and Ireland. It was coordinated by the JNCC in partnership with other organisations such as SNH and RSPB. Beginning in 1998 and completed in 2002, Seabird 2000 counted over 8 million breeding seabirds at 3,300 coastal colonies, 900 inland colonies and 170 islands.

Relevant seabird breeding colony records within 3km of the two landfall points considered in the early stages of development prior to the final selection of Inverboyndie were sought from Seabird 2000. Records were received for colonies at five locations (Table 2).

Table 2. Seabird 2000 seabird breeding colony records

Location	Approximate Distance to Sandend Bay Landfall (km)	Approximate Distance to Inverboyndie Landfall (km)	Species	Number of occupied nests
Banff town	13	2	Herring gull	33
Macduff town	15	4	Herring gull	25
Findlater	2	13	Fulmar	123
			Great black-backed gull	2
			Herring gull	115
			Kittiwake	104
Garron Point	1	12	Fulmar	61
			Great black-backed gull	3
			Herring gull	720
			Kittiwake	211
			Shag	27
Redhythe Point	2	10	Fulmar	13
			Great black-backed gull	4
			Herring gull	137
			Kittiwake	198
			Shag	13

Wetland Bird Survey (WeBS)

WeBS is a joint scheme coordinated by the BTO, RSPB and JNCC in association with the Wildfowl and Wetlands Trust (WWT). The scheme monitors non-breeding waterbird populations across the UK to provide a scientific basis for their conservation. The records received from WeBS are ‘core counts’. Core counts are coordinated for approximately 2,500 coastal and inland wetland sites throughout the UK. Counts are made monthly, for a range of species, throughout the year.

Relevant wetland bird count data were sought from the WeBS survey area in the Deveron Estuary (Table 3). The estuary at its closest point (southern end) is approximately 1.1 km from the modified OnTI.

Table 3. WeBS wetland bird count data for the Deveron Estuary count site, three year period from May 2007 to November 2010 (species for which mean peak monthly count across five years is <1 are not presented, 'unidentified gull' also not presented)

Bird species (alphabetical order)	Peak monthly count per year									Mean peak monthly count across 3 years
	May 2007-March 2008			January 2009-February 2009			October 2009-December 2010			
	Peak count	Month	Number of counts on which recorded (out of 9)	Peak count	Month	Number of counts on which recorded (out of 2)	Peak count	Month	Number of counts on which recorded (out of 10)	
Arctic tern	4	May	1	-	-	-	-	-	-	1.3
Bar-tailed godwit	-	-	-	-	-	-	3	Jan	2	1
Black-headed gull	18	Feb	5	-	-	-	54	Mar	8	24
Common gull	-	-	-	-	-	-	20	Oct (2009)	2	6.7
Cormorant	5	Aug	8	6	Jan	1	120	Nov (2009)	9	43.7
Curlew	1	Oct	1	3	Jan	1	16	Dec	9	6.7
Dunlin	1	Dec	1	-	-	-	-	-	-	0.3
Eider	13	Feb	4	2	Jan	2	23	Feb	9	12.7
Goldeneye	16	Nov	6	7	Feb	2	8	Apr	2	10.3
Goosander	5	Oct	6	1	Jan & Feb	2	-	-	-	2
Great black-backed gull	153	Oct	8	16	Jan	2	300	Jan	9	156.3
Great northern diver	-	-	-	-	-	-	2	Jun	2	0.7
Grey heron	10	Feb	8	1	Jan	1	5	Apr	4	5.3
Herring gull	1,000	Nov	9	300	Jan	2	1,351	Nov (2009)	9	883.7
Iceland gull	-	-	-	1	Feb	1	-	-	-	0.3
Lapwing	-	-	-	-	-	-	12	Mar	1	4
Long-tailed duck	-	-	-	3	Feb	1	1	Mar	1	1.3
Mallard	107	Nov	9	44	Jan	1	4	Apr	2	51.7
Mute swan	1	May, Sep, Nov & Jan	4	-	-	-	1	May	1	0.7
Oystercatcher	28	Feb	9	14	Jan	1	63	Jan	9	35
Pink-footed goose	-	-	-	-	-	-	3	May	1	1
Purple sandpiper	-	-	-	-	-	-	3	Nov (2009 & 2010) & Mar	3	1
Red-breasted merganser	2	Mar	1	-	-	-	4	Oct (2009), Jan, Feb & Jun	4	2
Redshank	108	Dec	7	30	Jan	1	63	Nov (2009)	10	67
Red-throated diver	-	-	-	-	-	-	1	Nov (2010)	1	0.3
Sanderling	-	-	-	-	-	-	2	May	1	0.3

Bird species (alphabetical order)	Peak monthly count per year									Mean peak monthly count across 3 years
	May 2007-March 2008			January 2009-February 2009			October 2009-December 2010			
	Peak count	Month	Number of counts on which recorded (out of 9)	Peak count	Month	Number of counts on which recorded (out of 2)	Peak count	Month	Number of counts on which recorded (out of 10)	
Shag	-	-	-	4	Jan	1	43	Nov (2009)	7	15.7
Turnstone	3	Dec	2	-	-	-	28	Nov (2009)	6	10.3
Velvet scoter	2	Mar	1	-	-	-	-	-	-	0.7

Corn Bunting Results

Corn bunting is a red-listed BoCC, listed on the SBL, and noted as a NE LBAP priority species. The species is a scarce resident breeder in north east Scotland where it is at the northern extremity of its breeding range. There are an estimated 550-600 corn bunting territories in Aberdeenshire and Moray. This number comprises 64% of the Scottish population and 6% of the UK population. The northeast Scotland population has declined significantly in the past two decades. Most birds occur in the Buchan plain of Aberdeenshire, now the Scottish stronghold for the species, in several hotspots between Rattray and Rosehearty. Here, densities can reach 21 males/km^2 and the hotspots are therefore among the most densely populated areas of corn bunting in the UK (Francis and Cook, 2011). Extensive conservation work is being undertaken across Aberdeenshire to benefit this declining species (www.rspb.org.uk/ourwork/projects).

Corn buntings occur in open, lowland arable and mixed farmland. Nests are built on the ground within crops or in dense, grassy vegetation. The following nesting habitats are favoured (Forrester et al., 2007):

- Cereals;
- Set-aside;
- Improved grassland (ungrazed);
- Unimproved grassland (ungrazed);
- Brassica crops;
- Pea crops;
- Bean crops;
- Linseed crops; and
- Bulbs.

The following winter feeding habitats are favoured (Forrester et al., 2007):

- Cereal stubbles;
- Oilseed rape stubbles;
- Livestock feed sites;
- Grain spills;
- Unharvested crops; and
- Newly sown spring cereals.

Corn buntings typically rear two broods per year, first clutches are laid from late-May and second clutches are laid as late as mid-August, thus chicks can still be in the nest well into September (Forrester et al., 2007). Early nests are usually built in autumn-sown cereals or grass managed for silage and later nests in spring-sown cereals. The chick diet is centred on insects (Francis and Cook, 2011).

Corn buntings are broadly sedentary and form flocks from late-October to early-May. In winter the flocks sometimes move locally when deep snow or ploughing of stubble reduces food supplies. The species has very similar breeding and winter distributions (Forrester et al., 2007).

RSPB were consulted (31.08.11) to provide any relevant information on corn bunting presence. No additional consultation was sought with the RSPB regarding the species (Table 4).

Table 4. RSPB corn bunting consultation

Organisation	Consultation response
Hywel Maggs, Conservation Officer for Northeast Scotland, and Kathleen Sinclair, Assistant Conservation Officer for Northeast Scotland, both RSPB	Hywel Maggs confirmed Aberdeenshire was remaining UK stronghold for the species. He agreed that potential construction impacts on the species would be low and of a temporary nature. It was verified that there is no ideal season for construction as corn bunting are present all year round (31 August 2011).

Raptors

At the time of submission of this Technical Appendix, no response had been returned from the NESRSG

Protected Habitats and Species

The following section details the records received from relevant recording bodies regarding protected species and habitat present within 2 km of the modified OnTI. A summary of these can be seen in Table 5 below within details of records received from NESBReC in tables 6 to 8 and the Botanical Society of Britain and Ireland (BSBI) in Table 9 below.

Table 5. Recording bodies consultation responses

Organisation	Consultation response
Deveron, Bogie and Isla Rivers Charitable Trust	Awaiting response at the time of writing.
District Salmon Fisheries Boards	Directed to the Deveron, Bogie and Isla Rivers Charitable Trust. Awaiting response at the time of writing.
NESBReC	Provided data on protected habitats and species within the data search area. Tables 6 to 8.
Saving Scotland's Red Squirrels (SSRS)	Advised that all their records are available on NBN Gateway.
SWT	Provided a shapefile containing all SWT reserves and protected species records from the data search area.
North East Scotland Bat Group	Advised that all their records are held by NESBReC.
Botanical Society of Britain and Ireland (BSBI)	Records of IUCN red listed species and those present on the SBL received for a 2km buffer surrounding route option 1. Table 9 below.

North East Scotland Biological Records Centre (NESBReC)

Relevant bird, plant, mammal and fish records within the modified OnTI were sought from the NEBReC. A total of 21 bird species were returned by NEBReC (excluding green-listed birds of conservation concern which do not have other conservation designations associated with them). These are presented showing their associated conservation designations (Table 6). Eight mammal species were found, these are also presented showing their associated conservation designations (Table 7). Fifty-one plant species of conservation concern were returned and these are similarly presented with their associated conservation designations (Table 8).

Table 6. Records of Protected Bird Species within 2 km of the modified OnTI

Species	Annex I of Birds Directive	Schedule 1 of Wildlife and Countryside Act
Barn owl		✓
Barnacle goose	✓	
Black-throated diver	✓	✓
Brambling		✓
Common tern	✓	

Species	Annex I of Birds Directive	Schedule 1 of Wildlife and Countryside Act
Goldeneye		✓✓(Part II only)
Golden plover	✓	
Hen harrier	✓	✓
Kingfisher	✓	✓
Merlin	✓	✓
Osprey	✓	✓
Peregrine falcon	✓	✓
Purple sandpiper		✓
Red-throated diver	✓	✓
Redwing		✓
Ruff	✓	✓
Sandwich tern	✓	
Short-eared owl	✓	
Snow bunting		✓
White-tailed eagle	✓	✓
Whooper swan	✓	✓

Table 7. Records of Protected Species (Excluding Birds) within 2 km of the modified OnTI

Mammal and fish species (alphabetical order)	Conservation designation					Grid square presence
	Schedule 2 of Conservation of Habitats and Species Regulations 2010 (European protected)	Schedule 5 of Wildlife and Countryside Act 1981 (UK-protected)	SBL	NE LBAP priority species	Protection of Badgers Act 1992	
Badger	-	-	✓	-	✓	NJ56, NJ66, NJ74, NJ 75,
Chiroptera	✓	-	-	-	-	NJ56, NJ66
Otter	✓	✓	✓	Species Action addressed through relevant Habitat Action Plan	-	NJ56, NJ65, NJ66, NJ74, NJ75, NJ84
Pipistrellus	✓	-	-	-	-	NJ56, NJ65, NJ66, NJ85
Common pipistrelle	✓	-	✓	Species Action addressed through relevant Habitat Action Plan	-	NJ75
Brown long-eared. *(Plecotus auritus)*	✓	-	✓	-	-	NJ85
Red squirrel	-	✓	✓	Dedicated Species Action Plan	-	NJ56, NJ66, NJ75, NJ76, NJ84, NJ85
Water vole	-	✓	✓	Dedicated Species Action Plan	-	NJ74, NJ84,

Table 8. Records of IUCN Red Listed and SBL listed species recorded by the NESBReC as present within 2 km of the modified OnTI

Taxa	IUCN Red Listed	SBL Listed
Alopecurus myosuroides		✓
Anagallis arvensis		✓
Arabis alpine		✓
Astragalus danicus	✓	✓
Brassica oleracea		✓

Taxa	IUCN Red Listed	SBL Listed
Campanula glomerata		✓
Carex maritime	✓	✓
Carum carvi	✓	✓
Centaurea cyanus		✓
Chelidonium majus	✓	✓
Chenopodium bonus-henricus	✓	✓
Cichorium intybus		✓
Coeloglossum viride	✓	
Coronopus squamatus		✓
Diphasiastrum complanatum		✓
Draba incana		✓
Euphorbia helioscopia		✓
Fallopia convolvulus		✓
Filago vulgaris		✓
Galeopsis speciosa	✓	✓
Gentianella campestris	✓	✓
Gnaphalium sylvaticum	✓	✓
Hyoscyamus niger	✓	✓
Iberis amara	✓	
Juniperus communis		✓
Juniperus communis subsp. communis		✓
Linnaea borealis		✓
Lithospermum officinale		✓
Lolium temulentum	✓	
Mentha arvensis		✓
Mertensia maritima	✓	
Papaver argemone	✓	✓
Plantago media		✓
Platanthera bifolia	✓	✓
Pyrola media	✓	✓
Ranunculus arvensis	✓	
Ranunculus sardous		✓
Rosa tomentosa		✓
Salsola kali subsp. kali	✓	✓
Saxifraga hypnoides	✓	✓
Scandix pecten-veneris	✓	
Scleranthus annuus	✓	✓
Sherardia arvensis		✓
Silene noctiflora	✓	✓
Sinapis alba		✓
Sinapis arvensis		✓
Stachys arvensis	✓	✓
Teesdalia nudicaulis	✓	✓

Taxa	IUCN Red Listed	SBL Listed
Torilis nodosa		✓
Trifolium micranthum		✓
Viola tricolour subsp. tricolor	✓	✓

Botanical Society of Britain and Ireland

Plant records within the modified OnTI were sought from the BSBI. A total of 41 species were returned from the BSBI. These are presented showing their associated conservation designations (Table 9).

Table 9. Records of IUCN Red Listed and SBL listed species recorded by the BSBI as present within 2 km of the modified OnTI

Taxa	IUCN Red Listed	SBL Listed
Anagallis arvensis		✓
Astragalus danicus	✓	✓
Centaurea cyanus		✓
Cichorium intybus		✓
Cochlearia officinalis subsp. scotica		✓
Euphorbia exigua	✓	
Euphorbia helioscopia		✓
Euphrasia arctica subsp. borealis	✓	
Euphrasia confuse	✓	
Euphrasia foulaensis	✓	
Euphrasia micrantha	✓	
Euphrasia tetraquetra	✓	
Fallopia convolvulus		✓
Fumaria capreolata		✓
Gentianella campestris	✓	✓
Glebionis segetum	✓	
Gnaphalium sylvaticum	✓	✓
Hyoscyamus niger	✓	✓
Juniperus communis		✓
Juniperus communis subsp. communis		✓
Linnaea borealis		✓
Lithospermum officinale		✓
Mentha arvensis		✓
Mertensia maritima	✓	
Papaver argemone	✓	✓
Platanthera bifolia	✓	✓
Poterium sanguisorba		✓
Pyrola media	✓	✓
Radiola linoides	✓	
Salsola kali subsp. kali	✓	✓
Scandix pecten-veneris	✓	
Scleranthus annuus	✓	✓
Sherardia arvensis		✓
Silene noctiflora	✓	✓
Sinapis alba		✓
Sinapis arvensis		✓
Spergula arvensis	✓	
Stachys arvensis	✓	✓
Trifolium micranthum		✓
Viola canina	✓	
Viola tricolor subsp. tricolor	✓	✓

Scottish Biodiversity List and North East Local Biodivesity Action Plan

Priority habitats, birds and mammals most likely to occur along the length of the modified OnTI and surrounding area were sought from the SBL and NE LBAP. Twenty-five priority habitats (Table 10) and 48 priority bird and mammal species (Table 11) were found.

Table 10. SBL and NE LBAP priority habitats

Habitat type	NE LBAP priority/SBL habitat	NE Habitat Action Plan
Coastal		
Coastal sand dunes	SBL /NE priority	Coastal sand dunes and shingle
Coastal vegetated shingle	SBL /NE priority	Coastal sand dunes and shingle
Maritime cliff and slope	SBL/NE priority	Maritime cliff and slope
Coastal heath and shrub	Locally important	Coastal heath and scrub
Farmland and grassland		
Cereal field margins	SBL/NE priority	Farmland/field margins and boundary habitats
Arable and cultivated land	Locally important	Farmland
Boundary and linear feature including hedgerows	SBL/NE priority	Field margins and boundary habitats
Lowland meadow (neutral grassland)	SBL/NE priority	Species-rich grassland
Improved grassland	Locally important	Species-rich grassland
Woodland		
Lowland wood pastures and parkland	SBL/NE priority	Wood pasture, parkland and boundary trees
Lowland Birch woodland	Locally important	Broadleaved woodland
Scrub	Locally important	Broadleaved woodland
Wet woodland	NE priority	Wet and riparian woodland
Riparian woodland	Locally important	Wet and riparian woodland
Planted coniferous woodland	Locally important	Planted coniferous woodland
Bog		
Lowland raised bog	NE priority	Lowland raised bog
Blanket bog	NE priority	Blanket bog
Wetland and Freshwater		
Reedbeds	NE priority	Wetland
Fens	NE priority	Wetland
Coastal and floodplain grazing marsh	NE priority	Wetland
Fen, carr, marsh, swamp and reedbed	Locally important	Wetland
Rivers and burns	Locally important	Rivers and burns
Standing open water	Locally important	Lochs and ponds
Ponds	Locally important	Lochs and ponds
Urban		
Urban	Locally important	Urban areas

Table 11. NE LBAP priority birds and mammals

Species (alphabetical order)	Habitat type	NE Species Action Plan	
		Species action addressed through relevant Habitat Action Plan	Species with dedicated North East Species Action Plan
SBL Species			
Black grouse	Montane, heath and bog	✓	
Brown hare	Farmland and grassland	✓	

Species (alphabetical order)	**Habitat type**	**NE Species Action Plan**	
		Species action addressed through relevant Habitat Action Plan	**Species with dedicated North East Species Action Plan**
SBL Species			
Bullfinch	Woodland	✓	
Capercaillie	Woodland	✓	
Common scoter	Coastal and marine	✓	
Corn bunting	Farmland and grassland	✓	
Grey partridge	Farmland and grassland	✓	
Linnet	Farmland and grassland	✓	
Otter	Wetland and freshwater	✓	
Pipistrelle bat	Woodland	✓	
Red squirrel	Woodland		✓
Reed bunting	Wetland and freshwater, mountain, heath and bog	✓	
Scottish crossbill	Woodland	✓	
Skylark	Farmland and grassland	✓	
Song thrush	Woodland	✓	
Spotted flycatcher	Woodland	✓	
Tree sparrow	Woodland	✓	
Water vole	Wetland and freshwater		✓
UK species of conservation concern			
Arctic tern	Coastal and marine	✓	
Barn owl	Farmland and grassland	✓	
Bearded tit	Freshwater and wetland	✓	
Common tern	Coastal and marine	✓	
Crested tit	Woodland	✓	
Curlew	Coastal and marine	✓	
Daubenton's bat	Woodland/freshwater/farming and grassland		✓
Dotterel	Montane, heath and bog	✓	
Eider	Coastal and marine	✓	
Golden eagle	Montane, heath and bog	✓	
Golden plover	Montane, heath and bog	✓	
Goldeneye	Freshwater and wetland	✓	
Grasshopper warbler	Farming and grassland	✓	
Hen harrier	Montane, heath and bog	✓	
Kestrel	Montane, heath and bog	✓	
Lapwing	Farmland and grassland	✓	
Lesser redpoll	Woodland	✓	
Little tern	Coastal and marine	✓	
Redshank	Coastal and marine	✓	
Sandwich tern	Coastal and marine	✓	
Slavonian grebe	Coastal and marine	✓	
Snipe	Freshwater and wetland	✓	
Snow bunting	Montane, heath and bog	✓	
Spotted crake	Freshwater and wetland	✓	
Tree pipit	Freshwater and wetland	✓	

Species (alphabetical order)	Habitat type	NE Species Action Plan	
		Species action addressed through relevant Habitat Action Plan	Species with dedicated North East Species Action Plan
SBL Species			
Twite	Farming and grassland	✓	
Water rail	Freshwater and wetland	✓	
Water shrew	Freshwater and wetland	✓	
Yellowhammer	Farming and grassland	✓	
Locally important species			
Ptarmigan	Montane, heath and bog	✓	

National Biodiversity Network (NBN)

The NBN was formed in 2000 and is a partnership of many UK conservation organisations. Previously, there was a vast amount of biodiversity data gathered over the years by various organisations and individuals, held in various formats. Now, the NBN acts as a 'data warehouse' for a broad range of this biodiversity information.

Relevant bird, mammal and fish records within the modified OnTI were sought from the NBN. A total of 79 bird species were returned from the data search of the NBN (excluding green-listed birds of conservation concern which do not have other conservation designations associated with them). These are presented showing their six associated conservation designations (Table 12). Ten mammal species and one fish species were found, these are similiarly presented with their five associated conservation designations (Table 13).

Table 12. NBN bird records (in BNG NJ56, NJ65, NJ66, NJ74, NJ75, NJ76, NJ84, NJ85, and NJ94 squares)

Bird species (alphabetical order)	Conservation designation					
	Annex I of Birds Directive (European protected)	Schedule 1 of Wildlife and Countryside Act 1981 (UK-protected)	Red-listed Bird of Conservation Concern (BoCC)	Amber-listed Bird of Conservation Concern (BoCC)	SBL Listed Species	NE LBAP priority species
Barn owl		✓			✓	✓
Black guillemot				✓		
Black-headed gull					✓	
Brambling		✓			✓	
Bullfinch					✓	✓
Common crossbill		✓				
Common gull				✓		
Common sandpiper				✓		
Cuckoo			✓		✓	
Curlew				✓	✓	✓
Corn bunting			✓		✓	✓
Corncrake	✓	✓	✓			
Dunlin			✓		✓	
Dunnock				✓	✓	
Eider				✓		✓
Fieldfare		✓				
Fulmar				✓		
Gannet				✓		
Golden plover	✓			✓	✓	
Grasshopper warbler			✓		✓	✓

Bird species (alphabetical order)	**Conservation designation**					
	Annex I of Birds Directive (European protected)	**Schedule 1 of Wildlife and Countryside Act 1981 (UK-protected)**	**Red-listed Bird of Conservation Concern (BoCC)**	**Amber-listed Bird of Conservation Concern (BoCC)**	**SBL Listed Species**	**NE LBAP priority species**
Great black-backed gull				✓		
Green woodpecker				✓		
Grey partridge			✓		✓	✓
Grey wagtail				✓		
Greylag goose				✓		
Guillemot				✓		
Herring gull			✓		✓	
House martin				✓		
House sparrow			✓		✓	
Kestrel				✓	✓	✓
Kingfisher	✓	✓		✓	✓	
Kittiwake				✓		
Lapwing			✓		✓	✓
Lesser black-backed gull				✓		
Lesser redpoll			✓		✓	✓
Linnet			✓		✓	✓
Little egret	✓			✓		
Little grebe				✓		
Mallard				✓		
Meadow pipit				✓		
Mistle thrush				✓		
Oystercatcher				✓		
Pink-footed goose				✓		
Puffin				✓		
Quail		✓		✓		
Razorbill				✓		
Red grouse				✓	✓	
Red-backed shrike	✓	✓	✓		✓	
Redshank				✓		✓
Redwing		✓	✓		✓	
Reed bunting				✓	✓	✓
Ring ouzel			✓		✓	
Ringed plover				✓		
Sand martin				✓		
Sandwich tern	✓			✓	✓	✓
Shag				✓		
Shelduck				✓		
Short-eared owl	✓			✓	✓	
Skylark			✓			✓
Snipe				✓		✓
Song thrush			✓		✓	✓
Spotted flycatcher			✓		✓	✓
Starling			✓		✓	

Bird species (alphabetical order)	Conservation designation					
	Annex I of Birds Directive (European protected)	Schedule 1 of Wildlife and Countryside Act 1981 (UK-protected)	Red-listed Bird of Conservation Concern (BoCC)	Amber-listed Bird of Conservation Concern (BoCC)	SBL Listed Species	NE LBAP priority species
Stock dove				✓		
Swallow				✓		
Swift				✓		
Teal				✓		
Tree sparrow			✓		✓	✓
Tree pipit			✓		✓	✓
Tufted duck				✓		
Twite			✓		✓	✓
Wheatear				✓		
Whinchat				✓		
Whitethroat				✓		
Willow warbler				✓		
Woodcock				✓	✓	
Wood warbler			✓		✓	
Yellow wagtail			✓		✓	
Yellowhammer			✓		✓	✓

Table 13. NBN protected species records and the relevant BNG squares in which they have historically been recorded

Mammal species (alphabetical order)	Conservation designation					NBN grid square presence
	Schedule 2 of Conservation of Habitats and Species Regulations 2010 (European protected)	Schedule 5 of Wildlife and Countryside Act 1981 (UK-protected)	SBL	NE LBAP priority species	Protection of Badgers Act 1992	
Badger	-	-	✓	-	✓	NJ 94
Otter	✓	✓	✓	Species Action addressed through relevant Habitat Action Plan	-	NJ56, NJ65, NJ66. NJ75, NJ84, NJ94
Red squirrel	-	✓	✓	Dedicated Species Action Plan	-	NJ56, NJ65, NJ66. NJ74, NJ75, NJ76, NJ84, NJ85, NJ94
Water vole	-	✓	✓	Dedicated Species Action Plan	-	NJ74, NJ84, NJ85, NJ94
Pine marten	-	✓	✓	-	-	NJ56, NJ66, NJ75
Atlantic Salmon *(Salmo salar)*	-	-	✓	Species Action addressed through relevant Habitat Action Plan	-	NJ74, NJ85, NJ94
Common Pipistrelle *(Pipistrellus pipistrellus)*	✓	-	✓	Species Action addressed through relevant Habitat Action Plan	-	NJ75
Daubenton's *(Myotis daubentonii)*	✓	-	✓	-	-	NJ94
Soprano Pipistrelle *(Pipistrellus pygmaeus)*	✓	-	✓	Species Action addressed through relevant Habitat Action Plan	-	NJ85
Chiroptera	✓	-	-	-	-	NJ56, NJ65, NJ75, NJ84
Wild cat	✓	✓	✓	-	-	NJ75

5. Field Survey Results

5.1 Ornithological Surveys

Winter Bird Surveys

A total of nineteen bird species were recorded during the course of the winter walkover surveys (Table 14). Of these, four (long-tailed duck, red-throated diver, redwing and whooper swan) are listed on Annex I of the Birds Directive and on Schedule 1 of the Wildlife and Countryside Act 1981. In addition, golden plover, which is also listed on Annex I of the Birds Directive, was also recorded in November 2013 only. The majority of the remaining species were recorded in low numbers and/or infrequently. However, herring gull, starling, tree sparrow and yellowhammer, which are all red-listed BoCC, were all recorded in relatively high numbers (peak counts of 400, 594, 144 and 164, respectively).

Table 14. Species recorded during winter walkover surveys, including peak counts for each

Bird species (alphabetical order)	Conservation designation							
	Annex I of Birds Directive (European protected)	Schedule 1 of Wildlife and Countryside Act 1981 (UK-protected)	Red-listed Bird of Conservation Concern (BoCC)	Amber-listed Bird of Conservation Concern (BoCC)	SBL Listed Species	NE LBAP priority species	Peak count	Number of visits on which recorded
Corn bunting			✓		✓	✓	15 (Mar)	3
Dunnock				✓	✓		3 (Nov)	1
Golden plover	✓			✓	✓	✓	134 (Mar)	1
Greylag goose				✓			10 (Mar)	1
Herring gull			✓		✓		400 (Mar)	3
House sparrow			✓		✓		62 (Mar)	3
Lapwing			✓		✓	✓	20 (Feb)	2
Linnet			✓		✓	✓	53 (Apr)	3
Long-tailed duck		✓					2 (Mar)	1
Pink-footed goose		✓		✓			60 (Nov)	1
Red-throated diver	✓	✓		✓	✓			
Redwing		✓	✓		✓		1 (Apr)	1
Skylark			✓		✓	✓	96 (Mar)	3
Song thrush			✓		✓	✓	3 (Mar)	3
Starling			✓		✓	✓	594 (Nov)	3
Tree sparrow			✓		✓	✓	144 (Mar/Apr)	3
Twite			✓		✓	✓	11 (Nov)	1
Whooper swan	✓	✓		✓	✓	✓	1 (Mar)	1
Yellowhammer			✓		✓	✓	164 (Mar/Apr)	3

Breeding Bird Surveys

At the time of writing this Technical Appendix, breeding bird surveys are on-going, with a single visit currently completed along Route Options 1a. This survey included the route to the potential Sandend Bay landfall location which has since been scoped out. However, for the purposes of providing a breadth of data for the modified OnTI and the surrounding area, these results have been included within this report. Full results of the breeding bird surveys, including the results of territory analysis, will be provided within a report to be provided in July following submission of this ES including all results for refined Route Option 1b.

In summary, however, a total of 57 species were recorded during the first of the 2014 breeding bird surveys (Table 15). A single osprey, which is listed on Annex I of the Birds Directive and on Schedule 1 of the Wildlife and Countryside Act 1981, was observed flying overhead during this survey. In addition, two flocks of golden plover (numbering 120 and 28 birds), which are listed on Annex I, were also recorded flying high overhead. Six golden plover were also recorded on the ground but were not observed to be displaying any evidence of breeding. A total of 18 singing corn buntings were encountered. The remaining species are, in general, common and widespread. Figure 4.6-3 shows a summary of the corn bunting records recorded along Route Option 1a to the proposed landfall at Inverboyndie.

Table 15. List of species recorded to date (single visit) during breeding bird survey programme

Bird species (alphabetical order)	Conservation designation					
	Annex I of Birds Directive (European protected)	Schedule 1 of Wildlife and Countryside Act 1981 (UK-protected)	Red-listed Bird of Conservation Concern (BoCC)	Amber-listed Bird of Conservation Concern (BoCC)	SBL Listed Species	NE LBAP priority species
Blackbird						
Blackcap						
Blue tit						
Bullfinch					✓	✓
Buzzard						
Carrion crow						
Chiffchaff						
Chaffinch						
Coal tit						
Cormorant						
Curlew				✓	✓	✓
Corn bunting			✓		✓	✓
Dunnock				✓	✓	
Goldcrest						
Golden plover	✓			✓	✓	✓
Goldfinch						
Great spotted woodpecker						
Great tit						
Greenfinch						
Grey heron						
Greylag goose				✓		
Grey partridge			✓		✓	✓
Grey wagtail				✓		
Herring gull			✓		✓	
House sparrow			✓		✓	
Kestrel				✓	✓	✓
Lapwing			✓		✓	✓
Lesser redpoll			✓		✓	✓
Linnet			✓		✓	✓
Mallard				✓		
Magpie						
Meadow pipit				✓		
Osprey	✓	✓		✓	✓	
Oystercatcher				✓		

Bird species (alphabetical order)	**Conservation designation**					
	Annex I of Birds Directive (European protected)	**Schedule 1 of Wildlife and Countryside Act 1981 (UK-protected)**	**Red-listed Bird of Conservation Concern (BoCC)**	**Amber-listed Bird of Conservation Concern (BoCC)**	**SBL Listed Species**	**NE LBAP priority species**
Pheasant						
Pied wagtail						
Red-legged partridge						
Reed bunting				✓	✓	✓
Robin						
Rook						
Sand martin				✓		
Sedge warbler						
Siskin						
Sparrowhawk						
Skylark			✓			✓
Snipe				✓		✓
Song thrush			✓		✓	✓
Starling			✓		✓	
Stock dove				✓		
Swallow				✓		
Tree sparrow			✓		✓	✓
Wheatear				✓		
Whitethroat				✓		
Willow warbler				✓		
Wood pigeon						
Wren						
Yellowhammer			✓		✓	✓

Coastal Bird Surveys

At the time of writing this Technical Appendix, coastal bird surveys are on-going, with a single visit currently completed. Full results of these surveys will be presented within a report to be provided in July following submission of this ES.

A total of twenty species were recorded at the proposed Inverboyndie landfall option. These are shown in Table 16. Four species (great northern diver, red-throated diver, sandwich tern and whimbrel) are listed on Annex I, while six (common scoter, great northern diver, long-tailed duck, red-throated diver, whimbrel and white-billed diver) are listed on Schedule 1 of the Wildlife and Countryside Act 1981. White-billed divers are uncommon in British waters, with the area around Banff thought to be an important wintering ground for the species (Baxter *et al*., 2013). The likely effects on this species are considered in the Environmental Statement.

Table 16. List of species recorded to date at Inverboyndie landfall point option, including numbers of each present

Bird species (alphabetical order)	**Conservation designation**						
	Annex I of Birds Directive (European protected)	**Schedule 1 of Wildlife and Countryside Act 1981 (UK-protected)**	**Red-listed Bird of Conservation Concern (BoCC)**	**Amber-listed Bird of Conservation Concern (BoCC)**	**SBL Listed Species**	**NE LBAP priority species**	**Number recorded**
Common gull				✓			6
Common scoter		✓	✓		✓	✓	2
Eider				✓		✓	8
Gannet				✓			1
Great black-				✓			2

backed gull							
Great northern diver	✓	✓		✓	✓		1
Grey heron							1
Guillemot				✓			7
Herring gull			✓		✓		292
Kittiwake				✓			1
Long-tailed duck		✓					9
Oystercatcher				✓			14
Razorbill				✓			4
Red-throated diver	✓	✓		✓	✓		14
Ringed plover				✓			2
Sandwich tern	✓			✓	✓	✓	65
Shag				✓			7
Shelduck				✓			1
Whimbrel	✓	✓		✓			9
White-billed diver		✓					1

5.2 Phase 1 Habitat Surveys

Baseline field survey results show that the habitat within the modified OnTI comprises an intensively managed, open landscape of predominantly arable land and improved grassland, with a small number of built up areas present, particularly surrounding the landfall studied in the north. Pockets of both plantation and semi-nature woodland are present scattered along the length of the modified OnTI. A total of 23 Phase 1 Habitat types were recorded within the c.13.4 km^2 of the cable route corridor surveyed. Due to access restrictions at the time of the survey, a further c5 km^2 within the survey area was unable to be accessed. However, as previously mentioned within the limitation section, this is not thought to detract from the robustness of the survey given the largely homogenous nature of the habitats found, and the requirement for additional surveys to be completed prior to construction commencing in 2016.

Phase 1 Habitat results are presented below (Table 17) with three associated conservation designations considered to give the findings of the survey perspective in relation to the likely effects associated with the modified OnTI. Target notes recorded during the course of the survey highlighting areas of particular interest or importance are presented in Table 19.

Table 17. Phase 1 Habitats recorded within the Ecology Survey Area, their quantity and relevant conservation designation.

Phase 1 habitat	Potentially overlaps with Annex I of Habitats Directive (European protected)	Potentially overlaps with SBL habitat	Potentially overlaps with NE LBAP priority habitat	Total area surveyed within cable route corridor (ha)	Total % of cable route corridor surveyed (descending order)
Arable land	-	Arable field margins	Farmland Field margins and boundary habitats	943.93	51. 2
Improved grassland	-	Coastal and floodplain grazing marsh	Farmland Field margins and boundary habitats	122.50	6.7

Phase 1 habitat	Potentially overlaps with Annex I of Habitats Directive (European protected)	Potentially overlaps with SBL habitat	Potentially overlaps with NE LBAP priority habitat	Total area surveyed within cable route corridor (ha)	Total % of cable route corridor surveyed (descending order)
Semi-natural broadleaved woodland	-	Lowland mixed deciduous woodland Lowland wood-pastures and parkland Upland birchwoods Upland mixed ashwoods Upland oakwood Wet woodland	Wet and riparian woodland Wood pasture, parkland and wayside trees	67.40	3.7
Plantation coniferous woodland	-	-	-	47.26	2.6
Road	-	-	-	38.41	2.1
Marshy grassland	-	Lowland meadows Purple moor grass and rush pastures	-	32.91	1.8
Semi-improved neutral grassland	-	Lowland meadows	Farmland Field margins and boundary habitats	32.48	1.8
Bare ground	-	-	-	12.71	0.7
Amenity grassland	-	-	Urban areas	10.15	0.6
Buildings	-	-	Urban areas	6.70	0.4
Semi-improved acid grassland	-	Lowland dry acid grassland	Lowland dry acid grassland	5.57	0.3
Plantation broadleaved woodland	-	Lowland mixed deciduous woodland Lowland wood-pastures and parkland Upland mixed ashwoods Upland oakwood Wet woodland	Wood pasture, parkland and wayside trees	5.38	0.3
Dense/continuous scrub	-	Lowland mixed deciduous woodland Lowland wood-pastures and parkland	-	4.34	0.2

Phase 1 habitat	Potentially overlaps with Annex I of Habitats Directive (European protected)	Potentially overlaps with SBL habitat	Potentially overlaps with NE LBAP priority habitat	Total area surveyed within cable route corridor (ha)	Total % of cable route corridor surveyed (descending order)
		Upland birchwoods Upland mixed ashwoods Upland oakwood Wet woodland			
Tall ruderal herb and fern	-	-	Field margins and boundary habitats	2.70	0.1
Running water	-	Rivers	Rivers and burns	2.58	0.1
Wet modified bog	Degraded raised bogs still capable of natural regeneration	Blanket bog Lowland raised bog	Lowland raised bog	1.85	0.1
Quarry	-	-	-	1.56	0.1
Plantation mixed woodland	-	Lowland mixed deciduous woodland Lowland wood-pastures and parkland Upland birchwoods Upland mixed ashwoods Upland oakwood Wet woodland	Wood pasture, parkland and wayside trees	1.06	0.1
Standing water	Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea* Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.	Ponds Reedbeds Lakes	Wetland	0.92	0.1
Parkland – mixed trees	-	Lowland mixed deciduous woodland Lowland wood-pastures and parkland	Wood pasture, parkland and wayside trees	0.29	<0.1

Phase 1 habitat	Potentially overlaps with Annex I of Habitats Directive (European protected)	Potentially overlaps with SBL habitat	Potentially overlaps with NE LBAP priority habitat	Total area surveyed within cable route corridor (ha)	Total % of cable route corridor surveyed (descending order)
		Upland birchwoods Upland mixed ashwoods Upland oakwood Wet woodland			
Inland Cliff	-	Inland rock outcrop and scree habitat	-	0.18	<0.1
Semi-natural mixed woodland	-	Lowland mixed deciduous woodland Lowland wood-pastures and parkland Upland birchwoods Upland mixed ashwoods Upland oakwood Wet woodland	Wood pasture, parkland and wayside trees	0.04	<0.1
Scattered scrub	-	-	-	0.02	<0.1
Note: 1. No access was available to c.489 ha (26.7%)of the proposed route at the time of survey. 2. Other habitats not classified within the Phase 1 Habitat nomenclature occupied c.6.03 ha (0.3%)of the survey area. All such habitats were target noted recording the use of the area.					

Field boundaries and woodland edges form important linear features in otherwise open, homogonous landscapes such as the arable land and improved grassland within the modified OnTI. Native, species-rich hedgerows were widespread, comprising rowan (*Sorbus aucuparia*), silver birch (*Betula pendula*), hawthorn (*Crataegus monogyna*), hazel (*Corylus avellana*) and elder (*Sambucus nigra*). Fences, with or without hedgerows, were common, and small number of dry stone walls existed.

Phase 1 Habitats within the modified OnTI were summarised into the following habitat categories:

- Arable land and grassland, 61.8 %;
- Woodland, 6.7 %;
- Built-up areas, 4.1 %
- Scrub, tall herb and fern, 0.4 %
- Water and wetland features, 0.2 %;
- Mire, 0.1 %; and,
- Rock and quarry, 0.1%.

Key Phase 1 Habitats within these categories are summarised below along with additional target notes corresponding to features of interest/importance in Table 19. A visual representation of the mosaics of habitats present along the modified OnTI can be seen in Figure 4.6-5.

Arable Land and Grassland

The prevalence of this habitat category (61.8%) underscores the predominance of agriculture within the landscape of the modified OnTI. Arable land (51.2%) was the most widespread Phase 1 Habitat, comprising mostly barley, wheat, oilseed rape, oats, silage, potatoes and short-term grazing. Improved grassland (6.7%) was the second most widespread habitat. Marshy grassland (1.8%), semi-improved neutral grassland (1.8%) and semi-improved acid grassland (0.3%) comprised the remaining Phase 1 Habitats within this category.

Arable land and grassland within the modified OnTI potentially overlaps with six SBL habitats (arable field margins; coastal and floodplain grazing marsh; lowland meadows; lowland dry acid grassland; maritime cliff and slopes; and purple moor grass and rush pastures) and three NE LBAP priority habitats (farmland; and field margins and boundary habitats).

Woodland

The limited abundance of this habitat category (6.7%) reflects the openness of the landscape within the modified OnTI. Plantation woodland (3.0%) and semi-natural woodland (3.7%) are equally represented across the area. Plantation coniferous (2.6%), broadleaved (0.3%) and mixed (0.1%) woodland mainly occurred as commercial forestry blocks or shelter belts, or along roadsides and around farm buildings. Semi-natural broadleaved (3.7%) and semi-natural mixed (<0.1%) woodland mostly occurred as small, disconnected linear features. Woodlands were usually mature and comprised the following species: Sitka spruce (*Picea sitchensis*), lodgepole pine (*Pinus contorta*), Scots pine (*Pinus sylvestris*), silver birch, sycamore (*Acer pseudoplatanus*), pedunculate oak (*Quercus robur*), rowan, goat willow (*Salix caprea*) and wych elm (*Ulmus glabra*).

Woodland within the modified OnTI potentially overlaps with seven SBL habitats (lowland mixed deciduous woodland; wood-pastures and parkland; birchwoods; upland mixed ashwoods; upland oakwood; wet woodland; and native pinewoods) and two NE LBAP priority habitats (wood pasture, parkland and wayside trees; and wet and riparian woodland).

Built-up Areas

The low occurrence of this habitat category (4.1%) highlights the largely rural nature of the landscape within the modified OnTI. Roads were the most abundant feature in the category (2.1%), with buildings (0.4%), bare ground (0.7%), amenity grassland (0.6%) and ‘other’ areas(including parkland – mixed trees) (0.3%) contributing to the overall total land use for this category.

Built-up areas within the modified OnTI potentially overlap with one NE LBAP priority habitat; urban areas.

Scrub, Tall Herb and Fern

This category occupies approximately 0.4% of the total area surveyed. Tall ruderal herb and fern (0.1%) was found bordering linear features such as field boundaries and watercourses. Rosebay willow-herb (*Epilobium angustifolium*) was the most widespread species, alongside common nettle (*Urtica dioica*) and broadleaved dock (*Rumex obtusifolius*). Scattered (<0.1%) and dense/continuous (0.2%) scrub occurred on many field verges, along drainage ditches and among grazed fields. Common gorse (*Ulex europaeus*) was the most frequent species, with occasional rowan, goat willow and silver birch seedlings interspersed.

Scrub, tall herb and fern within the modified OnTI potentially overlaps with seven SBL habitats (lowland mixed deciduous woodland; lowland wood-pastures and parkland; native pinewoods; upland birchwoods; upland mixed ashwoods; upland oakwood; and wet woodland) and one NE LBAP priority habitat (field margins and boundary habitats).

Mire

Mire habitats accounted for only 0.1% of Phase 1 Habitats found within the modified OnTI, with only wet-modified bog habitat recorded and most closely matches the M15 *Trichophorum germanicum – Erica tetralix* wet heath commmunty.

This habitat potentially overlaps with three Annex I habitats (degraded raised bogs still capable of natural regeneration; blanket bog; and depressions on peat substrates of the Rhynchosporion), two SBL habitats (blanket bog and lowland raised bog) and two NE LBAP priority habitats (lowland raised bog; and wetland).

Water and Wetland Features

Due to issues surrounding lone working near water and also unstable, soft ground, surveys of water and wetland features were restricted to areas considered safe for lone access. Running water (0.1%) was common within the modified OnTI, however much of this was associated with small burns and tributaries draining the farmland to larger watercourses outwith the survey area. One main watercourse is present along the modified OnTI; the River Deveron which flows south to north to discharge into the Moray Firth at Banff.

Standing water (0.1%) occurred as ponds; species associated within these small waterbodies included common clubrush (*Scirpus lacustris*), pondweed (*Potamogeton spp*.), duckweed (*Lemna minor*), branched bur-reed (*Sparganium erectum*) and bulrush (*Typha latifolia*).

Water and wetland features within the modified OnTI potentially overlap with three Annex I habitats (hard oligo-mesotrophic waters with benthic vegetation of *Chara spp*.; water courses of plain to montane levels with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation; and oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*), four SBL habitats (ponds; reedbeds; rivers; and purple moor grass and rush pastures) and three NE LBAP priority habitats (rivers and burns; wetland; and field margins and boundary habitats).

Rock and Quarry

Two areas of limited quarry habitat (0.1%) occurred within the modified OnTI, while inland cliff makes up <0.1% of the mapped habitats.

5.3 Protected Species Surveys

Table 18 below outlined the findings of the protected species surveys conducted along the length of the modified OnTI. As with the Phase 1 Habitat survey, not all areas of the corridor were able to be assessed due to access restrictions during the survey period. In summary, the following signs of protected mammals were recorded: 161 counts of badger presence; seven locations containing indicative sign of otter; two locations with signs indicative of red squirrel; and 37 counts of signs of water vole. Records of protected species presence are visually represented in Figure 4.6-6 showing the utilisation of the corridor by these species. Badger sett locations, due to their potentially sensitive nature, can be seen in the Confidential Annex to this document and the associated Figure 4.6-7.

Table 18. Protected species survey results: field evidence records (for badger sett records refer to Confidential Annex 4.6B of this ES)

Species	Easting	Northing	Field evidence	Sign Count	Details
Badger	382460	844249	latrine	2	Path and latrines. Recent
Badger	382773	845238	latrine	4	Recent
Badger	384060	845338	latrine	2	Recent
Badger	383112	845364	latrine	7	Some recent
Badger	383995	845653	latrine	2	Recent
Badger	380409	847761	latrine	5	Recent
Badger	379079	849612	latrine	8	Some recent
Badger	379335	849619	latrine	5	-
Badger	378799	850380	latrine	2	Recent latrines / path (multiple)
Badger	377365	852908	latrine	5	Recent
Badger	377125	853394	latrine	1	Recent
Badger	371111	859885	latrine	19	Very large latrine area
Badger	370911	860374	latrine	1	Recent
Badger	369799	861683	latrine	1	Recent
Badger	366676	861896	latrine	1	Recent
Badger	366650	861981	latrine	10	2 recent latrines
Badger	365737	862390	latrine	1	Recent
Badger	360739	863936	latrine	1	Old
Badger	366752	864243	latrine	1	Dung in latrine recent
Badger	359825	864296	latrine	1	Droppings in latrine recent
Badger	359250	864493	latrine	5	2 old, 3 recent
Badger	358635	864668	latrine	3	1 recent
Badger	356451	865060	latrine	4	Recent
Badger	356269	865067	latrine	12	Several recent
Badger	381975	843967	run	1	-
Badger	383200	844031	run	1	-
Badger	383159	844078	run	1	-
Badger	382657	844114	run	1	-
Badger	381917	844160	run	1	-
Badger	382508	844277	run	1	-
Badger	382902	844296	run	1	-
Badger	382855	844334	run	1	-
Badger	382104	844373	run	1	-
Badger	382536	844667	run	1	-
Badger	382907	844730	run	1	-
Badger	382585	844773	run	1	-
Badger	382921	844995	run	1	-
Badger	382777	845235	run	1	-
Badger	383158	845310	run	1	-
Badger	381964	845667	run	1	-
Badger	383716	845683	run	1	-
Badger	382077	845689	run	1	-
Badger	383749	845749	run	1	-
Badger	382005	845775	run	1	-
Badger	381853	845831	run	1	-
Badger	381607	845957	run	1	-
Badger	381665	846063	run	1	-
Badger	381844	846144	run	1	-
Badger	381686	846492	run	1	-
Badger	380591	847229	run	1	-
Badger	380467	847456	run	1	-
Badger	380281	847560	run	1	-
Badger	380200	847729	run	1	-

Species	Easting	Northing	Field evidence	Sign Count	Details
Badger	380369	847742	run	1	-
Badger	380290	847789	run	1	-
Badger	380481	847810	run	1	-
Badger	380693	847850	run	1	-
Badger	380272	847936	run	1	-
Badger	380599	847988	run	1	-
Badger	380322	848068	run	1	-
Badger	380506	848070	run	1	-
Badger	380345	848372	run	1	-
Badger	379948	848632	run	1	-
Badger	379811	848721	run	1	-
Badger	379961	848769	run	1	-
Badger	379423	849474	run	1	-
Badger	378971	849535	run	1	-
Badger	379259	849715	run	1	-
Badger	378900	850390	run	1	-
Badger	378041	851172	run	1	Path snuffle marks
Badger	377773	851715	run	1	-
Badger	377825	851822	run	1	-
Badger	377662	852171	run	1	-
Badger	377172	852287	run	1	-
Badger	377298	852731	run	1	-
Badger	377329	852908	run	1	-
Badger	377289	853021	run	1	-
Badger	377066	853389	run	1	-
Badger	375752	855000	run	1	-
Badger	372001	859019	run	1	-
Badger	369741	861491	run	1	-
Badger	369905	861569	run	1	-
Badger	368329	861577	run	1	-
Badger	368828	861774	run	1	-
Badger	369901	861779	run	1	-
Badger	367789	861860	run	1	-
Badger	367318	861868	run	1	-
Badger	367826	861981	run	1	-
Badger	369720	862007	run	1	-
Badger	366717	862058	run	1	-
Badger	366065	862486	run	1	Hair on barbed wire
Badger	366206	862583	run	1	Guard hair on barbed wire
Badger	366390	862735	run	1	Guard hair on barbed wire
Badger	366539	862861	run	1	-
Badger	366616	862914	run	1	-
Badger	366824	863090	run	1	-
Badger	360443	863800	run	1	-
Badger	361273	864007	run	1	-
Badger	359324	864359	run	1	-
Badger	358257	864566	run	1	-
Badger	358238	864623	run	1	-
Badger	358123	864924	run	1	Guard hair on fence
Badger	356398	865044	run	1	Guard hair on fence
Badger	357330	865051	run	1	Guard hair on fence
Badger	356936	865196	run	1	Guard hair snout marks
Badger	357189	865306	run	1	Crossing A98
Badger	357033	865330	run	1	Crossing A98
Badger	356139	865392	run	1	Guard hair on fence
Badger	382773	843999	snuffle hole	1	Recent

Species	Easting	Northing	Field evidence	Sign Count	Details
Badger	382633	844139	snuffle hole	1	Recent
Badger	382433	844708	snuffle hole	1	Recent
Badger	383886	845254	snuffle hole	1	Recent
Badger	383615	845676	snuffle hole	1	Recent
Badger	381663	846288	snuffle hole	1	Path and snuffle marks. Recent
Badger	381228	847093	snuffle hole	1	Path and snuffle marks. Recent
Badger	380484	847428	snuffle hole	1	Path and snuffle marks. Recent
Badger	380249	847727	snuffle hole	1	Path and snuffle marks. Recent
Badger	380232	847937	snuffle hole	1	Recent
Badger	380562	848096	snuffle hole	1	Path and snuffle marks. Recent
Badger	380234	848403	snuffle hole	1	Recent
Badger	380300	848638	snuffle hole	1	Path and snuffle marks. Recent
Badger	378074	851193	snuffle hole	1	Snuffle marks - recent
Badger	372048	859032	snuffle hole	1	Snuffle marks - recent
Badger	365912	862405	snuffle hole	1	Recent snuffle marks
Badger	358240	864673	snuffle hole	1	Recent
Otter	378657	850209	couch	1	Recent spraint - fish remains - resting up place
Otter	378747	850327	couch	1	Recent spraint - resting up place
Otter	360792	864128	couch	1	Hole in river bank, probably used as a resting up place. No signs of recent use, grass growing up in entrance
Otter	382968	844278	spraint	1	Under road bridge. Recent
Otter	378587	850135	spraint	1	Recent fish remains
Otter	357809	864965	spraint	3	2 old, 1 recent
Otter	356213	865509	spraint	5	3 old, 2 recent fish remains
Red Squirrel	378875	849447	feeding signs	1	Scots pine cone chewed by red squirrel
Red Squirrel	370989	860382	sighting	2	Seen on feeder at Coll Mhor cottage. Residents said they appeared about a year ago after woodland was clear felled in the area.
Watervole	382422	844714	burrow	2	-
Watervole	382416	844721	burrow	4	-
Watervole	382397	844734	burrow	1	-
Watervole	382389	844740	burrow	3	-
Watervole	382382	844742	burrow	2	Burrows and latrine. Recent
Watervole	382368	844756	burrow	3	-
Watervole	382347	844772	burrow	1	-
Watervole	381821	845836	burrow	1	-
Watervole	381764	845846	burrow	4	-
Watervole	381722	845864	burrow	3	-
Watervole	381659	845874	burrow	2	-
Watervole	381686	845882	burrow	5	-
Watervole	381593	845958	burrow	3	-
Watervole	381528	846016	burrow	1	-
Watervole	381489	846061	burrow	3	-
Watervole	379926	848491	burrow	2	-
Watervole	379927	848492	burrow	2	-
Watervole	379928	848504	burrow	2	-
Watervole	379931	848528	burrow	2	-
Watervole	379934	848536	burrow	2	-
Watervole	379933	848545	burrow	2	-
Watervole	379932	848567	burrow	2	-
Watervole	379931	848599	burrow	1	Burrows and run. Recent
Watervole	379942	848725	burrow	2	-
Watervole	379943	848775	burrow	3	-
Watervole	379973	848853	burrow	2	-
Watervole	379970	848855	burrow	2	-

Species	Easting	Northing	Field evidence	Sign Count	Details
Watervole	379988	848890	burrow	2	-
Watervole	380003	848926	burrow	7	-
Watervole	380005	848934	burrow	2	-
Watervole	380021	848976	burrow	2	-
Watervole	380023	848988	burrow	2	-
Watervole	381561	845996	latrine	1	Burrow, latrine. Recent
Watervole	381724	846240	latrine	1	Recent
Watervole	379940	848760	latrine	1	Recent
Watervole	379983	848878	latrine	1	Recent
Watervole	380016	848965	latrine	1	Recent

Protected species evidence collected along the length of the modified OnTI shows the area is highly utilised by badgers. Thirty-six individual setts were recorded along the length of the corridor (these results can be seen in the Confidential Annex and the associated figure). Thirty of these setts were defined as main setts, with at least eleven of these exhibiting signs of current use. Well used runs, recently visited latrines, and snuffle holes and marks found along the corridor route similarly corroborate the high utilisation of the area by the species.

Use of watercourses by otters for foraging appears widespread with numerous couches and spraint locations discovered during the course of the surveys. Much of the indicative evidence shows recent use of the area, and it is likely the species uses watercourses within the corridor as part of a number of wider territories.

Feeding signs of red squirrel were noted at a single location; however a sighting of an individual was recorded within the ecology survey area. Due to this confirmation of species presence, precautions should be taken if areas of suitable habitat fall within the construction footprint.

Water vole sign was found throughout the survey area in habitats dominated by marshy grassland. Thirty-two burrow and five latrines were found across the ecology survey area.

No evidence of pine marten presence was recorded during the protected mammal surveys. Habitat suitable for pine marten was limited due to the low density of suitable woodland habitats along the cable route.

No evidence of wildcat was recorded during the protected mammal surveys and the habitat was considered to have low potential to support this species.

Bat Roost and Habitat Suitability Survey

Studies of bat habitat preferences show most species favour deciduous/mixed woodland and water for foraging. Bats favour landscapes with well-connected networks of different foraging habitats with abundant mature trees and buildings for roosting. They require a varied supply of insect prey throughout the year, thus intensive agricultural landscapes tend to be of low habitat suitability. Local climate is also important, with higher winds and lower night temperatures reducing bat activity. Consequently, the modified OnTI's northerly latitude and managed, open landscape of predominantly arable land and improved grassland, lacking well-connected networks of different foraging habitats, suggests low numbers and diversity of bats.

Grampian (north east Scotland) supports at least five resident bat species (Haddow and Herman, 2000):

- Soprano pipistrelle (*Pipistrellus pygmaeus*);
- Common pipistrelle (Pipistrellus pipistrellus);
- Brown long-eared bat (*Plecotus auritus*);
- Daubenton's bat (*Myotis daubentonii*); and
- Natterer's bat (*Myotis nattereri*).

Soprano pipistrelles use a wide range of habitats and roost in various buildings and trees, however they strongly favour foraging over habitats associated with water, especially rivers and lochs with marginal woodlands, yet few such waterbodies exist within the modified OnTI. However common pipistrelles are better adapted to agricultural landscapes with limited woodland and water, such as that within the modified OnTI. Daubenton's bat is a specialist of sheltered, calm water with a healthy chironomid midge population, whilst Brown long-eared and Natterer's bats favour foraging habitat of mixed landscapes with mature woodland, and roosting habitat in old, large buildings; few such habitats for any of these species exist within the modified OnTI. As such, common pipistrelle is likely to be best adapted to the habitat found along the cable route.

Assessments conducted of habitat suitability along the modifed OnTI in conjunction with the Phase 1 Habitat surveys categorised habitats throughout the route as either high, medium, or low according to their ability to provide bat species with roosting, foraging or commuting habitats. Table 19 details the target notes collated for Phase 1 and Bat Habitat Suitability surveys. Locations of these notes and the corresponding habitats they relate to can be seen in Figure 4.6-5.

Table 19, Bat Roost and Habitat Suitability survey results

Target Note Number	Easting	Northing	High suitability for bat species	Target Note Comment
1	366534	864009	✓	Property has medium to high roost potential with the surrounding habitat offering good opportunities for commuting and foraging bats.
2	366699	863241	✓	Semi-natural broadleaved woodland. Is present at this location dominated by mature beech. Cracks and fissures present throughout the area which are suitable for roosting bats.
3	365941	862432	✓	Semi-mature deciduous woodland. Mostly beech, birch and sycamore. Many trees with holes/fissures suitable for bats. Valuable within the context of the area and intrinsically.
4	367900	862092	✓	Species rich deciduous semi-natural woodland including sycamore, beech, elm. Many roosting opportunities for bats within the mature canopy.
5	367760	861695		Inaccessible cliffs.
6	368367	861826	✓	Open birch woodland - semi - mature - mature. Diverse understory in places. Grazed by cattle. Good foraging potential for bats. Some trees had a roosting potential within cracks and fissures.
7	368412	862027	✓	Semi-mature/mature semi-natural woodland containing a diverse understory in places. Valuable within context of survey area for bat species. Some trees with high bat roost potential as cracks and fissures present. Birch is the dominant species.
8	373381	857342	✓	Old farm buildings and farmhouse offering high potential for roosting bats.
9	374148	856606	✓	Highly suitable habitat containing the potential for bat roosts in the deciduous trees and some of the farm buildings. Good network of ditches and watercourses, coupled with a pond creates highly suitable foraging and commuting habitat within the area for the species.
10	374690	856433	-	Herb rich habitat dominated by reed canary grass, however the area is not classified as swamp as the water table well below the surface. Other species included lesser celandine and wood anemone.
11	374972	855758	-	Standing water is present at this location, however pollutants were noted and no invertebrates were recorded. As a result these ponds have little value for foraging bats.

Target Note Number	Easting	Northing	High suitability for bat species	Target Note Comment
12	379148	850209	✓	Highly suitable bat habitat recorded at this location. A pond, coupled with a sheltered valley containing marshy grassland species, young broadleaved trees in tubes and scattered scrub would provide high quality foraging and commuting habitat for bat species. Plant diversity throughout the area is moderately high.
13	379214	849885	-	Probable arable field however the land currently appears 'set-aside' with a range of species (moderately diverse) present.
14	379945	848670	✓	All running water recorded in this location contains high commuting and high foraging potential for bat species.
15	379946	848321	-	Wet heath / wet modified bog habitat present at this location. Natural regeneration of Scots pine is occurring across the habitat.
16	380108	848203	-	A patch of wet modified bog is present at this location. Sphagnum abundance and diversity appears poor across this habitat with abundant hare's tail cotton-grass and ling heather present.
17	380224	848217	-	Species rich marshy grassland is present at this location. Soft rush and sharp-flowered rush dominate the vegetation interspersed with a diverse herbal ground flora including marsh violet and stitchwort.
18	380213	848247	-	A recently dug man-made pond containing no vegetation on the surrounding banks.
19	381594	846588	✓	High bat roost potential within the semi-mature/mature beech trees present in this area. Trees contain abundant pockets and fissures for single roosting individuals.
20	381321	846193		A watercourse is present at this location, fenced on either side and with planted young deciduous (broadleaved) trees along the banks.
21	382360	845464	✓	Burn of Asleid contains high bat foraging and commuting potential, with abundant mature deciduous trees present along its banks.
22	382553	843632	✓	High foraging potential present at this location as fields contain cows increasing the invertebrate potential of the area.
23	382185	844226	-	A riding arena partially overgrown with grasses is present at this location. This is not deemed to be valuable ecologically.
24	381903	844225	✓	Two large mature broadleaved trees are present in proximity to the mapped house. The area would provide medium roosting, high foraging, and medium commuting potential for bat species.
25	382261	844325	✓	These improved grassland fields are grazed by horses which will provide a high invertebrate diversity, and therefore contain high bat foraging potential.

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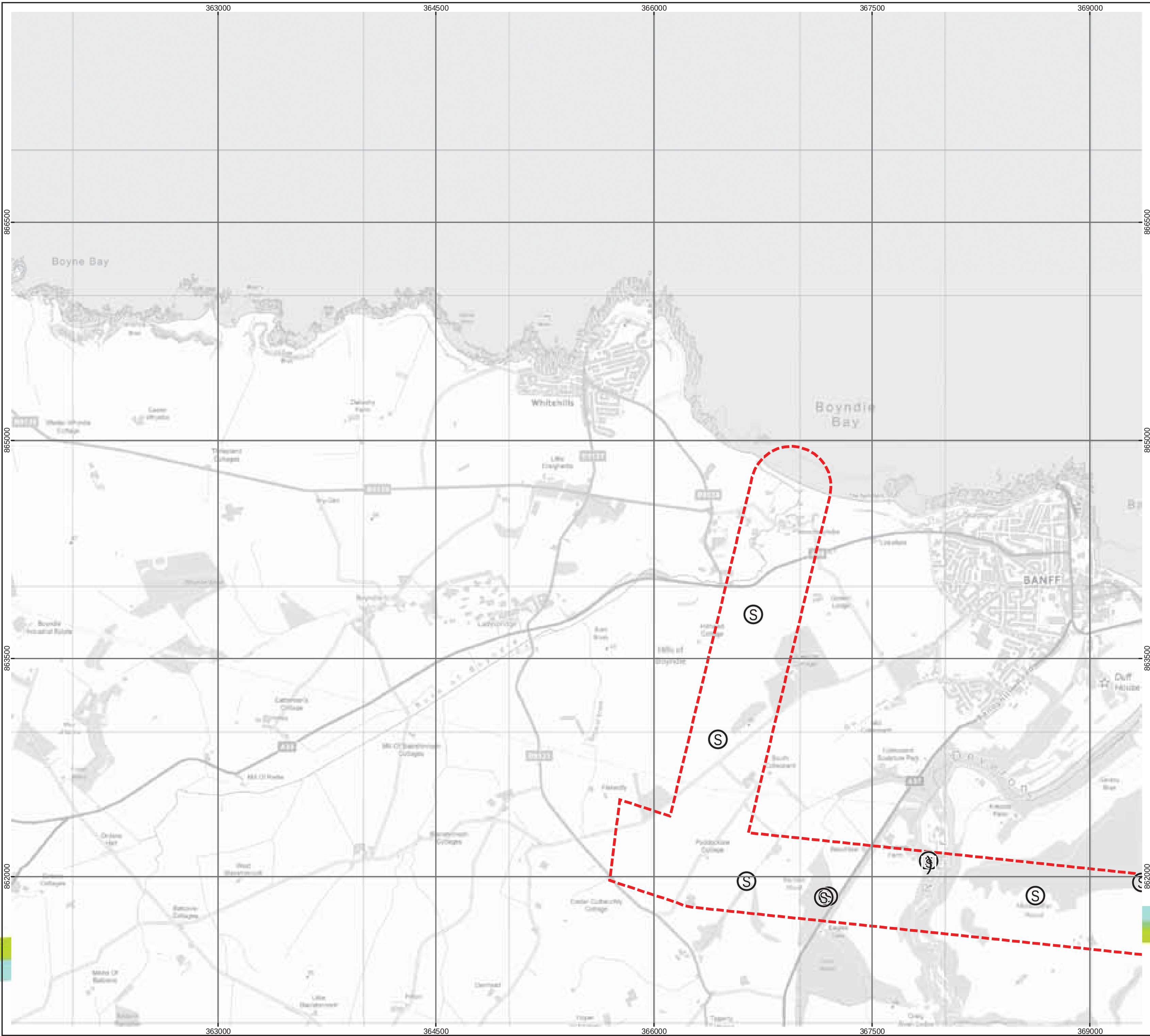

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KEY

Option 1a - Ecological Survey Area (550m)

Badger Sett locations

Main sett

Annex sett

Horizontal Scale: 1:25,000

A3 Chart

0 500 1,000 Meters

Geodetic Parameters: British National Grid

Produced: SEL
Reviewed: ES
Approved: PM

CONFIDENTIAL

Date: 19/06/2014
Revision: A

REF:8460001-PSO0109-RPS-MAP-0024

Figure 4.6-7
Badger Sett Locations
(1 of 5)

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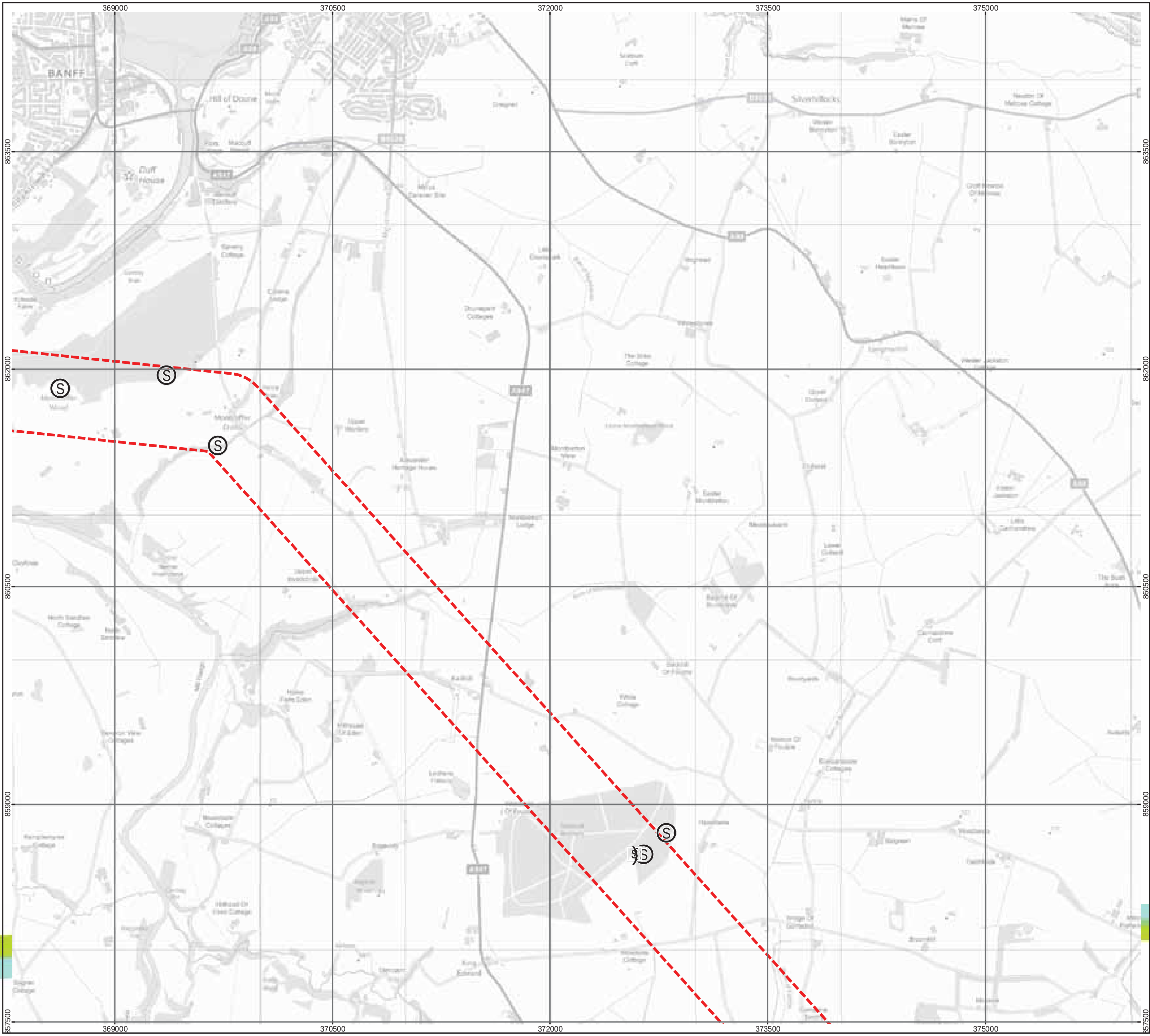

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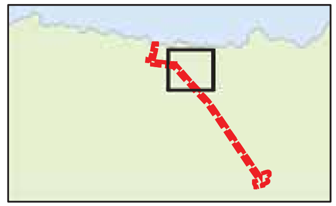
KEY

Option 1a - Ecological Survey Area (550m)

Badger Sett locations

Ⓢ Main sett

Annex sett



Horizontal Scale: 1:25,000   A3 Chart

0   500   1,000 Meters

Geodetic Parameters:	British National Grid
Produced: SEL Reviewed: ES Approved: PM	CONFIDENTIAL
Date: 19/06/2014	Revision: A
REF:8460001-PSO0109-RPS-MAP-0025	

Figure 4.6-7
Badger Sett Locations
(2 of 5)

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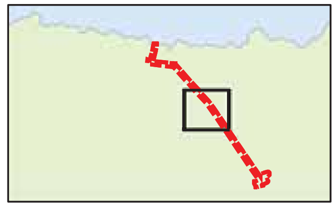
KEY

Option 1a - Ecological Survey Area (550m)

Badger Sett locations

Main sett

Annex sett



Horizontal Scale: 1:25,000 A3 Chart

0 500 1,000 Meters

Geodetic Parameters: British National Grid

Produced: SEL
Reviewed: ES
Approved: PM

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Date: 19/06/2014 | Revision: A

REF:8460001-PSO0109-RPS-MAP-0026

Figure 4.6-7
Badger Sett Locations
(3 of 5)

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KEY

Option 1a - Ecological Survey Area (550m)

Badger Sett locations

Main sett

Annex sett

Horizontal Scale: 1:25,000

A3 Chart

0 500 1,000 Meters

Geodetic Parameters: British National Grid

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Reviewed: ES
Approved: PM

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Date: 19/06/2014

Revision: A

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Figure 4.6-7
Badger Sett Locations
(4 of 5)

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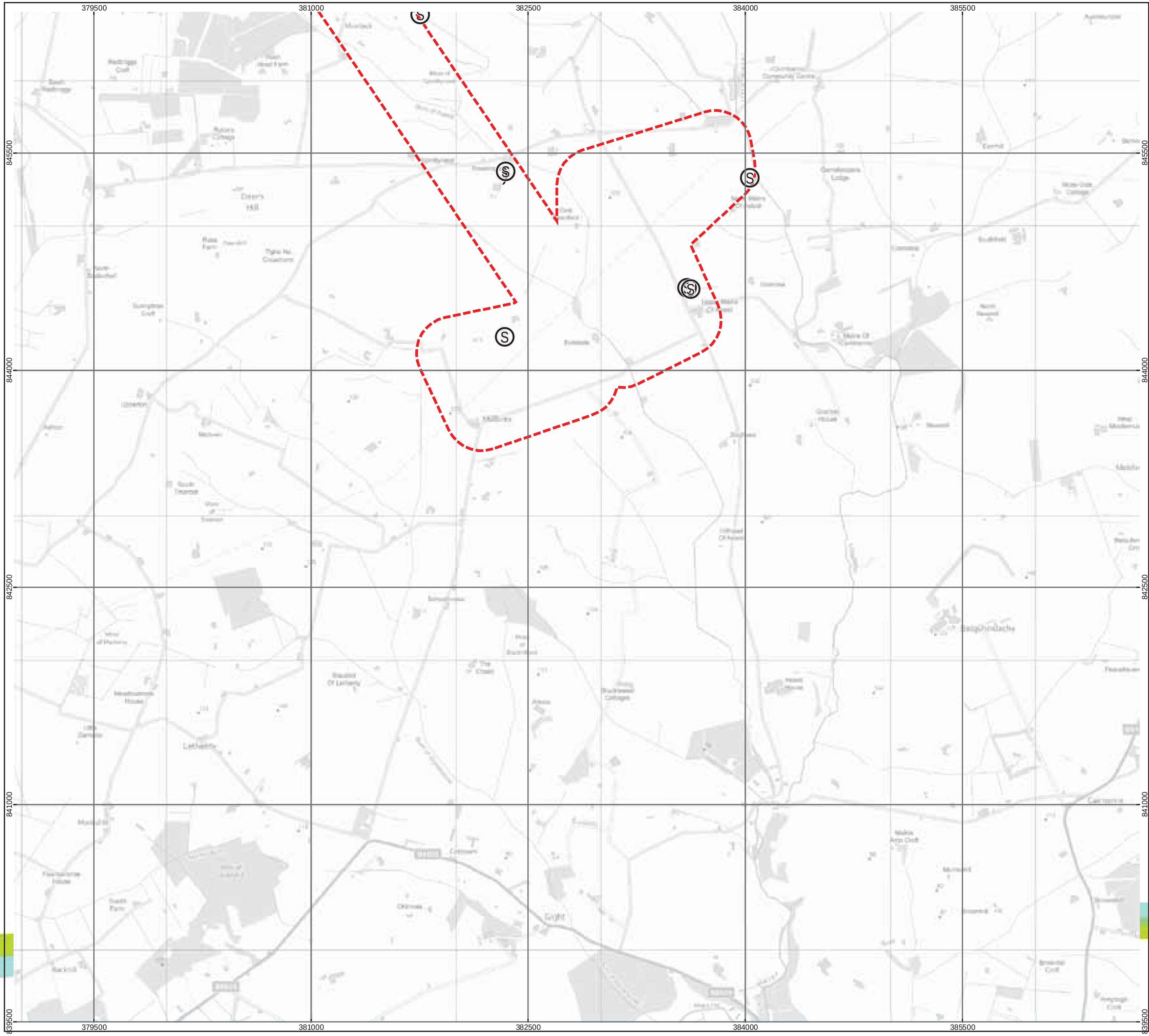

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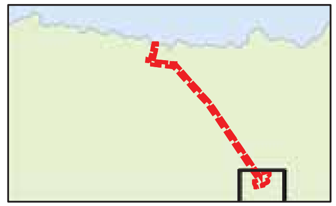
KEY

Option 1a - Ecological Survey Area (550m)

Badger Sett locations

Main sett

Annex sett



Horizontal Scale: 1:25,000 A3 Chart

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Date: 19/06/2014	Revision: A
REF:8460001-PSO0109-RPS-MAP-0028	

Figure 4.6-7
Badger Sett Locations
(5 of 5)

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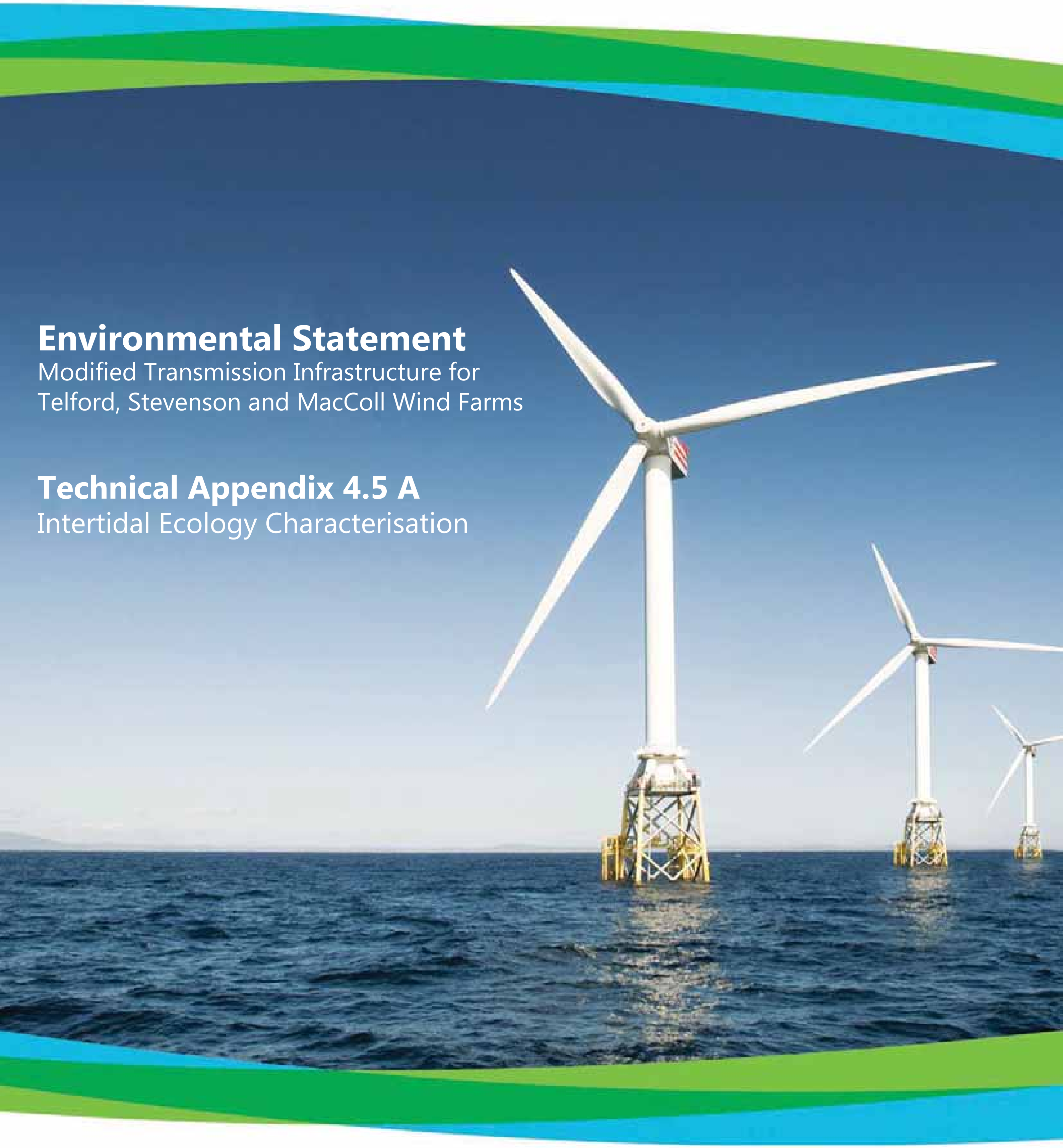
Developing Wind Energy In The Outer Moray Firth

Environmental Statement

Modified Transmission Infrastructure for Telford, Stevenson and MacColl Wind Farms

Technical Appendix 4.5 A

Intertidal Ecology Characterisation



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Document Owner		**Moray Offshore Renewables Ltd**			
Document Status		**Final**			
File Name		**C2610_MORL_IntertidalCharacterisationReport_FinalDraft**			
Revision	**Date**	**Description**	**Originated By**	**Checked By**	**Approved By**
A	13/06/2014	For Review	Jessica Holland	Paul English	Mark Gibson
B	20/06/2014	Final	Jessica Holland	Paul English	Mark Gibson

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1 Introduction

1.1 Project Background

Moray Offshore Renewables Limited (MORL) (a consortium developer comprising EDP Renovaveis and Repsol Nuevas Energias UK (formerly SeaEnergy Renewables)) commissioned a detailed technical study of the modified offshore transmission infrastructure (OfTI) corridor for the three consented wind farms (Telford, Stevenson and MacColl).

This study will be used to inform the Environmental Impact Assessment (EIA), with respect to any predicted effects of the installation of the export cable and its landfall site to assist in the development of mitigation measures, where agreed and appropriate. This will aid in the development of the Environmental Statement (ES) in support of the consent application.

To address these aspects, Fugro EMU Limited (Fugro EMU) was commissioned to undertake an intertidal ecological characterisation survey of the cable landfall at Inverboyndie for the modified OfTI. Accordingly, this document presents the survey methods used, the data collected and gives a characterisation of the intertidal benthic environment within and around the proposed export cable landfall option, in terms of the habitats available and their associated biological communities. Similarly, a sublittoral benthic study, relevant to the modified OfTI cable corridor, have been undertaken and reported separately. Both studies will be used to underpin EIA.

1.2 Aims of the Study

The study aims include:

- The characterisation of the intertidal environment within the vicinity of the proposal export cable landfall at Inverboyndie, including the associated infauna, epifauna and the subsequent allocation and mapping of biotopes; and
- Production of a biotope map to inform the EIA.

1.3 Study Overview

The proposed export cable makes landfall on the Aberdeenshire coastline at Inverboyndie Bay, as shown on **Error! Reference source not found.**.

2 Background

2.1 Regional Physical Environment

The proposed cable landfall site is situated on the west side of the north Aberdeenshire coastline, which stretches from Logie Head near Cullen (15 km to the west of Inverboyndie Bay) to the mouth of the River North Esk by St. Cyrus. Inverboyndie Bay extends approximately 700 m long and during a tidal cycle, the intertidal width can extend from 0-180 m (SEPA and Natural Scotland, 2014).

Most of the geology of the coastline, which is comprised of a mix of metamorphic, sedimentary and igneous rocks, is older than the Carboniferous era (~360 million years ago), however, some date back to the Precambrian era (>590 million years old). The coastline varies from long sandy beaches, to rock and shingle beaches (Barne *et al.*, 1996; Aberdeenshire Council, 2014).

Due to the hard nature of the bedrock, predominantly metamorphic Dalradian rocks, there are many rocky outcrops along the coastline (Barne *et al.*, 1996). Many outcrops extend sublittorally (Eleftheriou *et al.*, 2004), as found on the west side of Inverboyndie Bay intertidal survey area.

Sediment shores are also common along the coastline; they are often backed with dunes or sea cliffs (Eleftheriou *et al.*, 2004). Such shores often exhibit steep profiles and mobile sediments, due to the high energy and exposure of the shores; this is exhibited in surveys at Fraserburgh and Rattray (Terry and Sell, 1986; Eletheriou and Robertson, 1988). The mobility of the sediments, especially in sands, can often result in the sediments being naturally impoverished.

The beach at Inverboyndie has amenity value including surfing, windsurfing, bathing and wildlife walks. It is backed by a caravan park and is a designated bathing water beach.

2.2 Regional Biological Context

Many species of birds, fish, marine mammals and invertebrates are supported by the wide range of aquatic habitats that are present on and off the east coast of mainland Scotland, see Barne *et al.* (1996). In general, local assemblages share much in common with the west coast of Scotland, the North Sea, the North East Atlantic and Ireland (Eleftheriou *et al.*, 2004).

Sandy beaches in the area are characterised by polychaetes, crustaceans and molluscs (Eleftheriou and Robertson, 1988). Typical species include *Bathyporeia pilosa* and *Talitrus saltator* on the upper shore and *Haustorius arenarius*, *Eurydice pulchra*, *Bathyporeia pelagica* and *B. sarsi*, *Paraonis fulgens*, *Eteone longa*, *Ophelia rathkei* and *Scolelepis squamata* on the mid shore (Eleftheriou and Robertson, 1988). Lower shore sediment support the polychaetes *Spio filicornis*, *Nephtys cirrosa*, *Spiophanes bombyx* and *Lanice conchilega*, the crustaceans *Pontocrates altamarinus*, *B. elegans*, Pseudocuma *gilsoni* and *Atylus swammerdami* and the bivalves *Tellina tenuis* and *Donax vittatus* (Eleftheriou and Robertson, 1988). Many of the local sandy sediment shore communities are impoverished if the mobility of the sandy sediments and/or wave exposure is high.

Typical zonation is noted in rocky littoral habitats in the area, however, these shores noted to be less diverse than their counterparts on the west coast of Scotland (Eleftheriou *et al.*, 2004). Terry and Sell (1986) also note the rocky shore zonation, describing common presence of: ephemeral green and red algae, e.g. *Prasiola stipitata* and *Porphyra umbilicalis,* and winkles *Littorina saxatilis* on the upper shore; barnacles *Semibalanus balanoides,* bladderwrack *Fucus vesiculosus,* mussels *Mytilus edulis,* limpets *Patella vulgata,* dog whelks *Nucella lapillus* and mixed red algae species on the mid shore;

and crustose/turf forming red algae, thong weed *Himanthalia elongata,* kelp *Alaria esculenta* and a diverse range of cryptic amphipod and isopod crustaceans on the lower shore. Similarly to sediment shores, the diversity of rocky littoral shore also depends upon the exposure of the shore and on more gently sloping boulder and bedrock shorelines, like Inverboyndie Bay, zonation is usually less pronounced.

Reviews of existing biological and environmental data relative to the foreshore at Inverboyndie Bay reveal that this site does not hold any statutory designations for nature conservation.

3 Methods

3.1 Survey Design

At the proposed export cable landfall site at Inverboyndie Bay (**Error! Reference source not found.**), a broad scale biotope mapping survey of the intertidal area within 200 m either side of the cable landfall route was conducted.

The survey encompassed sampling points situated at varying levels within the vertical width of the shore, extending from the supra-littoral (splash/lichen) zone to the sub-littoral fringe, within an area extending 200 m either side of the proposed cable landfall route. Surveys followed JNCC Procedural Guidelines 3-1 (Wyn and Brazier, 2001) and comprised modified Phase I habitat mapping surveys along the route of the proposed cable on the foreshore.

No sampling of the intertidal zone was carried out, however, dig overs were carried out, from which substrate conditions were noted and key species were identified and enumerated (using the SACFOR scale) in situ.

3.2 Sampling Survey

Surveys were conducted on 20 May 2014 during low spring tides to allow access to the lowest reaches of the shore and to maximise working time.

In the field, base maps derived from aerial photography and Ordnance Survey were annotated with inventories of conspicuous species where possible.

Biotopes were classified on the basis of the Marine Habitat Classification System (Connor *et al.*, 2004).

The boundaries of each intertidal polygon/biotope were located and recorded using a Garmin 48 hand held Global Positioning System unit (GPS), accurate to 10 m, but often achieving <5 m accuracy. Polygon boundaries were identified by a change in the dominance or occurrence of conspicuous species or communities in combination with changes in physical characteristics of the habitat.

For each polygon the following information was noted:

- Physical characteristics, such as substrate type and topographic features (sand ripples, areas of standing water etc.);
- Species present and their SACFOR abundances; and
- Details of specimen samples taken from sites within the polygon.

Each waypoint marked with the GPS was noted on the waypoint log form along with the following information:

- Waypoint number;
- A description of what the waypoint represented; and
- Any photo numbers associated with each waypoint.

Digital photographs were taken to illustrate each habitat.

Biotope maps were augmented with target notes to record any un-mappable information. These are designed to include any features too small (<25 m²) to be accurately portrayed on a map, features on vertical faces and those found under boulders or overhangs. Target notes were also used to describe any human activities, such as outfalls, coastal protection measures and other man made features that are potential habitat modifiers.

Key species and substrate conditions that characterised the biotopes were identified and enumerated on site using the SACFOR abundance scale.

The biotope classifications were subsequently assigned and mapped over aerial photographs to allow area wide interpolation of the survey data. The boundaries of each biotope were digitised and incorporated within an ArcGIS and overlaid onto the base-mapping layer as a series of polygons.

3.3 Biotope Classification

Biotope code allocations were made using the current UK Marine Classification System V 4.05 (Connor *et al.*, 2004). Choice of biotope was made using the biotope decision making tool BioScribe (Hooper *et al.*, 2011). The BioScribe tool matches the species list from a sample to the biological communities usually recorded with potential biotope matches. Confidence indicators and direct links to habitat descriptions from the Marine Habitat Classification for Britain and Ireland are provided to facilitate the process. The tool was used by an experienced ecologist practiced in matching UK biotopes to field survey data with codes applied through expert judgment based on the BioScribe outputs and knowledge of the current biotope classification system. All survey data was used to inform the biotope allocation process, including site descriptions, photographic data, and target notes.

4 Results

4.1 General Information

Appendix 1 presents summary site descriptions and species recorded at each waypoint location at Inverboyndie Bay. Appendix 2 and Appendix 3 present the site photographs and associated logs.

4.2 Biotope Mapping

A total of six biotopes were identified across the Inverboyndie Bay survey area. Table 4.1 presents a summary of observed biotopes and provides links to the full descriptions, as per Connor *et al.* (2004). The distribution of the intertidal biotopes is presented in **Error! Reference source not found.**. Table 4.2 to Table 4.7 present the details of the observed biotopes across the Inverboyndie Bay survey area, together with illustrative photographs and data supporting biotope classification. The associated habitats and communities observed at Inverboyndie Bay are summarised within Section 4.3.

Table 4.1 Summary and classification (Connor *et al.*, 2004) of the observed intertidal biotopes within the survey area at Inverboyndie Bay.

Waypoints	Assigned Biotope Code and Classification Link	
2, 3, 4, 5, 6, 7, 15, 16, 30	**LS.LSa.MoSa.BarSa**	Barren littoral coarse sand
	Link:	http://jncc.defra.gov.uk/marine/biotopes/biotope.aspx?biotope=JNCCMNCR00000187
12, 13	**LS.LSa.FiSa.Po**	Polychaetes in littoral fine sand
	Link:	http://jncc.defra.gov.uk/marine/biotopes/biotope.aspx?biotope=JNCCMNCR00002182
9	**LR.FLR.Eph.Ent**	*Enteromorpha* spp. on freshwater-influenced and/or unstable upper eulittoral rock
	Link:	http://jncc.defra.gov.uk/marine/biotopes/biotope.aspx?biotope=JNCCMNCR00000414
17, 18, 19	**LR.FLR.Eph.EntPor**	*Porphyra purpurea* and *Enteromorpha* spp. on sand-scoured mid or lower eulittoral rock
	Link:	http://jncc.defra.gov.uk/marine/biotopes/biotope.aspx?biotope=JNCCMNCR00000422
10, 11, 20, 21, 22, 23, 24, 27, 28, 29	**LR.MLR.BF.Fser.R**	*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock
	Link:	http://www.jncc.gov.uk/marine/biotopes/biotope.aspx?biotope=JNCCMNCR00000368
26	**IR.MIR.KR.Ldig.Bo**	*Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders
	Link:	http://jncc.defra.gov.uk/marine/biotopes/biotope.aspx?biotope=JNCCMNCR00000496

Table 4.2 LS.LSa.MoSa.BarSa observed biotope at Inverboyndie Bay.

Broad Habitat	**LS**	Littoral sediment
Habitat Complex	**LSa**	Littoral sand
Biotope Complex	**MoSa**	Barren or amphipod-dominated mobile sand shores
Biotope	**BarSa**	Barren littoral coarse sand

 Waypoint 4 Lower shore area of barren sand. Photo taken facing east.	 Waypoint 6 Mid shore area of barren sand facing the upper shore cobble rock armour. Photo taken facing south.	 Waypoint 5 Upper shore barren sand, close to the proposed cable route landing site. Photo taken facing north.
 Waypoint 3 Upper shore barren sand, meeting cobble rock armour. Photo taken facing east.	 Waypoint 16 Close-up of a small strip of rippled sand.	 Waypoint 5 Close-up of barren sand in the upper shore.

Description of Observed Biotope

This biotope extended across the whole length of the survey area, stretching from the upper to lower shore on the east of the survey area and from upper to mid shore on the west. The sediments at all the waypoints consisted of sands, with occasional pebbles noted in the mid shore (Waypoints 3 and 6). A small strip of rippled sand was noted at Waypoint 16. No obvious species were noted within the biotope, other than some drift algae along the strandline at Waypoints 2 and 5.

The substrate type and absence of fauna supports the classification as the **LS.LSa.MoSa.BarSa** biotope. The sand associated with this biotope characterised as clean, mobile and free-draining, typically drying out between tides, especially on the upper shore. This is likely to have attributed to the lack of species in this area.

Table 4.3 LS.LSa.FiSa.Po observed biotope at Inverboyndie Bay.

Broad Habitat	**LS**	Littoral sediment
Habitat Complex	**LSa**	Littoral sand
Biotope Complex	**FiSa**	Polychaete/amphipod-dominated fine sand shores
Biotope	**Po**	Polychaetes in littoral fine sand

Waypoint 13

Close-up on lugworm casts in rippled sand beside existing pipe.

Waypoint 12

View of the existing pipe running down shore across the sand. Photo taken facing north.

Description of Observed Biotope

This biotope was present in two areas of sand, located to the west of the proposed cable route, between the existing pipe and freshwater stream, in areas absent from rock. The sediments consisted of sands, predominantly rippled, upon which, lugworm casts were present. During dig overs, the species *Arenicola marina* were noted to be occasional/common in abundance. Upon the pipe, *Enteromorpha* spp. and *Porphyra* spp. algae were recorded.

The **LS.LSa.FiSa.Po** biotope is usually characterised by stable, clean, fine sand that contains little organic matter and remains damp throughout the tidal cycle. The sediment is often noted to be rippled and can lack an anoxic layer. The biotope occurs mainly in the lower part of the shore. Other species can also be found in the biotope, however, the lack of species other than *A. marina* may be similar to the depauperate nature of shore where boulders are not present.

Table 4.4 LR.FLR.Eph.Ent observed biotope at Inverboyndie Bay.

Broad Habitat	**LR**	Littoral rock (and other hard substrata)
Habitat Complex	**FLR**	Features of littoral rock
Biotope Complex	**Eph**	Ephemeral green or red seaweed communities (freshwater or sand-influenced)
Biotope	**Ent**	*Enteromorpha* spp. on freshwater-influenced and/or unstable upper eulittoral rock

 View from Waypoint 8 Start of the freshwater stream at the top of the shore. Photo taken facing north.	 Waypoint 9 Situated on the freshwater stream. Bare sand and boulders with *Enteromorpha* spp. Photo taken facing north.	 Waypoint 9 Close-up of *Enteromorpha* spp. on bare sand and boulders within the freshwater stream.

Description of Observed Biotope

The area of the upper shore within the drainage path of the freshwater stream, including Waypoint 9, has been designated as this biotope. The area is characterised by the present of *Enteromorpha* spp. upon boulders amongst the freshwater drainage channels. Sand does intersperse the boulders and channels; this sand has been characterised as bare and is absent from obvious species.

The **LR.FLR.Eph.Ent** biotope description matches the designated area as it notes the regular occurrence of the considerable influence of freshwater runoff, as well as the depauperate nature of species, other than a characteristic dense mat of *Enteromorpha* spp.

Table 4.5 LR.FLR.Eph.EntPor observed biotope at Inverboyndie Bay.

Broad Habitat	**LR**	Littoral rock (and other hard substrata)
Habitat Complex	**FLR**	Features of littoral rock
Biotope Complex	**Eph**	Ephemeral green or red seaweed communities (freshwater or sand-influenced)
Biotope	**EntPor**	*Porphyra purpurea* and *Enteromorpha* spp. on sand-scoured mid or lower eulittoral rock

		
Waypoint 17 View of the rocky outcrops from the edge of the sand. Photo taken facing north.	Waypoint 18 View across the biotope towards the sand. Photo take facing south.	Waypoint 17 Close-up on boulders and sand with *Enteromorpha* spp. and *Porphyra* spp.

Description of Observed Biotope

This area is situated on the far west of the survey area, in the mid shore region. Similar to that identified as the **LR.FLR.Eph.Ent** biotope with the presence of boulders and *Enteromorpha* spp. However, this area occurs in the mid to lower shore area, does not appear to be freshwater influenced and has more species present. The present species include *Enteromorpha* spp. and *Porphyra* spp., as well as *Arenicola marina* within the sandy sediments around the boulders. The sands within northerly section of the biotope were noted in the field to be more rippled; this is attributed to its position on the shore, having more recently been submerged.

The **LR.FLR.Eph.EntPor** biotope classification concurs with the characteristics of the area, including the presence of areas of sand between the rocks. This sand is noted to have an abrasive effect on the rocks, as well as influencing the algae species present, primarily ephemeral red or green seaweeds, rather than wracks.

Table 4.6 LR.MLR.BF.Fser.R observed sub-biotope at Inverboyndie Bay.

Broad Habitat	**LR**	Littoral rock (and other hard substrata)
Habitat Complex	**MLR**	Moderate energy littoral rock
Biotope Complex	**BF**	Barnacles and fucoids on moderately exposed shores
Biotope	**Fser**	*Fucus serratus* on moderately exposed lower eulittoral rock
Sub-biotope	**R**	*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock

 Waypoint 11 Rocky outcrop from the lower shore. Photo taken facing west.	 View from Waypoint 20 Rocky outcrop from mid shore. Photo taken facing west.	 Waypoint 11 Close-up on *Semibalanus* balanoides, *Nucella lapillus, Patella vulgata*., *Fucus serratus, Enteromorpha* spp. and *Mastocarpus stellatus.*
 Waypoint 27 Close-up on *Semibalanus* balanoides., *Mastocarpus stellatus, Enteromorpha* spp. and *Cladophora* on boulders.	 Waypoint 22 Close-up on *Fucus serratus* on boulders.	 Waypoint 23 Close-up on *Fucus serratus*, *Corallina officinalis* and *Mastocarpus stellatus.*

Description of Observed Biotope

This biotope consisted of a large area of rocky outcrop, including large boulders. On which, multiple algae species were recorded, including *Fucus serratus*, *Corallina officinalis*, *M. stellatus*, *Cladophora* spp., *Enteromorpha* spp. and *Porphyra* spp., as well as *Semibalanus* balanoides., *Patella vulgata*. and *N. lapillus.*

The biotope **LR.MLR.BF.Fser.R** description focuses on the sense mosaic of algae species, predominantly brown and red seaweeds, including *C. officinalis* and *M. stellatus*. It also matches the classified area based on the species present under the seaweed canopy.

Table 4.7 IR.MIR.KR.Ldig.Bo observed sub-biotope at Inverboyndie Bay.

Broad Habitat	**IR**	Infralittoral rock (and other hard substrata)
Habitat Complex	**MIR**	Moderate energy infralittoral rock
Biotope Complex	**KR**	Kelp and red seaweeds (moderate energy infralittoral rock)
Biotope	**Ldig**	Laminaria digitata on moderately exposed sublittoral fringe rock
Sub-biotope	**Bo**	*Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders

 Waypoint 26 View of the rocky outcrop from the low water mark. Photo taken facing south.	 Waypoint 26 View of the rocky outcrop from the low water mark. Photo taken facing west.	 Waypoint 26 Close-up on *Laminaria digitata*, *Fucus serratus* and *Palmaria palmata* between the boulders.

Description of Observed Biotope

This biotope was recorded at the lowest extent of the survey area, west of the proposed cable route. The area is an extension of the rocky outcrop covering the majority of the western mid-lower shore part of the survey area, but is characterised by a dense mat of primarily *Laminaria digitata*., rather than the mixed seaweed of the **LR.MLR.BF.Fser.R** biotope.

The **IR.MIR.KR.Ldig.Bo** biotope is normally characterised as a moderately exposed boulder shore with the upper surfaces of the boulders colonised by dense *Laminaria digitata*, sometimes with other species present, like *F. serratus*. The noted community includes these species, as well as the presence of *P. palmata* under the canopy and barnacles like *Semibalanus balanoides* on the boulders.

4.3 Summary of Habitats and Communities at Inverboyndie Bay

4.3.1 Habitats

Inverboyndie Bay consisted of an exposed, high energy, clean sandy beach. To the east of the export cable corridor landfall was a large area barren sand; to the west, barren sand at the top of the shore and algae covered boulders towards the lower shore. The majority of the upper shore sand areas were noted to be flat. Rippled areas were noted in small areas, or in areas that had been recently submerged, i.e. were created by wave action or tidal currents.

A freshwater outflow to the west of the cable route created a shallow channel that bisected the intertidal survey area and flowed perpendicular to the shoreline. The associated directly influenced area may vary over time depending on the flow rate of the freshwater stream, as well as in part to interactions between tides and local currents.

An existing pipe was present on the shore (Plate 4.1), by which Waypoint 13 was located. On the surface of the pipe *Porphyra* spp. and *Enteromorpha* spp. were recorded. The extent of the pipe is recorded on the biotope and features plot (**Error! Reference source not found.**).

Plate 4.1 Existing pipe present to the west of the proposed cable route

Although not surveyed during the current study, gravel/pebble "rock armour" appears to have been placed at the top of the shore on the eastern side of the survey area (Plate 4.2). Static caravans, mobile caravans and a car park are located directly behind this gravel strip. The beach sediments directly in front of the strip were well drained and dry.

Plate 4.2 Gravel/pebble rock armour on the eastern side of the survey area

To the western end of the survey area, the shoreline shows evidence of wave action, with the terrestrial sediments appearing to have receded. Boulder-sized rock armour has been added to protect this section of coastline (Plate 4.3). Similarly to the gravel strip, this area has not been surveyed as part of this study.

Plate 4.3 Boulder rock armour on the western side of the survey area

While surveying the area, the surveyors also noted the presence of a sand martin nesting site (Plate 4.4) near Waypoint 14, to the west of the survey area. This is not included as part of this assessment but is included for context.

Plate 4.4 Sand martin nesting site in the western side of the survey area

4.3.2 Biotopes

The majority of the sandy sediments were noted to be highly depauperate and were accordingly classified as the **LS.LSa.MoSa.BarSa** (Barren littoral coarse sand) biotope. This biotope is typical of exposed shores with a more steep profile, where the mobility and degree of drainage of the sediments enables very few, if any, individuals to survive (Connor *et al.*, 2004), however, the sediments on this shore do appear to have sufficient drainage and mobility to fit this classification.

On the western end of the mid shore, an area of boulders interspersed with barren sand with a covering of *Enteromorpha* spp. was recorded. This area was categorised as **LR.FLR.Eph.EntPor** (*Porphyra purpurea* and *Enteromorpha* spp. on sand-scoured mid or lower eulittoral rock). The high level of sand scour is likely to have attributed to the abraded nature of the boulders and the dominance of ephemeral red/green seaweeds as opposed to wracks like *F. serratus* (Connor *et al.*, 2004), which is present in the **LR.MLR.BF.Fser.R** biotope elsewhere on the shore.

Two other small sandy areas were noted to have *Arenicola marina* present in the sediments, and casts on the rippled surface. These areas appeared in clearings within the rocky outcrops. The communities were characterised as **LS.LSa.FiSa.Po** (Polychaetes in littoral fine sand), however, the community is noted to be relative depauperate, consistent with the substrates of the shore as a whole.

A freshwater stream drains on to the shore to the west of the cable landing site. Within the drainage path, boulders and channels are present, with coverage of *Enteromorpha* spp. This coverage of algae appears to have been promoted by the freshwater influence, as the surrounding barren sand is absent from obvious species. This community fits well with the description of **LR.FLR.Eph.Ent** (*Enteromorpha* spp. on freshwater-influenced and/or unstable upper eulittoral rock) (Connor *et al.*, 2004).

To the northwest end of the survey area, the most complex community was recorded; this was classified as one biotope, **LR.MLR.BF.Fser.R** (*F. serratus* and red seaweeds on moderately exposed lower eulittoral rock). This area consists of rocky outcrops with coverage of various algal species, under which a number of epifaunal species were present. The definition between this biotope and the **IR.MIR.KR.Ldig.Bo** (*Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders) was difficult to accurately define, as the substrate and epifaunal species are similar, however, the former biotope includes the addition of *L. digitata* in a distinct canopy. The extent of each biotope has the potential to vary temporally, depending on wave action, tides and storms.

5 Discussion

This study has characterised the intertidal habitats and the associated macrofaunal communities around the proposed cable landfall site. These data will inform the EIA for the modified transmission infrastructure (TI).

The beach at Inverboyndie Bay was moderately exposed and consisted of clean sands subject to mobility as well as an area of rocky outcrop west of the proposed cable route. Boulder rock armour was recorded to the west of the site, protecting the receding terrestrial environment.

The majority of the survey area, especially to the east of the proposed cable landing site, was classified as the **LS.LSa.MoSa.BarSa** biotope. This reflects the impoverished nature of this area, due to the efficient draining of the sediment in the upper shore and intense wave action in the lower shore, therefore, appear to be unable to support to many beach fauna.

The remainder of the shore was comprised of a mix of small areas of sand, boulders and algal cover. Although the sand was still relatively depauperate, these areas did support epifauna attached to the boulders and various algal species, so providing some species richness to the shore. This area includes the biotopes **LR.FLR.Eph.EntPor**, **LR.MLR.BF.Fser.R** and **IR.MIR.KR.Ldig.Bo**, of which **IR.MIR.KR.Ldig.Bo** is potentially important, based on the following considerations.

- **Rocky Boulder and Bedrock communities**
  The EC Habitats Directive lists Annex I rocky reef habitats as a Habitat of International Conservation Importance (Council Directive EEC/92/43 on the Conservation of Natural Habitats and Wild Fauna and Flora). Such intertidal 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.
- **Under-boulder communities**
  Diverse under-boulder communities can be present under intertidal boulders, therefore, the habitat is listed as a priority habitats for conservation under the UK Biodiversity Action Plan.

The **IR.MIR.KR.Ldig.Bo** biotope was only recorded in two small areas of the intertidal survey area and neither were along the immediate route of the modified OfTI corridor, therefore, are not envisaged to be directly affected by the installation of the export cable at Inverboyndie Bay.

6 Conclusions

This study focuses on the intertidal area surrounding the proposed export cable landfall location on Inverboyndie Bay beach. The data from this characterisation of the beach and shoreline habitats and biological communities will inform the EIA to accompany the modified TI consent application.

The majority of the surveyed area was classified as barren sand, due to the extremely depauperate nature of the sand communities. The impoverished nature is likely to have been as a result of the exposure and dynamic nature of the sandy sediments. The majority of the flora and fauna was present on the rocky outcrops to the west of the cable route in the mid to lower shore. The flora included ephemeral green and red algae and kelps and the fauna included attaching organisms like barnacles, winkles and limpets. Of the species identified, none were considered rare or protected and the habitats found were typical of sandy beaches and rocky shores within the wider region.

The part of the rocky outcropping may match intertidal rocky reef and under-boulder communities. These communities are not located to the west of the modified export cable landfall, therefore, are likely to be beyond the predicted direct effects of cable installation activities.

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Appendix 1 Site Description and Species List - Inverboyndie

Waypoint no.	Position WGS84 DD° mm.mmm′		Description of site	Taxa and Abundance (SACFOR scale)	
	Longitude	Latitude			
T3 (East of cable route)	57º40.239'N	2º33.242'W	Rock dump at top of shore extends for 10 m. No obvious species.	n/a	
2	57º40.241'N	2º33.235'W	Edge of rock dump, barren sand. Small amount of drift algae present.	n/a	
3	57º40.265'N	2º33.242'W	Mid shore barren sand with occasional pebble. No obvious species.	n/a	
4	57º40.316'N	2º33.259'W	Lower shore - barren sand with small rippled patches. No obvious species.	n/a	
30	57º40.344'N	2º33.263'W	Low water mark - barren sand. No obvious species.	n/a	
T2 (Proposed Cable route)	57º40.294'N	2º33.464'W	Rock dump at top of shore extends for 11.8 m - no obvious species.	n/a	
5	57º40.299'N	2º33.463'W	Edge of rock dump, barren sand. Small amount of drift algae present.	n/a	
6	57º40.335'N	2º33.479'W	Mid shore barren sand with occassional pebble, slight ripples. No obvious species.	n/a	
7	57º40.380'N	2º33.493'W	Fresh water stream running down shore. No obvious species	n/a	
8	57º40.335'N	2º33.575'W	Fresh water stream - top of shore. No obvious species.	n/a	
9	57º40.349'N	2º33.571'W	Green filamentous algae on sand and boulders beside fresh water stream	*Enteromorpha*	A
10	57º40.399'N	2º33.499'W	Edge of rocky outcrop. Assortment of brown, red and green seaweeds. Obvious	*Semibalanus balanoides* *Nucella lapillus* *Littorina* sp.	S F O

Waypoint no.	Position WGS84 DD° mm.mmm′		Description of site	Taxa and Abundance (SACFOR scale)	
	Longitude	Latitude			
			fauna of barnacles, dogwhelks, winkles and limpets.	*Enteromorpha* spp.	C
				Porphyra spp.	C
				Mastocarpus stellatus	C
				Fucus serratus	C
				Patella vulgata	O
11	57º40.406'N	2º33.501'W	Lower shore at edge of rocky outcrop. Barren sand beside large boulders.	*Semibalanus balanoides*	S
				Nucella lapillus	F
				Patella vulgata	O
				Mastocarpus stellatus	C
				Littorina sp.	O
				Fucus serratus	C
				Enteromorpha spp.	C
				Porphyra spp.	C
27	57º40.406'N	2º33.493'W	Rocky outcrop. Mixed algae and fauna present.	*Semibalanus balanoides*	S
				Patella vulgata	O
				Nucella lapillus	C
				Littorina sp.	O
				Mastocarpus stellatus	C
				Enteromorpha spp.	C
				Porphyra spp.	O
				Cladophora spp.	O
28	57º40.406'N	2º33.493'W	Rocky boulders with patches of sand in-between. Beginning of kelp zone.	*Rhodothamniella floridula*	F
				Semibalanus balanoides	F
				Patella vulgata	O
				Nucella lapillus	F
				Littorina sp.	O
				Mastocarpus stellatus	C
				Enteromorpha spp.	O
				Porphyra spp.	O
				Cladophora spp.	O
				Fucus serratus	A
				Laminaria digitata	A
29	57º40.419'N	2º33.496'W	Rocky boulders with patches of sand in-	*Rhodothamniella floridula*	F
				Semibalanus balanoides	F

Waypoint no.	Position WGS84 DD° mm.mmm′		Description of site	Taxa and Abundance (SACFOR scale)	
	Longitude	Latitude			
			between. Beginning of kelp zone.	*Patella vulgata* *Nucella lapillus* *Littorina* sp. *Mastocarpus stellatus* *Enteromorpha* spp. *Porphyra* spp. *Cladophora* spp. *Fucus serratus* *Laminaria digitata*	O F O C O O O A A
12	57º40.381'N	2º33.538'W	Area of sand with *Arenicola* casts	*Arenicola marina*	O
13	57º40.381'N	2º33.580'W	Pipeline running down shore - covered in turf of green and red algae. Sandy area beside pipe rippled with *Arenicola* casts present.	*Enteromorpha* spp. *Porphyra* spp. *Arenicola marina*	C A C
14	57º40.361'N	2º33.673'W	Sand Martin nesting area at top of shore.	n/a	
T1 (West of cable route)	57º40.364'N	2º33.700'W	Rock dump at top of shore extends for 11.9 m - no obvious species.	n/a	
15	57º40.369'N	2º33.698'W	Edge of rock dump, barren sand with occasional pebbles. Small amount of drift algae present.	n/a	
16	57º40.377'N	2º33.707'W	Small strip of rippled sand. No obvious species.	n/a	
17	57º40.400'N	2º33.720'W	Area of boulders and rippled sand patches covered with red and green algae. *Arenicola* casts present on sand patches.	*Enteromorpha* spp. *Porphyra* spp. *Arenicola marina*	A C O
18	57º40.421'N	2º33.721'W	Large patch of slightly rippled sand between boulders. *Arenicola* casts present.	*Arenicola marina*	O
19	57º40.434'N	2º33.720'W	Low tide mark at edge of sand patch.	*Enteromorpha* spp. *Porphyra* spp.	A C

Waypoint no.	**Position WGS84 DD° mm.mmm′**		**Description of site**	**Taxa and Abundance (SACFOR scale)**	
	Longitude	**Latitude**			
			Boulders covered with red and green algae. *Arenicola* casts present on sandy patches between boulders.	*Arenicola marina*	O
20	57º40.424'N	2º33.655'W	Edge of large rocky outcrop. Boulders covered in red and green algae with areas of sand in-between.	*Enteromorpha* spp.	A
				Porphyra spp.	C
21	57º40.421'N	2º33.641'W	Mid shore area of rocky outcrop dominated by large brown seaweeds.	*Fucus vesiculosus*	C
				Fucus serratus	C
				Cladophora spp.	O
				Littorina sp.	O
				Semibalanus balanoides	C
				Nucella lapillus	O
				Patella vulgata	O
22	57º40.432'N	2º33.628'W	Mid shore area of rocky outcrop. Mixed turf of seaweeds.	*Fucus serratus*	A
				Osmundia hybrida	F
				Mastocarpus stellatus	C
				Patella vulgata	O
				Nucella lapillus	F
				Littorina sp.	O
				Semibalanus balanoides	C
23	57º40.433'N	2º33.629'W	Lower shore area of rocky outcrop - kelp zone. Some *Pomatoceros* tubes visible on rocks.	*Corallina officinalis*	F
				Laminaria digitata	C
				Fucus serratus	A
				Osmundia hybrida	F
				Mastocarpus stellatus	C
				Nucella lapillus	F
				Littorina sp.	O
				Semibalanus balanoides	C
				Patella vulgata	O

Waypoint no.	Position WGS84 DD° mm.mmm′		Description of site	Taxa and Abundance (SACFOR scale)	
	Longitude	Latitude			
24	57º40.444'N	2º33.622'W	Lower shore area of rocky outcrop - kelp zone.	*Fucus serratus*	A
				Mastocarpus stellatus	F
				Patella vulgata	O
				Nucella lapillus	O
				Cladophora spp.	O
				Red calcareous encrusters	O
				Corallina officinalis	F
				Palmaria palmata	F
				Laminaria digitata	A
26	57º40.462'N	2º33.565'W	Low water mark on rocky outcrop.	*Palmaria palmata*	C
				Red calcareous encrusters	O
				Laminaria digitata	A
				Fucus serratus	C
				Mastocarpus stellatus	F
				Patella vulgata	O
				Semibalanus balanoides	F

Appendix 2 Intertidal Photo Log - Inverboyndie

Waypoint no.	Position WGS84 Z30N DD° m.mmm′		Photo no.	Direction
	Longitude	Latitude		
Start of T3 (East of proposed cable route)	57º40.239'N	2º33.242'W	P5200001 P5200002 P5200003	North East West
2	57º40.241'N	2º33.235'W	P5200004 P5200005 P5200006 P5200007	North East West Close-up
3	57º40.265'N	2º33.242'W	P5200008 P5200009 P5200010 P5200011	North East West Close-up
4	57º40.316'N	2º33.259'W	P5200012 P5200013 P5200014 P5200015	East West South Close-up
30	57º40.344'N	2º33.263'W	P5200085 P5200086	South Close-up
Start of T2 (Proposed cable route)	57º40.294'N	2º33.464'W	P5200016 P5200017 P5200018	North East West
5	57º40.299'N	2º33.463'W	P5200019 P5200020 P5200021	North East West
6	57º40.335'N	2º33.479'W	P5200022 P5200023 P5200024 P5200025 P5200026	North East South West Close-up
7	57º40.380'N	2º33.493'W	P5200027	North
8	57º40.335'N	2º33.575'W	P5200028	North
9	57º40.349'N	2º33.571'W	P5200029 P5200030	North Close-up

Waypoint no.	Position WGS84 Z30N DD° m.mmm′		Photo no.	Direction
	Longitude	Latitude		
10	57º40.399'N	2º33.499'W	P5200031 P5200032 P5200033 P5200034	North Close-up Close-up Close-up
11	57º40.406'N	2º33.501'W	P5200035 P5200036 P5200037 P5200038	South East West Close-up
27	57º40.406'N	2º33.493'W	P5200080 P5200081 P5200082	North South Close-up
28	57º40.412'N	2º33.495'W	P5200083	Close-up
29	57º40.419'N	2º33.496'W	P5200084	South
12	57º40.381'N	2º33.538'W	P5200039	Close-up
13	57º40.381'N	2º33.580'W	P5200040 P5200041 P5200042	North Close-up Close-up
14	57º40.361'N	2º33.673'W	P5200043	Close-up
Start of T1 (West of proposed cable route)	57º40.364'N	2º33.700'W	P5200044 P5200045 P5200046	North East West
15	57º40.369'N	2º33.698'W	P5200047 P5200048 P5200049 P5200050	North East West South
16	57º40.377'N	2º33.707'W	P5200051	Close-up
17	57º40.400'N	2º33.720'W	P5200052 P5200053 P5200054 P5200055 P5200056 P5200057 P5200058	North East South West Close-up Close-up Close-up
18	57º40.421'N	2º33.721'W	P5200059 P5200060 P5200061 P5200062	North East South West

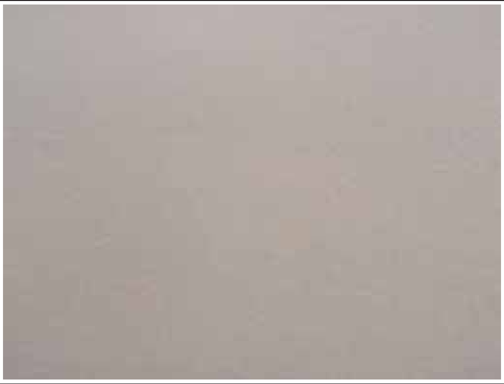
Waypoint no.	Position WGS84 Z30N DD° m.mmm′		Photo no.	Direction
	Longitude	Latitude		
19	57º40.434'N	2º33.720'W	P5200063 P5200064 P5200065 P5200066	North East South West
20	57º40.424'N	2º33.655'W	P5200067 P5200068	West Close-up
21	57º40.421'N	2º33.641'W	P5200069	Close-up
22	57º40.432'N	2º33.628'W	P5200070 P5200071	Close-up Close-up
23	57º40.433'N	2º33.629'W	P5200072	Close-up
24	57º40.444'N	2º33.622'W	P5200073 P5200074	Close-up Close-up
26	57º40.462'N	2º33.565'W	P5200076 P5200077 P5200078 P5200079	East South West Close-up

Appendix 3 Intertidal Photographs - Inverboyndie

Waypoint	Direction	Photo no.	Photograph	Comments / Description
Start of T3 (East of proposed cable route)	North	P5200001		From rock armour at top of shore
Start of T3 (East of proposed cable route)	East	P5200002		From rock armour at top of shore
Start of T3 (East of proposed cable route)	West	P5200003		From rock armour at top of shore
2	North	P5200004		From start of barren sand

Waypoint	Direction	Photo no.	Photograph	Comments / Description
3	East	P5200005		From start of barren sand
4	West	P5200006		From start of barren sand
5	Close-up	P5200007		Zoomed in - barren sand
3	North	P5200008		Mid shore - barren sand

Waypoint	Direction	Photo no.	Photograph	Comments / Description
3	East	P5200009		Mid shore - barren sand
3	West	P5200010		Mid shore - barren sand
3	Close-up	P5200011		Zoomed in - barren sand
4	East	P5200012		Lower shore - barren sand

Waypoint	Direction	Photo no.	Photograph	Comments / Description
4	West	P5200013		Lower shore - barren sand
4	South	P5200014		Lower shore - barren sand
4	Close-up	P5200015		Zoomed in - barren sand
30	South	P5200085		From low tide mark - barren sand

Waypoint	Direction	Photo no.	Photograph	Comments / Description
30	Close-up	P5200086		Zoomed in - barren sand
Start of T2 (Proposed cable route)	North	P5200016		From rock armour at top of shore
Start of T2 (Proposed cable route)	East	P5200017		From rock armour at top of shore
Start of T2 (Proposed cable route)	West	P5200018		From rock armour at top of shore

Waypoint	Direction	Photo no.	Photograph	Comments / Description
5	North	P5200019		From start of barren sand
5	East	P5200020		From start of barren sand
5	West	P5200021		From start of barren sand
6	North	P5200022		Mid shore - barren sand

Waypoint	Direction	Photo no.	Photograph	Comments / Description
6	East	P5200023		Mid shore - barren sand
6	South	P5200024		Mid shore - barren sand
6	West	P5200025		Mid shore - barren sand
6	Close-up	P5200026		Zoomed in - barren sand

Waypoint	Direction	Photo no.	Photograph	Comments / Description
7	North	P5200027		Fresh water stream running down shore
8	North	P5200028		Start of fresh water stream - top of shore
9	North	P5200029		Bare sand and boulders with *Enteromorpha* spp.
9	Close-up	P5200030		Zoomed in - *Enteromorpha* spp. on bare sand and boulders

Waypoint	Direction	Photo no.	Photograph	Comments / Description
10	North	P5200031		Edge of rocky outcrop
10	Close-up	P5200032		Boulder with *Semibalanus balanoides*, *Porphyra* spp. and *Enteromorpha* spp.
10	Close-up	P5200033		*Semibalanus balanoides*, *Enteromorpha* spp. *and Porphyra* spp.
10	Close-up	P5200034		*Semibalanus balanoides*, *Mastocarpus stellatus, Fucus serratus* and *Enteromorpha* spp.

Waypoint	Direction	Photo no.	Photograph	Comments / Description
11	South	P5200035		From lower shore - rocky outcrop
11	East	P5200036		From lower shore - rocky outcrop
11	West	P5200037		From lower shore - rocky outcrop
11	Close-up	P5200038		*Semibalanus balanoides, Nucella lapillus, Patella vulgata, Fucus serratus, Enteromorpha* spp. and *Mastocarpus stellatus*

Waypoint	Direction	Photo no.	Photograph	Comments / Description
27	North	P5200080		From lower shore - rocky outcrop
27	South	P5200081		From lower shore - rocky outcrop
27	Close-up	P5200082		*Semibalanus balanoides*, *Mastocarpus stellatus*, *Enteromorpha* spp., and *Cladophora* spp.
28	Close-up	P5200083		*Mastocarpus stellatus*, *Laminaria digitata*, *Enteromorpha* spp. and *Fucus serratus*

Waypoint	Direction	Photo no.	Photograph	Comments / Description
29	South	P5200084		From low water mark
12	Close-up	P5200039		Lugworm cast
13	North	P5200040		Pipeline running down shore
13	Close-up	P5200041		*Porphyra* spp. and *Enteromorpha* spp. on pipe

Waypoint	Direction	Photo no.	Photograph	Comments / Description
13	Close-up	P5200042		Lugworm casts in rippled sand beside pipe
14	Close-up	P5200043		Sand martin nesting site
Start of T1 (West of proposed cable route)	North	P5200044		From rock armour at top of shore
Start of T1 (West of proposed cable route)	East	P5200045		From rock armour at top of shore

Waypoint	Direction	Photo no.	Photograph	Comments / Description
Start of T1 (West of proposed cable route)	West	P5200046		From rock armour at top of shore
15	North	P5200047		Start of barren sand
15	East	P5200048		Start of barren sand
15	West	P5200049		Start of barren sand

Waypoint	Direction	Photo no.	Photograph	Comments / Description
15	South	P5200050		Start of barren sand
16	Close-up	P5200051		Small strip of rippled sand
17	North	P5200052		Start of rocky boulder zone
17	East	P5200053		Start of rocky boulder zone

Waypoint	Direction	Photo no.	Photograph	Comments / Description
17	South	P5200054		Start of rocky boulder zone
17	West	P5200055		Start of rocky boulder zone
17	Close-up	P5200056		Lugworm casts, *Enteromorpha* spp.
17	Close-up	P5200057		Boulders and sand with *Enteromorpha* spp. and *Porphyra* spp.

Waypoint	Direction	Photo no.	Photograph	Comments / Description
17	Close-up	P5200058		Boulders and sand with *Enteromorpha* spp. and *Porphyra* spp.
18	North	P5200059		Start of sand patch
18	East	P5200060		Start of sand patch
18	South	P5200061		Start of sand patch

Waypoint	Direction	Photo no.	Photograph	Comments / Description
18	West	P5200062		Start of sand patch
19	North	P5200063		End of sand patch - low tide mark
19	East	P5200064		End of sand patch - low tide mark
19	South	P5200065		End of sand patch - low tide mark

Waypoint	Direction	Photo no.	Photograph	Comments / Description
19	West	P5200066		End of sand patch - low tide mark
20	West	P5200067		Edge of sand patch - beginning of rocky outcrop
20	Close-up	P5200068		Boulder with *Enteromorpha* spp. and *Porphyra* spp.
21	Close-up	P5200069		Boulders with *Fucus vesiculosus, Fucus serratus, Nucella lapillus, Patella vulgata* and *Semibalanus balanoides*

Waypoint	Direction	Photo no.	Photograph	Comments / Description
22	Close-up	P5200070		*Osmundea hybrida, Fucus serratus, Enteromorpha* spp. and *Semibalanus balanoides*
22	Close-up	P5200071		*Fucus serratus*
23	Close-up	P5200072		*Fucus serratus*, *Corallina officinallis* and *Mastocarpus stellatus*
24	Close-up	P5200073		*Fucus serratus*, *Laminaria digitata* and *Mastocarpus stellatus*

Waypoint	Direction	Photo no.	Photograph	Comments / Description
24	Close-up	P5200074		*Fucus serratus*, *Palmaria palmata*
26	East	P5200076		Rocky outcrop - low water mark
26	South	P5200077		Rocky outcrop - low water mark
26	West	P5200078		Rocky outcrop - low water mark

Waypoint	Direction	Photo no.	Photograph	Comments / Description
26	Close-up	P5200079		*Laminaria digitata*, *Fucus serratus* and *Palmaria palmata*

Appendix 4 Figures

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

edp renewables

REPSOL

Moray Offshore Renewables Ltd

KEY

- Intertidal Survey Area
- Modified Offshore Transmission Infrastructure Area
- Modified Onshore Transmission Infrastructure Area
- Indicative Cable Landfall

Horizontal Scale: 1:8,000 A3 Chart

0 200 400 Metres

Geodetic Parameters: WGS84 UTM Zone 30N

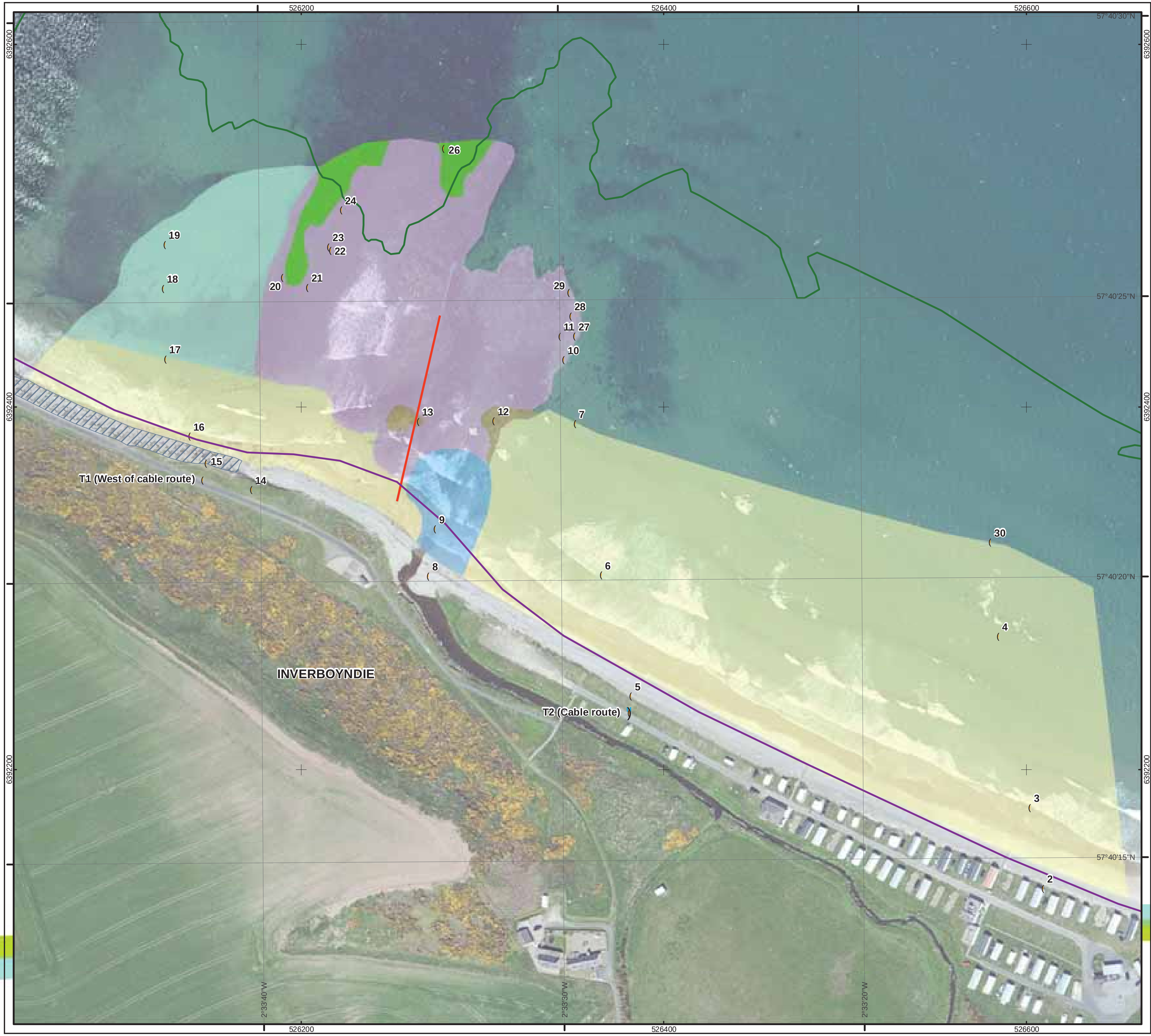
Produced: IMR
Reviewed: ES
Approved: CR

Date: 13/06/2014 Revision: A

REF: 8460001-PSO0131-EMU-MAP-003

Figure 1.0
Location Plot

Moray Offshore Renewables Ltd



Moray Offshore Renewables Ltd

KEY

- Modified Onshore Transmission Infrastructure Area
- Modified Offshore Transmission Infrastructure Area
- Indicative Cable Landfall
- Survey Site

Seabed Features

- Sewage Outlet Pipe
- Rock Armour

Biotopes

- LR.MLR.BF.Fser.R
- IR.MIR.KR.Ldig.Bo
- LR.FLR.Eph.Ent
- LR.FLR.Eph.EntPor
- LS.LSa.FiSa.Po
- LS.LSa.MoSa.BarSa

Horizontal Scale: 1:2,000 A3 Chart

0 50 100 Metres

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: IMR
Reviewed: ES
Approved: CR

Date: 13/06/2014 | Revision: A

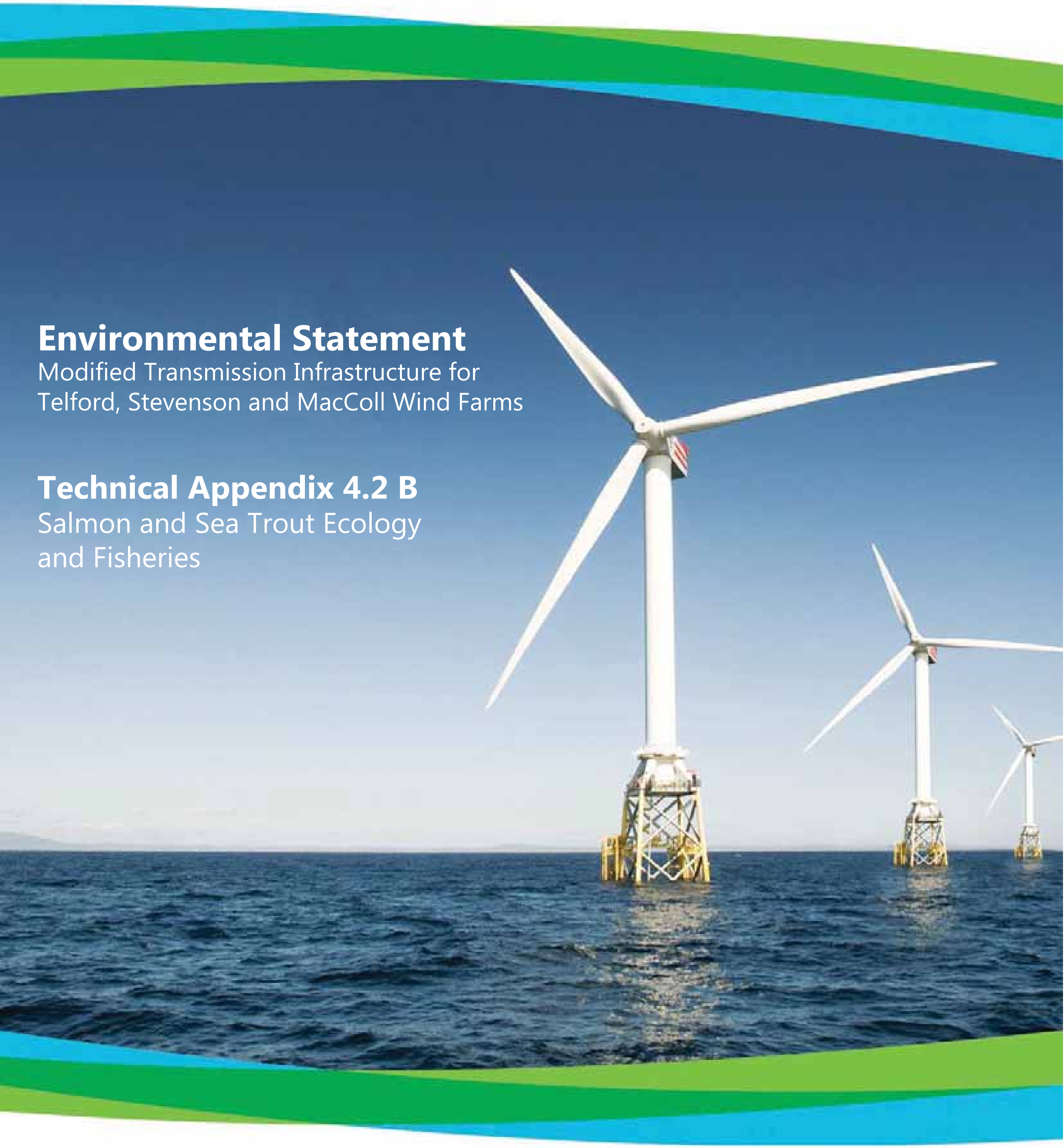
REF: 8460001-PSO0131-EMU-MAP-004

Figure 2.0
Biotopes and Features

Moray Offshore Renewables Ltd

moray offshore renewables ltd

Developing Wind Energy In The Outer Moray Firth



Environmental Statement

Modified Transmission Infrastructure for
Telford, Stevenson and MacColl Wind Farms

Technical Appendix 4.2 B

Salmon and Sea Trout Ecology
and Fisheries

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This document was produced by Brown and May Marine on behalf of Moray Offshore Renewables Ltd

Brown & May Marine

Document Owner	**Brown and May Marine**
Document Status	**Final**
File Name	**Salmon and Sea Trout Technical Report**

Revision	Date	Description	Originated By	Checked By	Approved By
A1	09/06/2014	Draft V001	JL	CF	SJA
A2	22/06/2014	Final	JL	CF	MORL

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1 Introduction

This technical report provides site specific information relating to the ecology, distribution and fisheries of salmon (*Salmo salar*) and sea trout (*Salmo trutta*) in areas relevant to the Modified Transmission Infrastructure (Modified TI) of the three consented wind farms (Telford, Stevenson and MacColl Offshore Wind Farms). The focus of the report is on those Salmon Fisheries Districts (SFDs) relevant to the proposed location of the Modified TI.

More detailed information regarding ecology, conservation status and fisheries located within other districts within the Moray Firth salmon fishery region can be found within the report (Appendix 9.3B) submitted as part of the Environmental Statement (ES) detailing the Telford, Stevenson and MacColl offshore wind farms in August 2012 (MORL, 2012).

2 Methodology

In the absence of standard practice or guidance by which to establish salmon and sea trout ecology and fisheries baseline assessments in relation to transmission infrastructure associated with offshore wind farm developments, a number of information and data sources have been used, which are detailed below.

2.1 Data and Information Sources

- Marine Scotland Science (MSS) (Freshwater Laboratory)
- Scottish Natural Heritage (SNH)
- Joint Nature Conservation Committee (JNCC)
- Centre for Environment Fisheries and Aquaculture Science (CEFAS)
- Association of Salmon Fishery Boards (ASFB)
- Rivers and Fisheries Trusts of Scotland (RAFTS)
- District Salmon Fishery Boards (DSFB)
- Salmon Net Fishing Association of Scotland (SNFAS)
- Atlantic Salmon Trust (AST)
- Moray and Pentland Firth Salmon protection group
- Moray Firth Sea Trout Project (MFSTP)
- Scientific papers and other relevant publications

2.2 Data & Information Sensitivities, Limitations and Gaps

2.2.1 MSS Salmon & Sea Trout Fisheries Catch Statistics

Each fishery in Scotland is required to provide the number and total weight of salmon, grilse and sea trout caught and retained in each month of the fishing season. In this context, the term salmon refers to multi-sea-winter salmon (MSW) whilst grilse refers to one-sea-winter salmon (1SW).

The catch data used for the purposes of this assessment are as reported by the fishery. Where there are no records of reported catches, it has been assumed that no fish have been caught. It is recognised that there may be a small degree of error within the catch dataset due to misclassification of fish between the grilse and salmon categories. There may also be errors as a result of misreporting of catches. The data used are as provided by Marine Scotland Science (MSS) in May 2014.

Rod and line fisheries are also required to provide the monthly numbers and total weight of salmon, grilse and sea trout caught and released back into the river ("catch and release"). As a result, MSS catch data for the rod and line fishery is broken down into two categories, "rod and line" (e.g. retained) and "catch and release" (e.g. released). Note that the total catch by the rod and line fishery is in effect the sum of the catches recorded in both categories. Where appropriate, data from both categories have been combined to give an indication of the total rod and line catch. Similarly, the catch by net and coble and fixed engines (bag and stake nets) has been combined in some instances to provide an indication of the total catch by the net fishery.

The analysis of fisheries statistics given below is not an assessment of the abundance or state of the stocks but provides an indication of the underlying population trends and relative importance of the fisheries of salmon and sea trout by region and fishery district in Scotland. The critical time for fisheries does not necessarily represent critical times for salmon and sea trout movement. In addition, catch data is limited in terms of presenting an accurate baseline of fish populations and fish migration outside of the time of fisheries. This is also the case for rod-and-line catches which do not account for the closed season giving no effort value.

The catch data used in this report are Crown copyright, used with the permission of MSS. MSS is not responsible for interpretation of these data by third parties. In addition, please note that the 2013 statistics included within this report are provisional.

2.2.2 Salmon Fishery Regions and Districts

Each Salmon Fishery District (SFD) applies its own voluntary or statutory conservation code, closure times, policies and regulations. Each SFD also has different management and conservation schemes (e.g. hatcheries, fish counters, water quality control and monitoring schemes). In addition, different districts include varying numbers of rivers and tributaries within their jurisdictions and have different catchment areas.

The boundaries of the salmon fishery regions and districts could not be provided by MSS as GIS data layers, this is due to third party copyright ownership of these data. The district and region boundaries shown in the charts provided in this report were produced by geo-referencing a raster image and should therefore be taken as approximate and for illustrative purposes only.

2.2.3 Data Gaps

There is insufficient information available at present to define the migratory routes and patterns of Scottish salmon and sea trout at the spatial resolution ideally required in this assessment. In addition, there is no detailed information regarding the possibility for the area covered by the Modified TI to be used by these species in other ways. This is particularly relevant for sea trout as marine migration is generally more localised and sea trout could potentially use the area of the Modified TI and its vicinity for extended periods of time when feeding.

Furthermore, the available data and information do not allow for the numbers and the origin of the fish potentially migrating through or near the area in which the Modified TI is located to be estimated or otherwise quantified.

2.3 Consultation

Consultation questionnaires were circulated to all the District Salmon Fishery Boards (DSFBs) in Scotland through the Association of Salmon Fishery Boards (ASFB) and to netsmen through the Salmon Net Fishing Association of Scotland (SNFAS) in 2011. In addition to questionnaires, consultation was also undertaken with individual DSFBs and associated organisations. Since submission of the applications for the now consented offshore wind farms, MORL has had regular and ongoing consultation with the ASFB, Moray Firth Sea Trout Project (MFSTP), Moray and Pentland Firths Salmon Protection Group (MPFSPG) and last met with representatives of these groups in May 2014.

A summary of information regarding salmon fisheries in the Spey and Deveron SFDs, within which the Modified TI makes landfall, was provided to DSFB staff at these organisations in June 2014 to check that the information gathered during previous consultation during 2011 was still relevant.

A full list of consultees and a template of the consultation questionnaires used are provided within Appendix 9.3B submitted as part of the previous Environmental Statement (ES) detailing the Telford, Stevenson and MacColl offshore wind farms in August 2012. As described above dialogue has been ongoing since submission of these applications.

MORL also sits on both the steering and the stakeholder groups for MSS's National Research and Monitoring Strategy for Diadromous Fish (NRMSDF). This is a strategy group led by MSS to investigate the potential for interactions between diadromous fish and wind, wave and tidal renewable energy developments through consultation and research. As part of this group, MORL is contributing to helping to develop a research plan to increase knowledge regarding the behaviour of diadromous fish in the Moray Firth region and around the wider Scottish coast.

2.4 Study Area

For the purposes of the assessment two study areas have been defined:

- A regional study area, that focuses on all the Salmon Fisheries Districts in the Moray Firth; and

A local study area that focuses exclusively on the Salmon Fisheries Districts where the landfall of the Modified TI is located: the Spey and Deveron districts

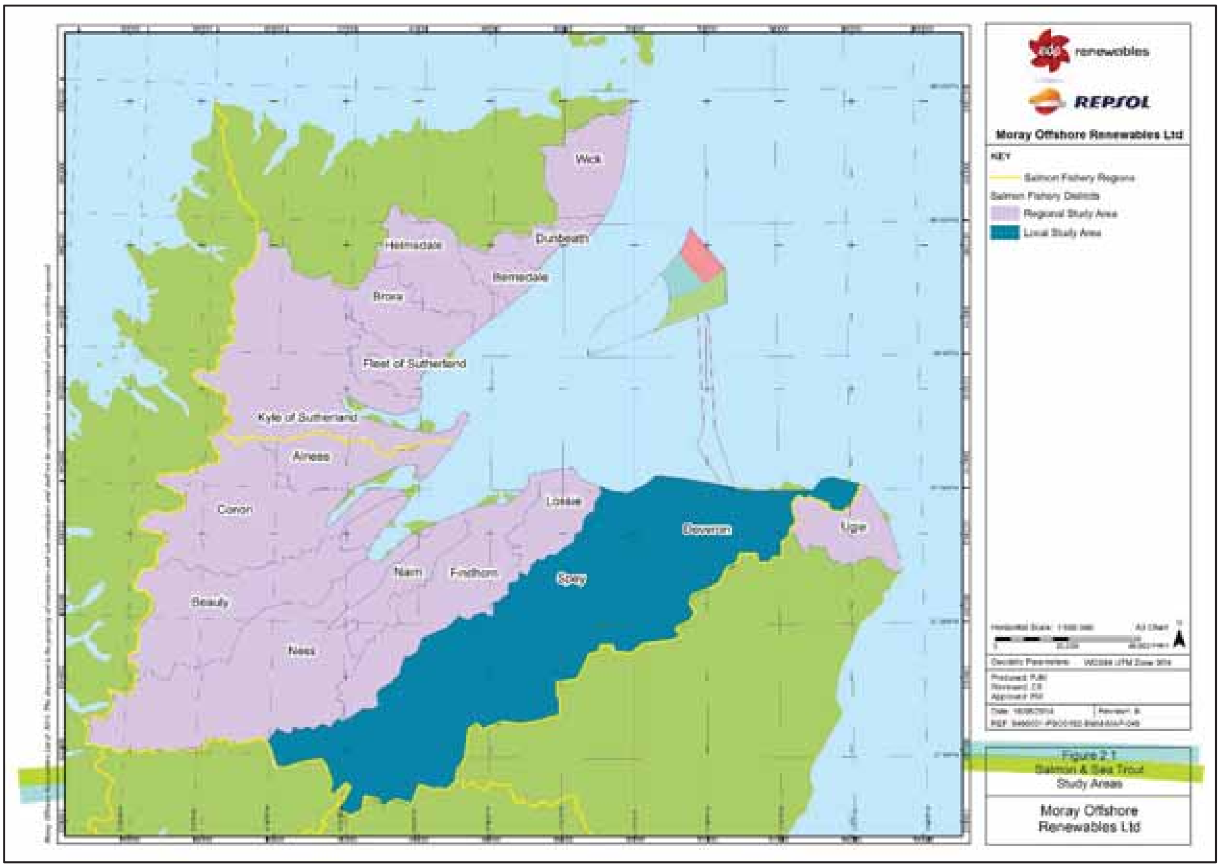


Figure 2.1 Salmon and Sea Trout study area

3 Salmon & Sea Trout Ecology

3.1 Introduction

Atlantic salmon and sea trout are anadromous migratory species of the family Salmonidae. Anadromous species spend a significant proportion of their life history in marine habitats and migrate to freshwater to spawn. Salmon and sea trout fisheries exploit the migratory behaviour of both species by intercepting fish in both rivers and coastal waters.

Atlantic salmon are widely distributed within the northeast Atlantic, occupying diverse biological and physical environments from northern Portugal to Finland (Klemetsen *et al*., 2003). The UK component constitutes a significant proportion of the stock in European Union (EU) waters. Salmon are found in over 300 UK rivers, where the size of the runs often exceeds 1000 individuals per annum (JNCC, 2010).

Sea trout are anadromous brown trout and the migratory and non- migratory forms are recognised as a single species. The mechanisms controlling anadromy in brown trout are not fully understood but involve both genetic and environmental components (Malcolm et al., 2010). The geographical range of brown trout is widespread; from Corsica, Sardinia and Sicily in the south to Iceland, Scandinavia and Russia in the north (Klemetsen et al., 2003).

The anadromous form is frequently found in brown trout populations with free access to the marine environment (Klemetsen et al., 2003). Accordingly, sea trout are found in suitable rivers throughout the geographical range of the species. Atlantic salmon and sea trout share many ecological similarities and frequently co-exist in UK rivers. The life cycles of both species are broadly similar with the exception of differences in the temporal scale of marine feeding migration.

3.2 Life Cycle and Ecology: Overview

Spawning of salmon and sea trout occurs in the upper reaches of rivers during late autumn and winter when females cut nests (known as a ‘redds’) in gravelly substrates in which the eggs are deposited (NASCO, 2012). Larvae (‘alevin’) hatch the following spring, feeding on an attached yolk sac before progressing to feeding on invertebrate prey at which point they are known as ‘fry’. At the end of their first summer of feeding juveniles are known as ‘parr’ (Potter & Dare, 2003).

After spending one to five years in freshwater, salmon and sea trout parr undergo ‘smolting’; a process of physiological and morphological changes which prepare for ocean entry (McCormick et al., 1998). Through late March to June smolts migrate down river and enter the ocean where they are known as ‘post smolts’, until the middle of their first winter at sea. A summary of the timing of smolt runs in Moray Firth rivers is provided in Table 3.1.

Salmon grow rapidly in the marine environment and return to their natal rivers as adults after spending between one to five years at sea. The marine diet typically comprises a high proportion of fish such as sandeels (Ammodytidae) and clupeids including herring (*Clupea harengus*) and sprat (*Sprattus Sprattus*) (Fraser, 1987; Reddin, 1985; Hyslop & Webb, 1992; Jacobsen & Hansen, 2001).

Time spent feeding at sea varies within and among salmon populations and different cohorts may return at different times of the year, spawning in different areas of the natal river (Klemetsen et al., 2003; Potter & Dare, 2003).

The majority of grilse tend to enter the river from early summer- autumn. Numbers of MSW fish will also begin upstream migration at this time, although smaller numbers of this stock component may begin to ascend the river as early as the autumn of the year before spawning. These larger, earlier running individuals are particularly prized by anglers who refer to them as ‘spring’ run fish.

Sea age structure of populations differs between Scottish coasts; in the smaller rivers on the west coast runs tend to be dominated by grilse, whilst higher numbers of MSW are found in populations from rivers on the north and east coasts (Malcolm et al., 2010). In addition, significant changes have been observed in the timings of salmon runs in rivers in Scotland and elsewhere in the UK in recent years.

This is manifest as a shift from spring-summer to summer-autumn runs (Gough et al., 1992; Milner et al., 2000; Aprahamian et al., 2008). In most rivers the change in run timing has also been associated with a decrease in the proportion of MSW fish in the annual run (Aprahamian et al., 2008; Environment Agency & Cefas, 2011). In Scottish (and other UK rivers) these observations have led to a number of conservation measures aimed at protecting the MSW stock component, including blanket catch and release policies, and delays to the start of both recreational and commercial fishing seasons.

The majority of salmon perish after spawning. The small proportion (around 5%) that survive are known as ‘kelts’ (Thorstad et al., 2008).

The life cycle of sea trout is similar to that of salmon. Sea trout marine migration is however shorter than that of Atlantic salmon, characterised by movements on smaller spatial scales occurring closer to natal rivers. A smaller proportion of individuals may undertake long distance offshore migration during marine feeding (Kallilo- Nyberg et al., 2001). In comparison to salmon, diet may be more varied with a higher occurrence of benthic invertebrates in addition to fish (Fahy, 1987).

Immature smolts that return to freshwater to overwinter after a short spell of feeding at sea and are known regionally known as ‘whitling’, ‘finncok’ or ‘herling’ (Malcolm et al., 2010). A further component of the stock referred to as ‘maidens’ do not return to freshwater to spawn until at least a year after migration (Gargan et al., 2004).

Sea trout migrate back to the sea in the spring, both as spawned kelts and immature fish that have overwintered without spawning. In contrast to salmon, post spawning survival rates are high in sea trout and repeat, annual spawning is common (Gargan et al., 2004).

Table 3.1 Timing of Smolt Runs as defined by District Salmon Fishery Boards during Consultation (2011, 2014)

District Salmon Fishery Board	Timing of Smolt Run
Spey (Local Study Area)	April-May (sometimes into early June).
Deveron (Local Study Area)	Mid-March to end of May (rarely into June). Migration in upper reaches can start in 2nd week in March. Sea trout broadly similar.
Cromarty Firth (Conon and Alness Districts)	May.
Ness and Beauly	April to June.
Helmsdale	May.
Caithness (Berriedale, Dunbeath and Wick Districts)	Mid April to mid-May with some earlier running smolts and a good number through June also.
Lossie	May, peaking towards the end of the month and finishing in early June.
Kyle of Sutherland	Spring and Autumn.

3.3 Conservation Status

Atlantic salmon is listed in Annexes II and V of the EU Habitats Directive as a species of European importance and Annex III of the Bern Convention. The protection given to salmon through the Habitats Directive however, is restricted to freshwater habitats, as marine and estuarine sites are excluded from selection. Similarly, salmon at sea are not protected under the Bern Convention.

Through the implementation of the Habitats Directive and as a result of the European importance of Scotland's salmon populations, 11 Scottish rivers have been designated as Special Areas of Conservation (SACs), with salmon being a primary reason for the selection of the sites. SAC Rivers within the Moray Firth and wider area for which salmon is a primary or qualifying feature are shown in Figure 3.1. Of these there is one within the Local Study Area, the River Spey, where the salmon population is considered of high quality.

Further to the protection given under the EC Habitats Directive, Atlantic salmon is listed as a UK Biodiversity Action Plan (BAP) priority species and is protected at the international level by the North Atlantic Salmon Conservation Organization (NASCO), an inter-governmental organisation devoted to the conservation, restoration, enhancement and rational management of wild salmon in the North Atlantic (Curd, 2010).

Sea trout is not subject to the same level of protection as salmon in Europe although it is also listed as a UK BAP priority species. In addition, as a result of the definition of the term salmon in the Scottish legislation, sea trout is currently protected at the same level as Atlantic salmon in Scotland. Under the Salmon (Scotland) Act (1986) the terms salmon means: *"all migratory fish of the species Salmo salar and Salmo trutta and commonly known as salmon and sea trout respectively or any part of any such fish".* In addition, the marine phase of the life cycle of both Atlantic salmon and sea trout is included in the draft list of Priority Marine Features (PMF) in Scottish coastal waters compiled by SNH.

The population dynamics of another species of conservation importance, the freshwater pearl mussel (*Margaritifera margaritifera*), is closely linked to the presence of salmonids in the rivers (JNCC, 2011). During the larval stage *M. margaritifera* attaches itself to the gills of salmonids in river in mid to late summer. The following spring it drops off its host to settle in the riverbed gravel where the juvenile grows into an adult. Freshwater pearl mussels are protected under the Wildlife and Countryside Act (1981) of Great Britain and listed as UK BAP Priority Species (UKBAP, 2011) and also listed on Annexes II and V of the EC Habitats Directive and Appendix III of the Bern Convention (Bern Convention, 2011; EC, 2011).

Recent declines in freshwater pearl mussel populations have been caused by factors such as pearl-fishing, pollution, acidification, organic enrichment, siltation, river engineering and declining salmonid stocks (JNCC, 2011). Pearl mussel are the primary reason for selection of four SACs in the Moray Firth: the Evelix, the Oykel, the Moriston and the Spey. In the Spey the population is estimated at several million and is considered of international significance (JNCC, 2011).

The distribution of sea lamprey (*Petromyzon marinus*), also a primary reason for selection of the River Spey SAC, is largely dictated by the distribution of their host (Waldman et al., 2008). At sea, lamprey feed on a variety of marine mammals and fish, including salmon, shad, herring, pollock, cod, haddock, swordfish and basking sharks (Kelly & King, 2001, ter Hofstede et al., 2008). Lamprey is listed as Annex III species in the Bern Convention and Annex II species in the Habitats Directive. Furthermore, the species has been listed as Priority Marine Feature (PMF) in Scottish territorial waters, in the UKBAP priority list and in OSPARs list of threatened and/or declining species and habitats.

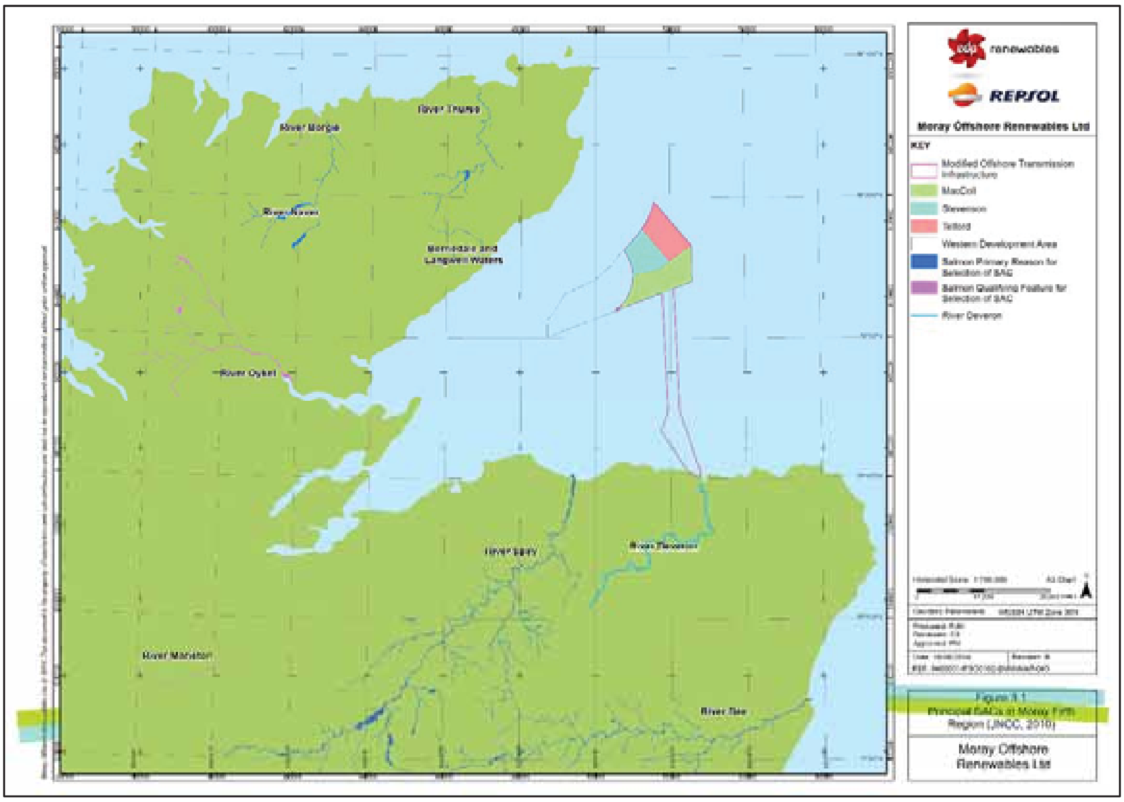


Figure 3.1 Distribution of SACs for Atlantic salmon (Note: River Deveron is also shown but is not a designated SAC)

4 Salmon & Sea Trout Fisheries

4.1 Introduction

Salmon and sea trout are an important part of Scotland's natural and cultural heritage and support commercial and recreational fisheries. These fisheries are of significant of importance to the Scottish economy: research commissioned by the Scottish Executive (Radford et al., 2004) estimated that game and coarse anglers spent a total of £131m in Scotland of which 65% (£73m) corresponded to salmon and sea trout fishing. A similar study undertaken in the Spey (Riddington et al., 2004) calculated that in 2003 the expenditure by salmon anglers generated £11.8 million and supported 367 full-time equivalent jobs in the catchment. Extrapolation of these results to all Moray Firth rivers indicates that angling generated approximately £28.8 million in the area (Butler, 2004). In the Kyle of Sutherland, Radford et al., (2007) estimated that angling related tourism was worth £3.37 million annually to the local economy (KSFT, 2007; Consultation Meeting, 2011b).

Detailed information regarding salmon fishing rights, administration and regulations is provided in the report (Appendix 9.3B) submitted as part of the previous Environmental Statement (ES) detailing the Telford, Stevenson and MacColl offshore wind farms in August 2012.

4.2 Salmon and Sea Trout Fisheries in the Regional Study Area

An indication of the annual reported catch by species and method in the regional study area is given in Table 4.1 and Table 4.2 respectively, expressed as the number of individuals caught by district (average 2004 to 2013).

Salmon and grilse account for the majority of the catch in all districts, with the exception of the Lossie, where sea trout is the principal species caught. Catches from the Spey and Deveron districts contribute the two highest proportions to the total salmon and sea trout catch from all Moray Firth Districts (32.7% and 13.5%, respectively). An overview of the salmon and sea trout fisheries, specific to the Spey and Deveron districts is given in Section 4.3.

Table 4.1 Annual Average Catch by Species and District (2004 to 2013)

District	Grilse	Salmon	Sea Trout	Total	Percentage of total Salmon and Sea Trout Catch (%)
Spey	2,998	5,897	2,152	11,046	32.7%
Deveron	1,548	2,291	720	4,559	13.5%
Kyle of Sutherland	1,902	1,753	507	4,162	12.3%
Findhorn	1,205	1,577	126	2,908	8.6%
Helmsdale	923	1,188	158	2,270	6.7%
Conon	1,119	531	203	1,852	5.5%
Beauly	842	489	175	1,506	4.5%
Ness	667	739	57	1,462	4.3%
Nairn	684	236	103	1,022	3.0%
Brora	189	418	193	800	2.4%
Wick	595	141	16	752	2.2%
Alness	447	165	37	650	1.9%
Lossie	152	45	185	381	1.1%
Berriedale	101	98	6	205	0.6%
Dunbeath	66	74	15	154	0.5%

The principal fishing method in the regional study area is rod-and-line and is the only method used in a number of districts, including the Spey and the Deveron

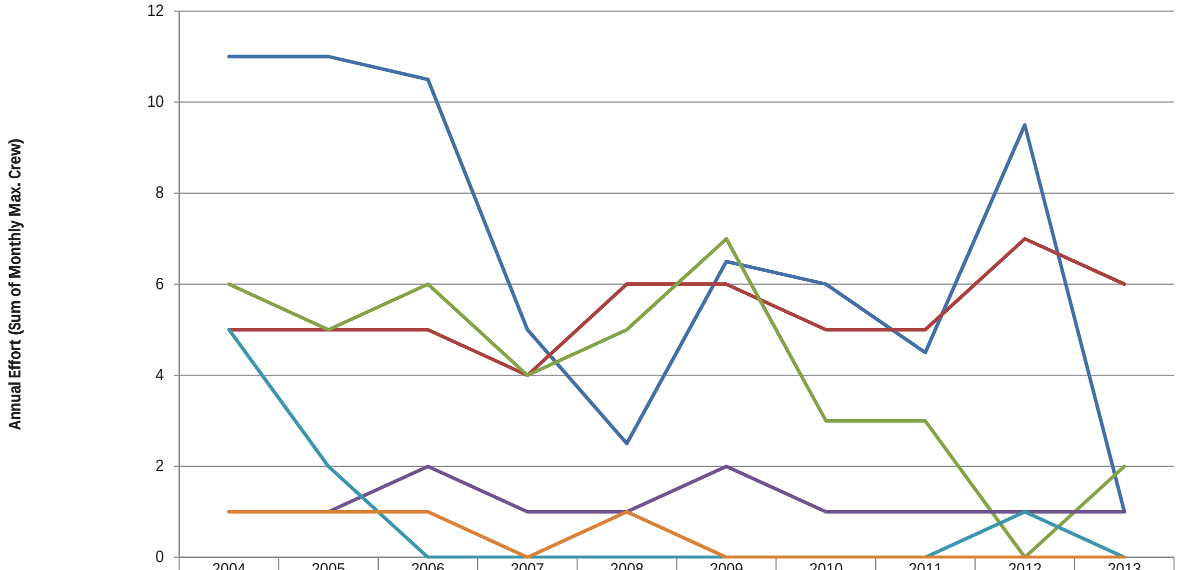
It can be seen that the proportion of fish released exceeds that retained in most Moray Firth districts. Netting by both fixed engines and net-and-coble occurs to a lesser extent and is now only practiced in six of the 15 districts for which data are given. A fixed engine fishery commenced operation on the Deveron in 2012, of which more detail is provided on this fishery in section 4.3. Up until 2012 there had been no fixed engine fishery in this district for a number of years.

Table 4.2 Annual Average Catch by Method and District (2004 to 2013)

District	Rod and Line (Catch & Release)	Rod and Line (Retained)	Fixed Engine	Net and Coble	Total	Percentage of total Salmon and Sea Trout Catch (%)
Spey	7,876	3,170	0	0	11,046	32.7%
Deveron	2,281	1,899	378	0	4,559	13.5%
Kyle of Sutherland	3,031	910	187	35	4,162	12.3%
Findhorn	1,834	1,074	0	0	2,908	8.6%
Helmsdale	1,530	740	0	0	2,270	6.7%
Conon	1,047	519	211	75	1,852	5.5%
Beauly	1,049	457	0	0	1,506	4.5%
Ness	683	553	0	226	1,462	4.3%
Nairn	379	644	0	0	1,022	3.0%
Brora	513	288	0	0	800	2.4%
Wick	205	547	0	0	752	2.2%
Alness	338	312	0	0	650	1.9%
Lossie	153	228	0	0	381	1.1%
Berriedale	91	78	0	36	205	0.6%
Dunbeath	38	90	0	27	154	0.5%

Figure 4.1 and Figure 4.2 provide an indication of the annual variation in fishing effort utilising the net-and-coble fishery and the fixed engine fishery statistics by effort as provided by MSS for the years 2004-2013. In both cases, the data for 2013 is provisional.

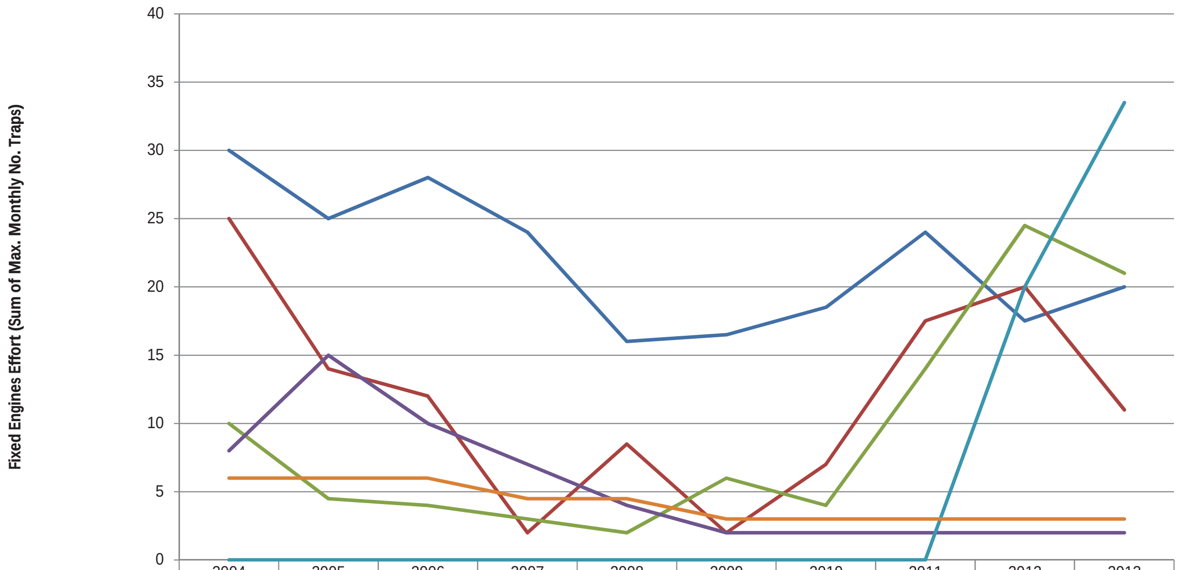
As shown in Figure 4.1, net and coble effort has been variable between 2004 and 2013. Effort in the Ness has declined severely from 11 in 2004 to one in 2013 whereas effort in the Conon has remained relatively stable at between four and seven per year. Effort in the Kyle of Sutherland had declined to zero in 2012 but has increased again in 2013. Effort in the Halladale and Kyle of Sutherland have remained stable from 2008 to 2013, whereas effort in the Deveron has changed dramatically increasing from zero in 2004-2011 to 33.5 in 2013. Effort in the Strathy has shown a general decline from 30 in 2004 to 20 in 2013.



Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Ness	11	11	10.5	5	2.5	6.5	6	4.5	9.5	1
Conon	5	5	5	4	6	6	5	5	7	6
Kyle of Sutherland	6	5	6	4	5	7	3	3	0	2
Berriedale	1	1	2	1	1	2	1	1	1	1
Thurso	5	2	0	0	0	0	0	0	1	0
Dunbeath	1	1	1	0	1	0	0	0	0	0

Year

Figure 4.1 Annual Net and Coble Effort (Max. crew) by SFD (2004- 2013) (Source: MSS, 2014)



Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Strathy	30	25	28	24	16	16.5	18.5	24	17.5	20
Conon	25	14	12	2	8.5	2	7	17.5	20	11
Thurso	10	4.5	4	3	2	6	4	14	24.5	21
Kyle of Sutherland	8	15	10	7	4	2	2	2	2	2
Deveron	0	0	0	0	0	0	0	0	20	33.5
Halladale	6	6	6	4.5	4.5	3	3	3	3	3

Year

Figure 4.2 Annual Fixed Engine Effort (Max. no. pots) by SFD (2004- 2013) (Source: MSS, 2014)

4.3 Salmon and Sea Trout Fisheries in the Local Study Areas

4.3.1 The Spey

Nets used at the mouth of the Spey were bought out by the Board and other conservation organisations in 1993 and as a result, there are no operational coastal netting stations in the district. Rod-and-line is now the only method currently used in the Spey district. There is a voluntary conservation policy in place which has delivered increasing release rates. In 2013, 88% of salmon and 76% of sea trout were released (Consultation, 2014). Figure 4.3 shows the progression of catch and release rates in the Spey (Spey Fisheries Board, 2014).

The seasonality of the fishery is shown in Figure 4.3, based on averaged monthly catches by species (2004-2013). The salmon rod and line fishery runs from 11th February to the 30th September (Consultation Meeting, 2011d). Overall, the highest total catches in the district (all species) are recorded from June to August inclusive followed by May and then September.

Salmon are principally caught from May to September. March and April record relatively high salmon catches reflecting the diversity of salmon stock components in the river. Grilse catches are highest in July and August.

The highest sea trout catches are recorded in June and July with low number in the earlier months of the season (Figure 4.4).

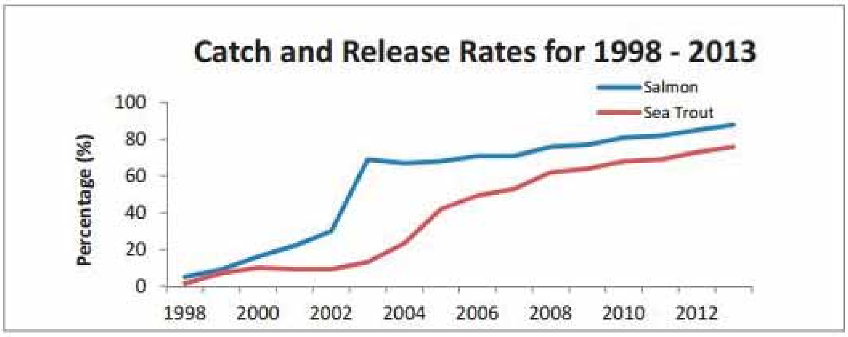
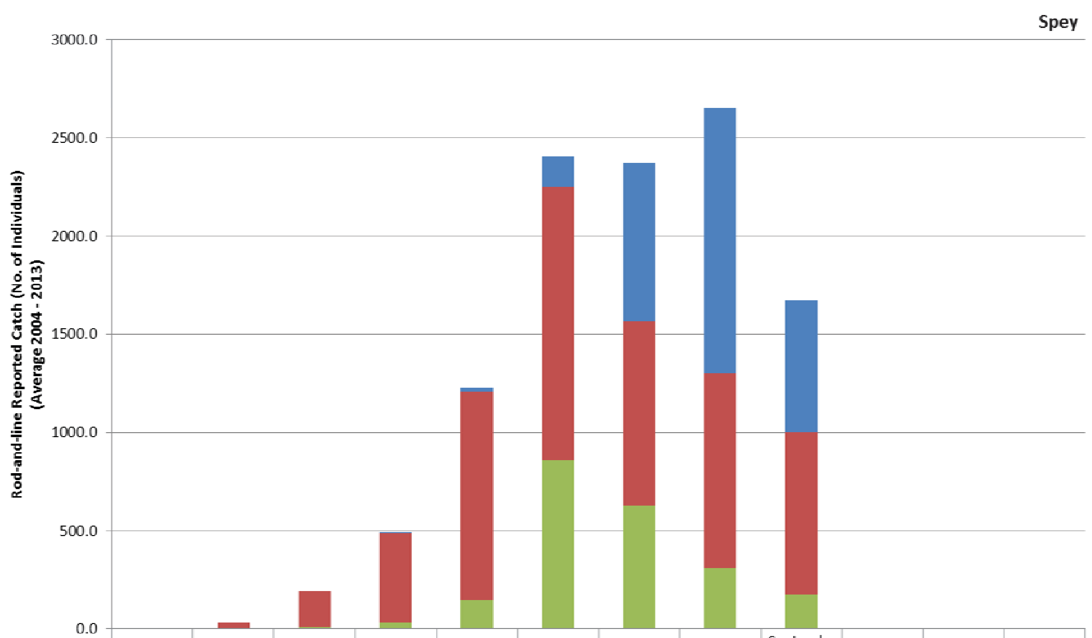


Figure 4.3 Proportion of rod-caught wild salmon and sea trout released on the river Spey (1998-2013) (Spey fisheries board, 2014)



	January	February	March	April	May	June	July	August	September	October	November	December
Grilse	0.0	0.0	0.0	1.3	18.7	152.9	801.7	1353.4	669.8	0.0	0.0	0.0
Salmon	0.0	32.5	185.4	462.1	1063.8	1394.7	943.8	989.5	824.9	0.0	0.0	0.0
Sea Trout	0.0	0.3	5.1	29.8	146.4	858.0	625.2	310.8	175.9	0.0	0.0	0.0

Month

Figure 4.4 Seasonality of Rod and line Reported Catch (average 2004-2013) in the Spey (Source: MSS, 2014)

4.3.2 The Deveron

The Deveron is primarily a salmon river although sea trout are important during the summer months (Consultation, 2011). From 1991 to 2012, rod and line was the only method used in this district. Although the majority of the netting rights were bought out in 1991, two redundant netting stations have recently been purchased by USAN fisheries Ltd and are now active.

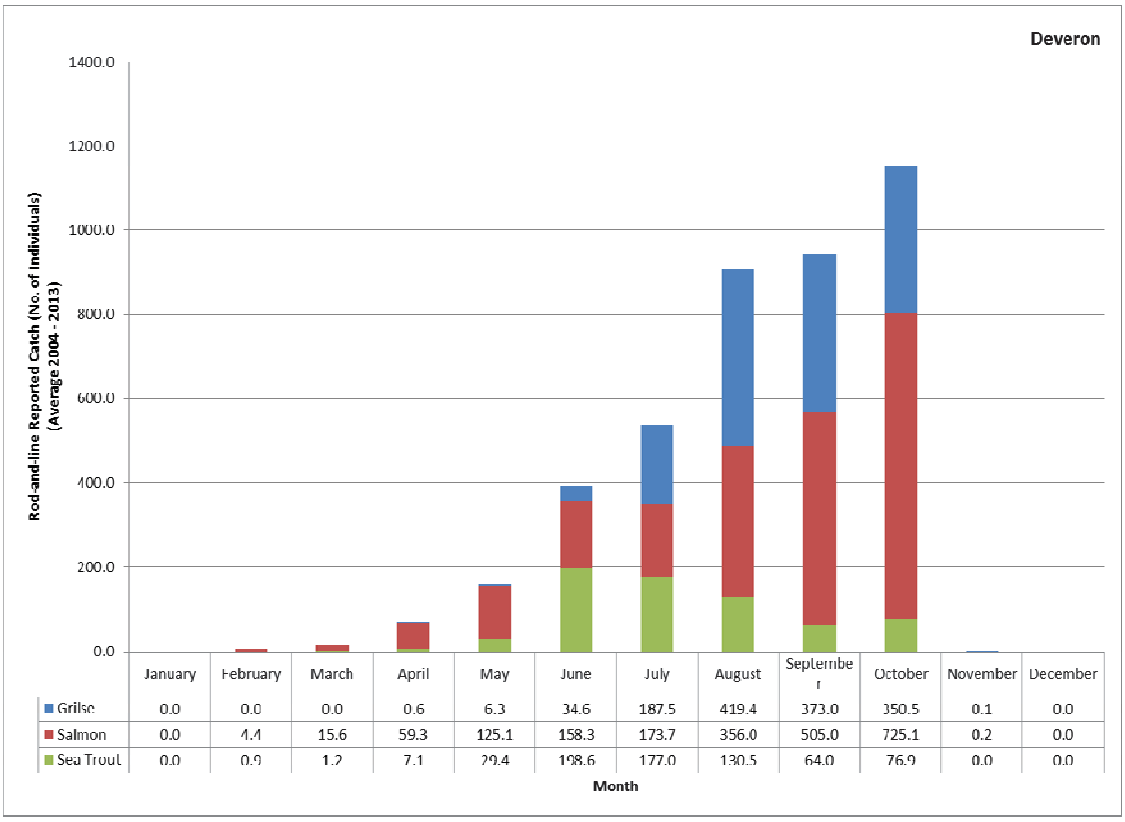
The port of operation for this fishery is Gardenstown and the bag nets are located at More Head in the Moray Firth and further east at Crovie Head (pers. comm, R.Miller Deveron Boga and Isla Rivers Trust, 29.05.2014). There is also a clause in place that allows the netting stations bought and decommissioned in the Deveron district by the Atlantic Salmon Conservation Trust and Deveron District Salmon Fishery Board to be used for scientific purposes (pers. comm. Deveron Salmon Fisheries Board, 2014). Total combined catches (salmon, grilse, and sea trout) from the commercial stations for the past two years were 1233 (in 2012) and 2254 (in 2013). Catches of salmon in this fishery are considerably greater than sea trout.

The seasonality of the rod and line catch by species is given in Figure 4.4 based on monthly reported catches by species (average 2004-2013). The period from August to October records the highest total catches (all species combined). Sea trout are caught in highest numbers in June and July. Grilse catches peak in August, although July, September and October also record relatively high numbers. Salmon are caught throughout the season with higher catches recorded in September and October.

The salmon and sea trout rod and line season is open from 11th February to 31st October (Consultation, 2011). All salmon and grilse must be released up to the end of May whereas after the

1st June one male salmon or grilse under 10lbs can be kept per day with a maximum of two fish per rod per week. In the case of sea trout all must be released throughout the season (pers. comm. Deveron Salmon Fisheries Board, 2014).

Sea trout smolts from the Deveron migrate out of the river at the end of March/April (broadly similar to the time of salmon smolts leave the river) and adults feed in grounds off the coast from March until September. Sea trout return to the rivers throughout this period, although most individuals return later in the year, around August, close to the spawning season (Consultation Meeting, 2011b).



	January	February	March	April	May	June	July	August	September	October	November	December
Grilse	0.0	0.0	0.0	0.6	6.3	34.6	187.5	419.4	373.0	350.5	0.1	0.0
Salmon	0.0	4.4	15.6	59.3	125.1	158.3	173.7	356.0	505.0	725.1	0.2	0.0
Sea Trout	0.0	0.9	1.2	7.1	29.4	198.6	177.0	130.5	64.0	76.9	0.0	0.0

Figure 4.5 Seasonality of Rod and line Reported Catch (average 2004-2013) in the Deveron

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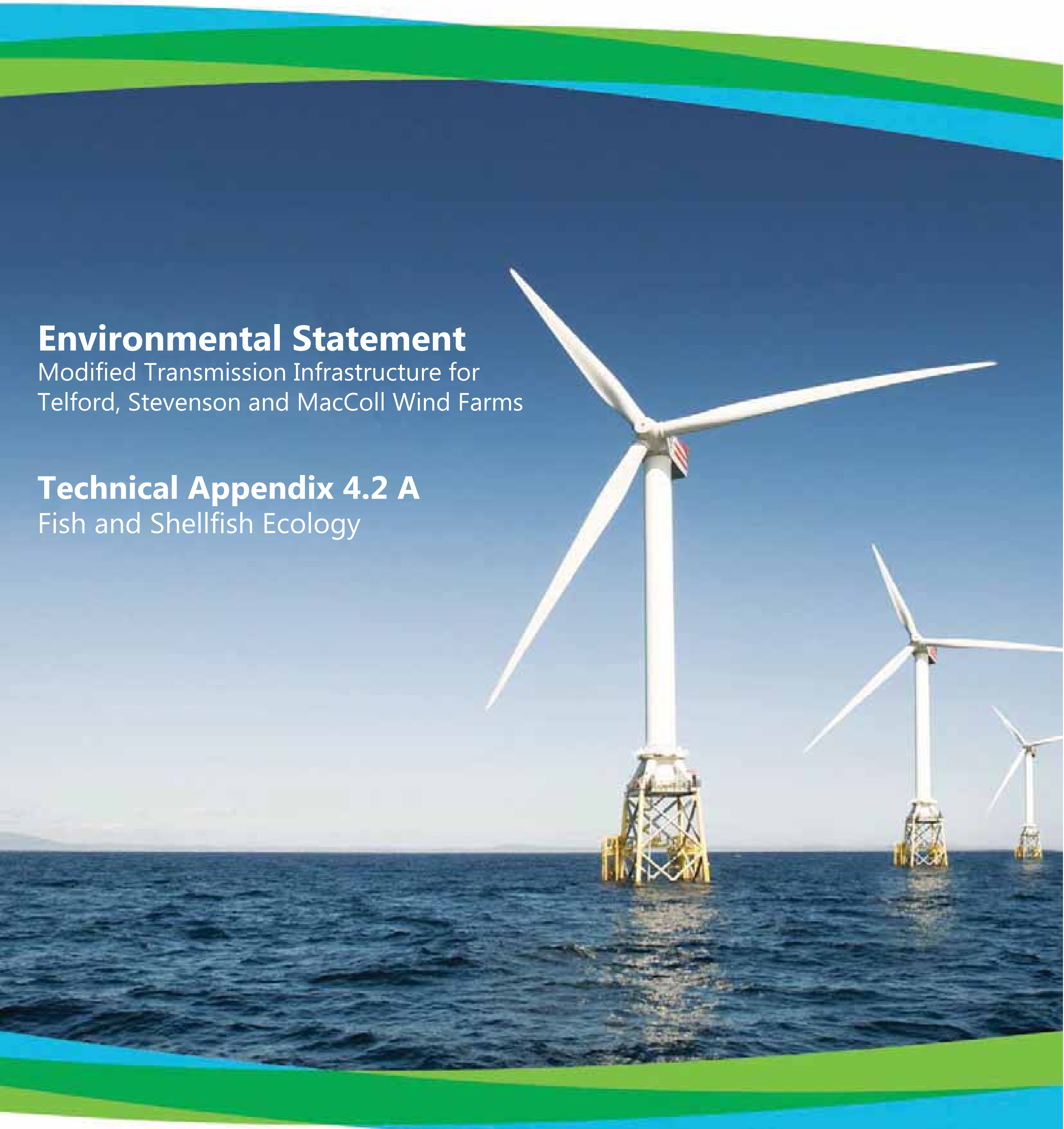
Developing Wind Energy In The Outer Moray Firth



Environmental Statement

Modified Transmission Infrastructure for
Telford, Stevenson and MacColl Wind Farms

Technical Appendix 4.2 A

Fish and Shellfish Ecology

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Brown & May Marine

Document Owner		**Brown and May Marine Ltd**			
Document Status		**Final**			
File Name		**Fish and shellfish ecology technical report**			
Revision	**Date**	**Description**	**Originated By**	**Checked By**	**Approved By**
A1	10/06/2014	Draft 1	JL	CF	
A2	22/06/2014	Final	JL	CF	MORL

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Table of Contents

1 Introduction

This technical report provides site specific information regarding the ecology and distribution of fish and shellfish species in areas relevant to the modified offshore transmission infrastructure (modified TI) of the Telford, Stevenson and MacColl offshore wind farms. Further detail regarding the ecology, life cycle and behaviour of the key species identified can be found within the relevant sections of the Fish and Shellfish Ecology Technical Report (Appendix 9.3A) submitted as part of the previous Environmental Statement (ES) detailing the Telford, Stevenson and MacColl Offshore Wind Farms in August 2012.

For the purposes of this report fish and shellfish species have been described within four broad categories:

- Species of commercial interest;
- Species potentially using the development area as a spawning or nursery ground;
- Key prey species; and
- Species of conservation importance, including diadromous and elasmobranch species.

Given the socio-economic and conservation status importance of salmon and sea trout in Scotland, their ecology and fisheries have been described separately in a standalone document (Appendix 4.2B).

2 Methodology

2.1 Guidance

The following documents have provided guidance for the undertaking of the Fish and Shellfish Ecology baseline assessment:

- Strategic Environmental Assessment (SEA) of Draft Plan for Offshore Wind Energy in Scottish Territorial Waters: Volume I: Environmental Report (Marine Scotland, 2010);
- Habitats Regulations Appraisal of Draft Plan for Offshore Wind Energy in Scottish Territorial Waters. Appropriate Assessment Information Review (Marine Scotland, 2011);
- CEFAS Guidance Note for Environmental Impact Assessment in Respect of the FEPA and CPA Requirements (CEFAS 2004);
- Marine Scotland Science (MSS) Scoping Opinion; and
- Scottish Natural Heritage (SNH) and Joint Nature Conservation Committee (JNCC) Scoping Opinion.

2.2 Sources of Data and Information

Establishing an ecological baseline for fish and shellfish species requires an approach that incorporates a number of different data and information sources. The principal sources of data and information used to inform the report were as follows:

- Marine Management Organisation (MMO) Landings Data by ICES rectangle for the period 2003-2013;
- Fisheries Sensitivity Maps in British Waters (Coull *et al*., 1998);
- Mapping spawning and nursery areas of species to be considered in Marine Protected Areas (Marine Conservation Zones). Report No 1 (Ellis *et al*., 2010a);
- Marine Scotland Science (MSS) publications;
- International Council for the Exploration of the Sea (ICES) publications;
- Centre for Environment, Fisheries and Aquaculture (CEFAS) publications;
- Results of Benthic Surveys undertaken in the area (Fugro EMU, 2011 and 2014??XXX); and
- Other relevant research publications.

2.3 Data sensitivities, Gaps and Limitations

2.3.1 MMO Landings Data

ICES statistical rectangles are the smallest spatial unit used for the collation of fisheries statistics by the European Commission (EC) and Member States. The boundaries of ICES rectangles align to 1° of longitude and 30' of latitude and are large in relation to the area occupied by the modified TI. In addition, fishing activity is rarely evenly distributed throughout the area of a rectangle. The analysis of the fisheries statistics provided below should therefore be taken in the context of the spatial limitations of the dataset.

Whilst landings data provide a good indication of the commercial species present by ICES rectangle, in some cases their relative abundance and importance may be misrepresented as a result of factors such as: low quota allocations, fluctuations in fishing effort, fisheries closures, changes in market demand, etc. In addition, the presence and distribution of fish and shellfish species are dependent on a number of biological and environmental factors that interact with each other in direct and indirect ways, and are subject to seasonal and annual variation.

2.3.2 Spawning and Nursery Grounds

The assessment of the area of the proposed modified TI as potential spawning and nursery grounds has primarily been undertaken using the charts provided in Coull *et al*. (1998) and Ellis *et al*. (2010a). It is acknowledged that whilst these are useful sources to identify broad scale spawning and nursery grounds, they do not delineate the exact location of grounds, especially in relation to discrete areas such as that occupied by the modified TI. In light of this limitation, alternative publications have been used to help define the extent of the grounds on a site specific basis where available.

2.3.3 Gaps in Current Knowledge

It is recognised that there are gaps in the understanding of the distribution, behaviour and ecology of certain species. This is particularly true for migratory species of conservation importance, such as Atlantic salmon (*Salmo salar*), sea trout (*Salmo trutta*), lamprey (*Lampetra fluviatilis*) sea lamprey, (*Petromyzon marinus)* and European eel (*Anguilla anguilla*). An absence of information in relation to specific migration routes, location of feeding grounds and the use of coastal/inshore areas by these species means that it is not possible to quantify the extent to which they may access areas occupied by the proposed modified TI.

2.4 Study Area

The study area used for this assessment has been defined by the ICES rectangles within which the modified TI is located (45E7 and 44E7) and is shown in Figure 2.1. Rivers designated as Special Areas of Conservation (SACs) in the Moray Firth and the wider area are also shown.

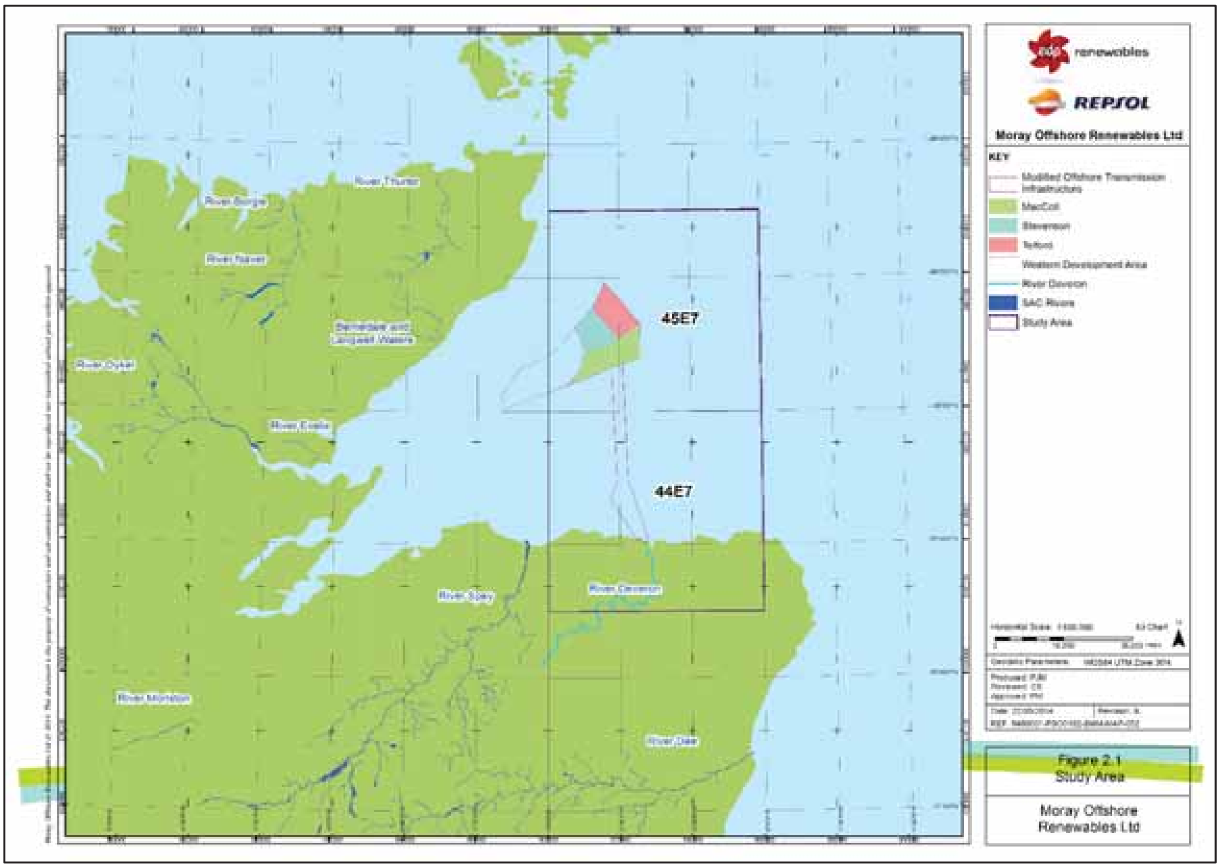

Figure 2.1 Modified Transmission Infrastructure study area

3 Baseline Characterisation

3.1 Substrate Types

In addition to factors such as water depth, temperature and salinity, substrate type can also determine the location and extent of feeding and spawning grounds for species such as *Nephrops (Nephrops norvegicus)*, king and queen scallops (*Pecten maximus, Aequipecten opercularis*), sandeels (Ammodytidae spp.) and herring (*Clupea harengus*).

The distribution of substrate types in the Moray Firth based on British Geological Survey (BGS) data is given in Figure 3.1. Muddy substrates dominate in the inner and southern area, whilst sand, gravelly sand and to a lesser extent sandy gravel and slightly gravelly sand, dominate in the northern and central areas.

The northern and southern sections of the modified TI are located in areas of coarser substrate, such as sandy gravel and gravelly sand, whilst the substrate in the middle section of the modified TI is characterised by the presence of muddy sand and sand.

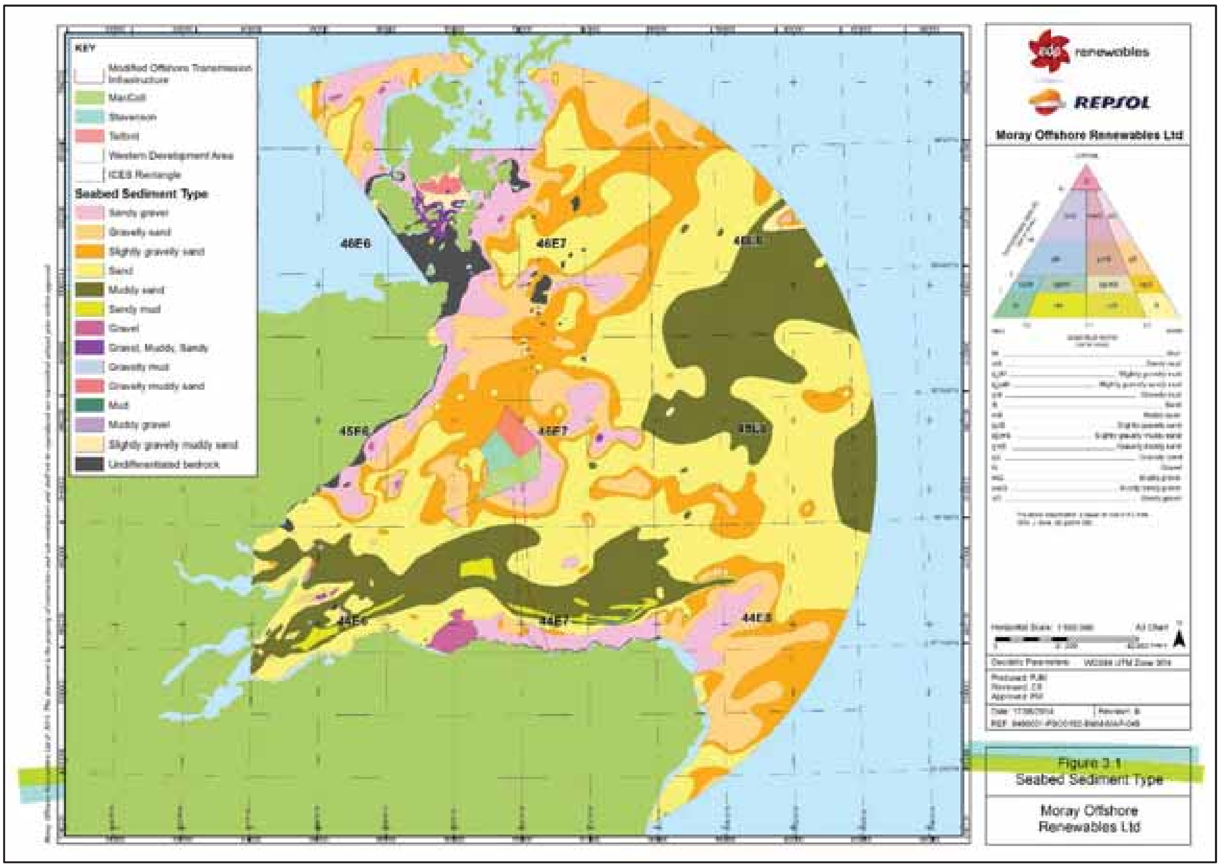

Figure 3.1 BGS (British Geological Survey) seabed sediment chart with ground type

3.2 Species of Commercial Interest

The Moray Firth supports a number of commercially targeted fish and shellfish species. An indication of the relative importance of these within the modified TI study area is given in Figure 3.2, based on annual average (2003 to 2012) landings weights (tonnes) by species and ICES rectangle.

The principal shellfish and cephalopod species landed are *Nephrops*, scallops and squid. With respect to fish, haddock, herring, whiting, monkfish, mackerel and cod constitute the majority of landings. The relative importance of each of these species to the total landings weights varies depending on the ICES rectangle under consideration.

In the case of scallops, landings weights are particularly high in rectangle 45E7, representing almost 50% of the total. In rectangle 44E7 *Nephrops* and squid account for higher proportions of total average weights. In both rectangles constituting the modified TI study area, haddock represents a considerably higher proportion of total landings than all other fish species. Landings weights for monkfish, cod and herring are comparatively low. Elasmobranch species (sharks and rays) comprise a minimal percentage of the landings weights in the study area being included under the category “other” in Figure 3.2 .

The annual average landings weights (2003 to 2012) by species and the proportion each contributes to the total are shown in Table 3.1 and Table 3.2 for shellfish and fish species respectively.

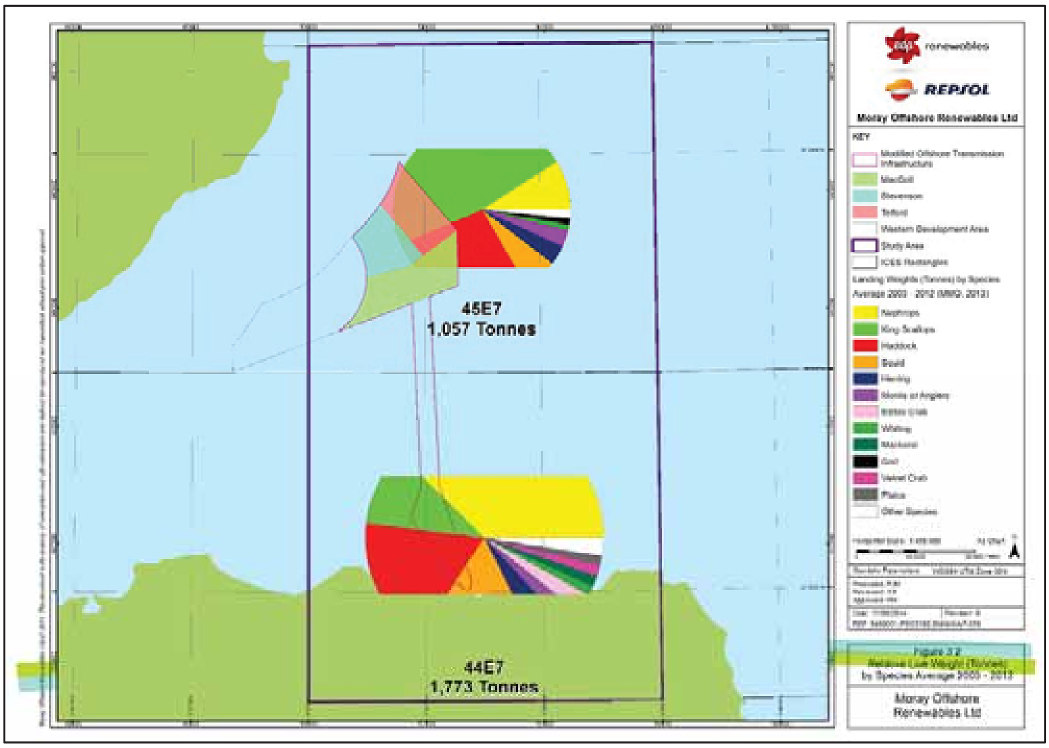

Figure 3.2 Live weight (tonnes) by species by ICES rectangle in the Study Area (2003-2012) (Source: MMO, 2013)

Table 3.1 Annual average landings weights (2003 to 2012) of principal commercial shellfish species in the study area (Source: MMO, 2013)

Common Name	Latin Name	Average (2003 - 2012) Landings Weight (t)	Percentage of Total Shellfish Landings Weight in 44E7 & 45E7	Percentage of Total Landings Weight (all fish and shellfish species combines) in 44E7 & 45E7
Nephrops	*Nephrops norvegicus*	756.7	40.4%	26.7%
King Scallops	*Pecten maximus*	678.2	36.2%	24.0%
Squid	*Loligo forbesi*	356.3	19.0%	12.6%
Edible Crab	*Cancer pagurus*	48.7	2.6%	1.7%
Velvet Crab	*Necora puber*	27.1	1.4%	1.0%
Lobsters	*Homarus gammarus*	3.8	0.2%	0.1%
Queen Scallops	*Aequipecten opercularis*	1.3	0.1%	< 0.1%
Octopus	n/a	1.1	0.1%	< 0.1%
Mixed Crabs	n/a	0.3	< 0.1%	< 0.1%
Whelks	*Buccinum undatum*	0.1	< 0.01%	< 0.01%
Green Crab	*Carcinus maenas*	0.1	< 0.01%	< 0.01%
Razor Clam	*Ensis* spp.	0.0	< 0.01%	< 0.01%
Periwinkles	*Littorina littorea*	0.0	< 0.01%	< 0.001%
Brown Shrimps	*Crangon crangon*	0.0	< 0.001%	< 0.0001%

Table 3.2 Annual average landings weights (2003 to 2012) of principal commercial fish species in the study area (Source: MMO, 2013)

Common Name	Latin Name	Average (2003 - 2012) Landings Weight (t)	Percentage of Total Fish Landings Weight in 44E7 & 45E7	Percentage of Total Landings Weight (all fish and shellfish species combines) in 44E7 & 45E7
Haddock	*Melanogrammus aeglefinus*	592.2	61.9%	20.9%
Herring	*Clupea harengus*	117.1	12.2%	4.1%
Monks or Anglers	*Lophius piscatorius / L. budegassa*	74.8	7.8%	2.6%
Whiting	*Merlangius merlangus*	34.0	3.6%	1.2%
Mackerel	*Scomber scombrus*	29.2	3.1%	1.0%
Cod	*Gadus morhua*	28.8	3.0%	1.0%
Plaice	*Pleuronectes platessa*	26.6	2.8%	0.9%
Witch	*Glyptocephalus cynoglossus*	9.4	1.0%	0.3%
Skates and Rays	n/a	6.5	0.7%	0.2%
Lemon Sole	*Microstomus kitt*	6.3	0.7%	0.2%
Hake	*Merluccius merluccius*	5.3	0.6%	0.2%
Megrim	*Lepidorhombus whiffiagonis*	4.1	0.4%	0.1%
Ling	*Molva molva*	3.4	0.4%	0.1%
Saithe	*Pollachius virens*	2.6	0.3%	0.1%
Halibut	*Hippoglossus hippoglossus*	1.7	0.2%	0.1%
Other Species	n/a	14.3	1.5%	0.5%

3.3 Spawning and Nursery Grounds

The modified TI falls within, or is in close proximity to, the spawning and nursery grounds of a number of species (Coull *et al*., 1998; Ellis *et al*., 2010). These are listed in Table 3.3, together with the spawning times and intensity of spawning (where defined). The spawning times given in Table 3.3 are as provided in Coull *et al*. (1998) and the intensity of the spawning/nursery intensity as described in Ellis *et al*. (2010).

Sandeel, *Nephrops*, cod, plaice, lemon sole, sprat and whiting spawning grounds have all been defined within the vicinity of the three consented wind farms. The modified TI does not cross the spawning grounds of either the Orkney/Shetland or the Buchan herring stocks (the two stocks known to have spawning grounds in the vicinity of the Moray Firth; see Figure 3.6).

In addition to the species listed in Table 3.3, king scallop may also use areas in the vicinity of the modified TI as spawning and nursery grounds. Post-planktonic stages of this species are generally associated with coarse sand gravel substrates and bryozoans/hydroid communities. Similarly, squid are known to spawn in inshore areas from December to June, with peak spawning having been reported from December to March, laying eggs onto biogenic or manmade structures and surfaces. Fishermen have reported finding squid eggs off Burghead and Buckie in May and June in water depths of 5-6 m and eggs have also been found on lobster creels shot on hard ground in the Moray Firth. It is therefore considered that some degree of spawning may take place in the vicinity of the modified TI.

Table 3.3 Species with spawning and nursery areas within/in close proximity to the Modified TI, together with spawning times and intensity (Coull *et al*., 1998; Ellis *et al*., 2010).

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Nursery
Sandeel													
Nephrops				*	*	*							
Cod		*	*										
Plaice	*	*											
Lemon Sole													
Sprat					*	*							
Whiting													
Herring													
Spurdog	n/a												
Thornback Ray	n/a												
Spotted Ray	n/a												
Blue Whiting	n/a												
Ling	n/a												
Hake	n/a												
Anglerfish	n/a												
Mackerel	n/a												
Haddock	n/a												
Saithe	n/a												

Colour key: (red) = high intensity spawning/nursery ground, (yellow) = low intensity spawning/nursery ground, (green) = unknown spawning/nursery intensity, (*) = peak spawning

A review of the species identified as having spawning and nursery grounds in the general area of the modified TI is given in the following sections.

3.3.1 Sandeels

For the purposes of fisheries management, the North Sea sandeel stock has been classified into seven reproductively isolated sub-stocks. The sandeel population of the Moray Firth is part of the Central Western North Sea sub-stock (ICES, 2009).

Sandeels have a prolonged dormant overwintering period (September to March) during which they are buried in benthic substrates (Winslade, 1974b; Wright & Bailey, 1993). This overwintering phase is interrupted by spawning which usually occurs during December and January (Winslade, 1974b; Gauld & Hutcheon, 1990; Bergstad *et al*., 2001). Females lay demersal eggs which hatch as planktonic larvae several weeks after spawning during February and March (Macer, 1965; Langham, 1971; Wright & Bailey, 1996). Following spawning, overwintering resumes until April which marks the start of an extended period of pelagic feeding through spring and summer (Winslade, 1974b; Van der Kooij *et al*., 2008).

Spawning grounds are shown in Figure 3.4 together with the results of recent egg and larval surveys, as presented in Ellis *et al*. (2010a). The modified TI is located in high intensity spawning grounds and a low intensity nursery ground for sandeels (Ellis *et al*., 2010a).

Sandeels are highly substrate specific and as such broad scale patterns of distribution show a high degree of heterogeneity (Wright, 1999a). Sandeels create temporary burrows in the substrate and ventilate their gills with interstitial water. The presence of fine particles of silt rich sediments potentially clogs the gills and inhibits respiration. Therefore, preferred habitats typically comprise a high proportion of medium and coarse sands (particle size 0.25-< 2 mm) with low silt content (Holland *et al*., 2005).

Based on the analysis of 2,885 grab-samples Holland *et al*. (2005) demonstrated that lesser sandeel is likely to be rare in sediments where the silt content (particle size < 0.63 μm) is greater than 4 % and absent where the silt content is greater than 10% (Holland *et al*., 2005; Wright *et al*., 2000). Holland *et al*. (2005) further defined sediment characteristics for suitable and unsuitable habitats for sandeels. A habitat was defined as unsuitable for sandeels if all of the four sediment characteristics described below are present:

- >1% Medium silt AND
- ≤55% Medium sand AND
- >2% Coarse silt AND
- ≤15% Coarse sand

Suitable habitat was only broadly defined requiring one or more of the characteristics:

- >55% Medium sand OR
- >15% Coarse sand OR
- ≤2% Coarse silt OR

In light of the highly specific habitat requirements of sandeels it is expected that the distribution of adults, juveniles, larvae and spawning grounds will occupy discrete 'patches' as opposed to being distributed homogenously throughout the Moray Firth and the area occupied by the modified TI. The benthic particle size distribution (PSD) data indicates that stations KPA2, KPA50 and KPA58 contain substrates suitable for sandeels (Fugro, 2014; Figure 3.3).

Based on the BGS data presented in Figure 3.1 the areas of suitable sandeel habitat are the relatively small discrete areas of slightly gravelly sand and sand located in the north, central and southern areas of the modified TI.

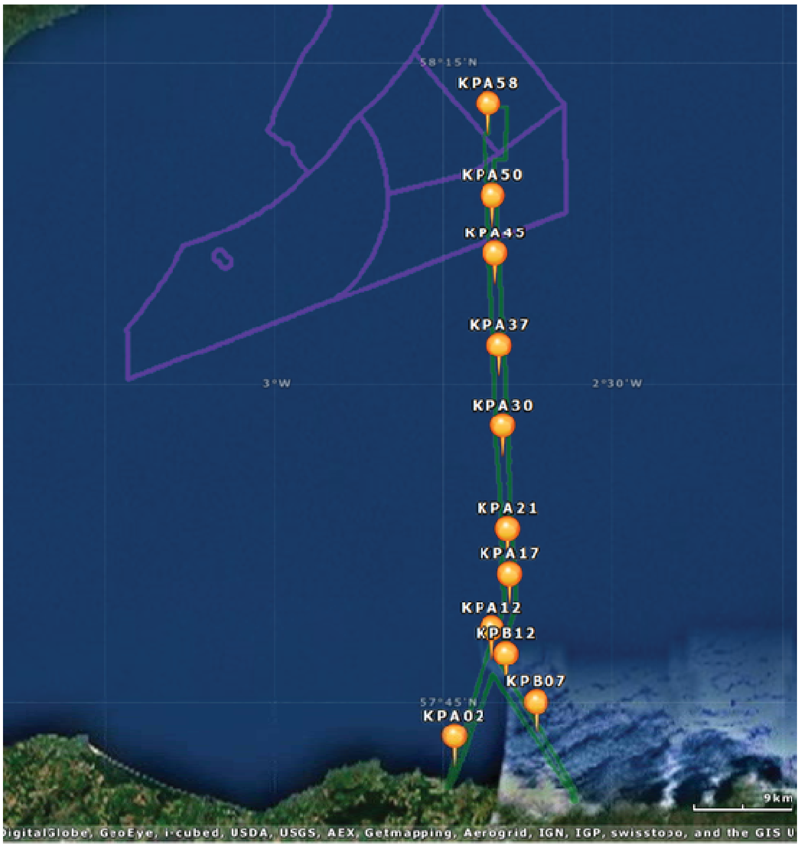

Figure 3.3 Benthic Particle Size Distribution (PSD) sample stations (Fugro, 2014)

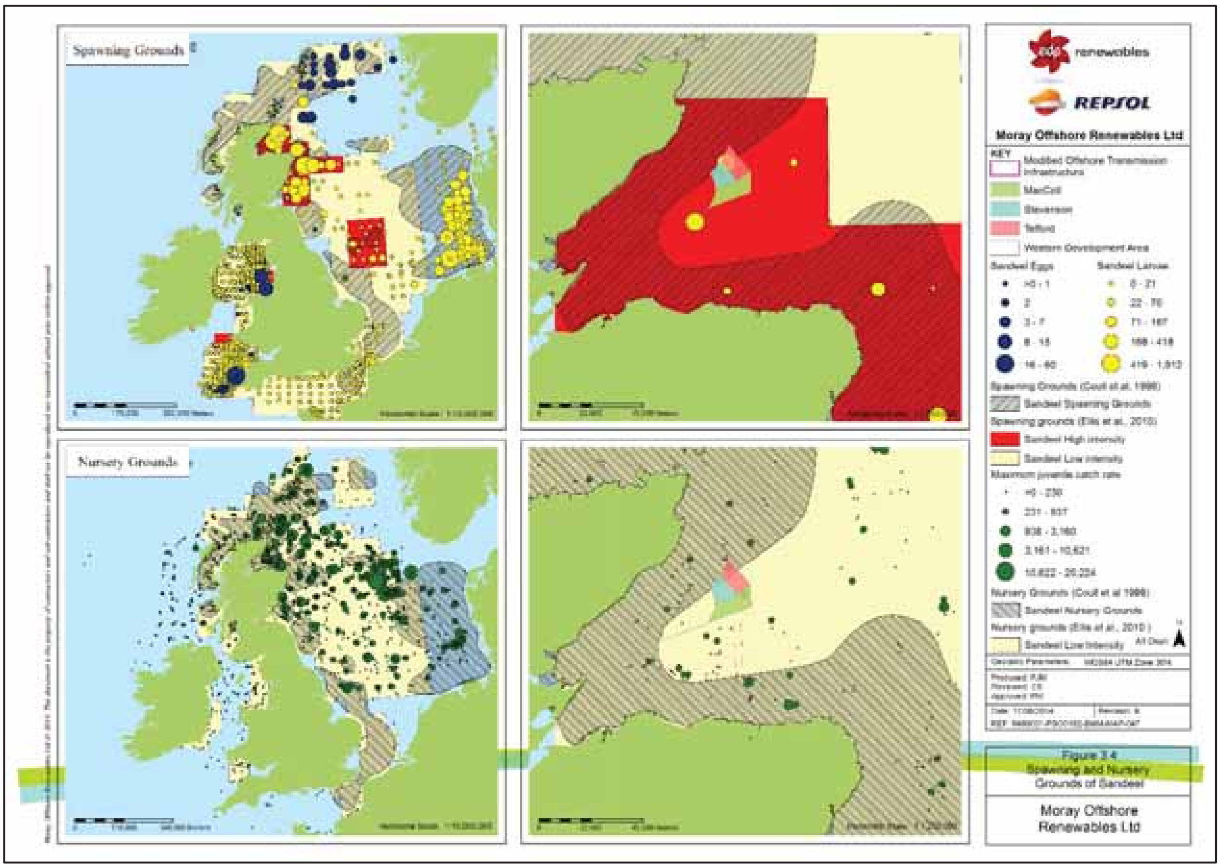

Figure 3.4 Sandeel spawning and nursery grounds (Modified from Ellis *et al*., 2010)

3.3.2 Nephrops

Nephrops are a burrowing species which spend a high proportion of their life cycle in burrows, leaving only when feeding and searching for a mate (Barreto & Bailey, 2013). In Scottish waters, spawning occurs from August to November (Howard 1989; Barreto & Bailey, 2013). Following fertilisation females incubate the eggs exogenously under the abdomen ('berried') for 8-9 months until they hatch as pelagic larvae from late April to August (Howard, 1989). Berried females remain in the burrow throughout the incubation period. Post hatch larval stages develop in the plankton before settling to the seabed six to eight weeks later as juveniles (Barreto & Bailey, 2013). The juveniles then enter burrows, remaining there for approximately one year (Howard, 1989).

Nephrops distribution is dependent upon the availability of substrates composed of fine cohesive mud within which they can construct burrows. Sediment type appears to affect the structure of *Nephrops* populations, with areas of fine sediment being characterised by the presence of large *Nephrops* and low population densities. Conversely, areas of coarser sediment may support higher population densities of smaller sized individuals (Howard, 1989). The benthic PSD data shows that "muddy sand" (BGS classification) was found at stations KPA12, KPA17 and KPB12, which are considered suitable sediments for *Nephrops* (Fugro, 2014; Figure 3.3).

Figure 3.5 shows that the location of the modified TI falls within the *Nephrops* spawning and nursery grounds defined by Coull *et al*. (1998). Based on the presence of significant fisheries in those ICES rectangles occupied by the modified TI, (particularly 44E7) and the presence of suitable habitats (muddy sand and sandy mud, see Figure 3.1) in central areas of its offshore route, it is likely that spawning and nursery grounds could occur in these locations.

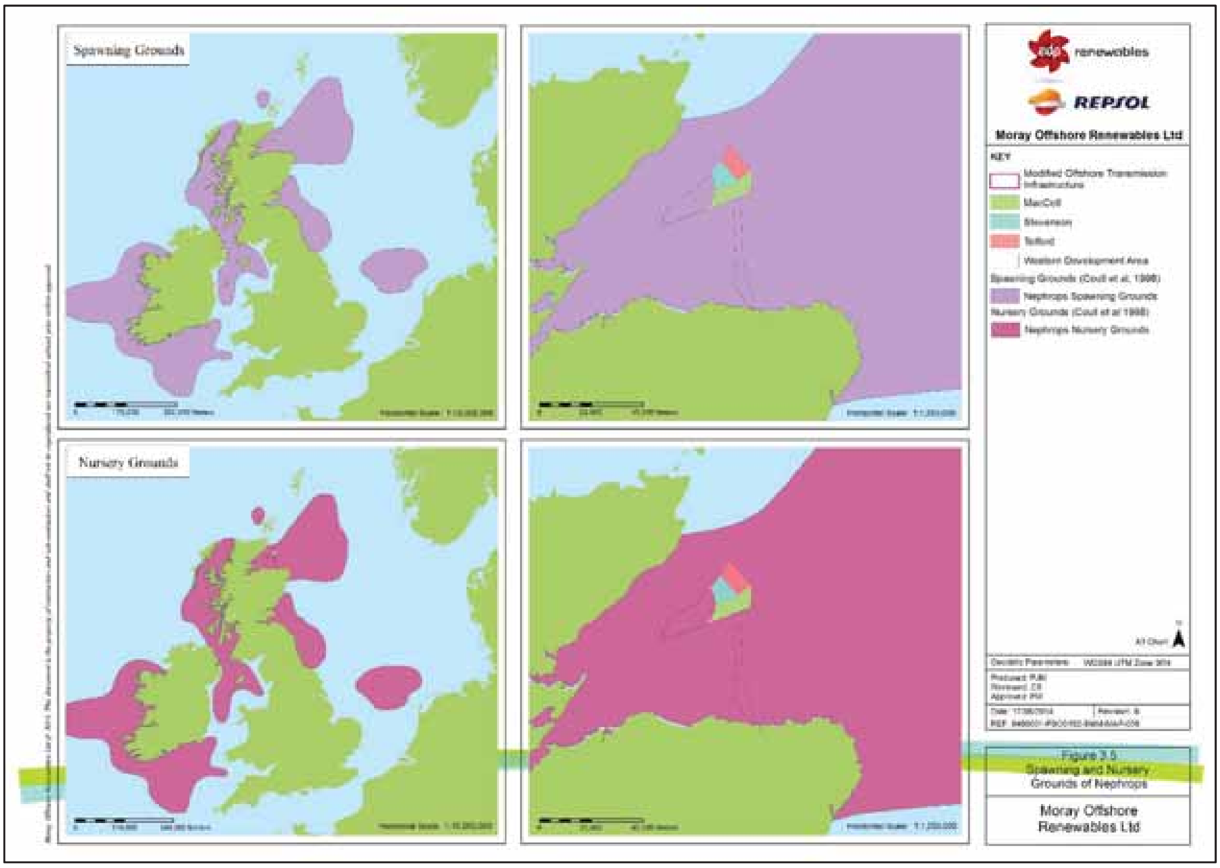

Figure 3.5 Nephrops spawning and nursery grounds (Modified from Coull *et al*., 1998)

3.3.3 Herring

North Sea herring is divided into four sub-stocks on the basis of areas used for spawning. The spatial limits of these sub-stocks are shown in Figure 3.6. The sub-stocks most relevant to the modified TI are the Orkney-Shetland stock and the Buchan stock. The Orkney-Shetland stock spawns off the Scottish east coast and in Shetland/Orkney waters and the Buchan stock spawns outside the Moray Firth off Fraserburgh and south as far as the Firth of Forth.

Herring are demersal spawners and show a strong preference for coarse grounds and high energy environments when selecting spawning grounds (Maucorps, 1969; de Groot, 1980; Blaxter, 1985; Munro *et al*., 1998; Barreto & Bailey, 2013). Females deposit sticky eggs in single batches directly onto the seabed in areas of coarse sand, gravel, small stones or rocks (Hodgson, 1957; Munro *et al*., 1998; Barreto & Bailey, 2013;).

Spawning of the Shetland-Orkney and Buchan sub-stocks occurs between August and September (Coull *et al*., 1998; Barreto & Bailey, 2013) and shoals of herring arrive at traditional spawning grounds in a series of waves, where they congregate (Lambert, 1987). The composition of herring spawning schools changes over time as new fish arrive at spawning grounds and spent fish leave (Geffen, 2009).

It is generally thought that herring larvae hatch after approximately three weeks, depending on sea temperature (Maucorps, 1969; de Groot, 1980; Blaxter, 1985; Munro *et al*., 1998; Barreto & Bailey, 2013). Morley & Batty (1996) found that herring larvae hatch between 6 and 10 days following fertilisation at water temperatures of 14.5°C. Hatched larvae measure between 7 and 10mm and depend on their yolk-sac until first feeding (Hodgson, 1957; ICES, 2013). Once this has been absorbed larvae become pelagic and feed on plankton. They are then passively carried by prevailing currents before arriving at nursery grounds (Munro *et al*., 1998; Barreto & Bailey, 2013). After hatching, herring larvae can travel up to 100 km in the first 15 days (Dickey-Collas *et al*., 2009).

Herring larvae from the Orkney-Shetland stock drift south into nursery grounds in the Moray Firth and east into nursery grounds in the Skagerrak and Kattegat. Larvae of the Buchan stock drift south into nursery grounds in the Firth of Forth and east to Skagerrak and Kattegat.

Herring spawning grounds as presented in Coull *et al*. (1998), including larval densities recorded in the 2008 International Herring Larvae Survey (IHLS) are given in Figure 3.6 (Ellis *et al*., 2010). The extent of herring nursery grounds, together with juvenile catch rates recorded in groundfish surveys are also shown (Ellis *et al*., 2010a). The modified TI does not pass through spawning grounds of either the Orkney-Shetland or Buchan herring stocks (Coull *et al*., 1998) but is located within high intensity nursery grounds as defined by Ellis *et al*. (2010a). Maximum juvenile catch rates were highest west of the central section of the modified TI.

The definition of herring spawning grounds is principally based on the results of the IHLS, which has been undertaken since 1967. A time series of larval densities of the Orkney-Shetland stock (larvae from which are the most likely to drift south into areas occupied by the modified TI) based on data from the IHLS (MSS, 2011a) is provided in Figure 3.7 and Figure 3.8. These show newly hatched larvae (<10 mm) densities from 1973-1994 (1-15 September) and from 1973 to 2004 (16-30 September), respectively. The distribution of larval densities in recent years (2005, 2006, 2008, and 2009) is illustrated in Figure 3.9, as provided in Rohlf & Gröger (2006, 2009, and 2010) and Schmidt *et al*. (2007, 2008).

Based on the data shown it appears that the highest larval densities occur in the north of the Moray Firth, off the coast of Caithness as opposed to central and southern areas relevant to the modified TI. It should be noted that not all stations are sampled each year during the IHLS survey, therefore the lack of larvae in some locations for a particular year does not necessarily imply that spawning did not occur. However, given the long time series for which data is shown it is expected to be broadly representative of the distribution and density of herring larvae within the Moray Firth.

Based on the BGS data presented previously in Figure 3.1, areas of suitable spawning habitat constitute a small proportion of the area covered by the modified TI and are located within the northern and southern sections.

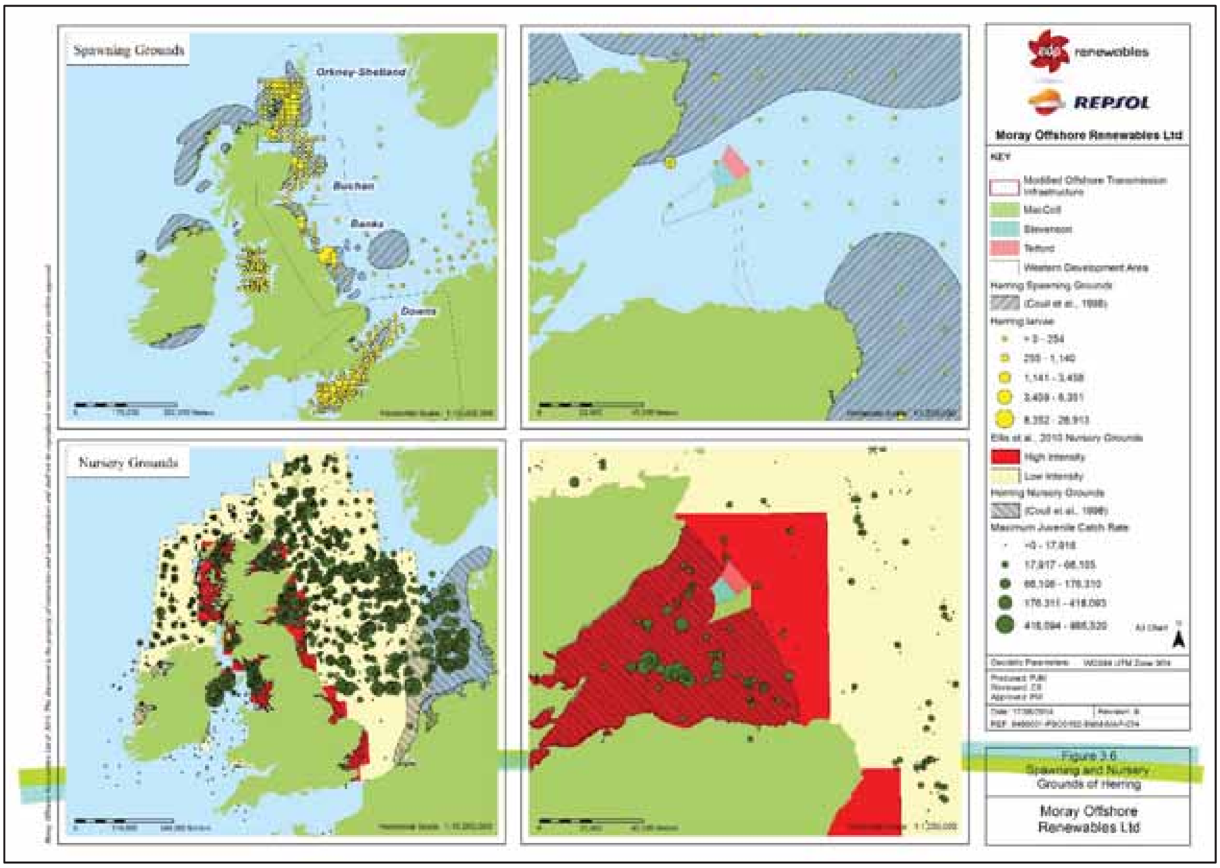

Figure 3.6 Herring spawning and nursery grounds (Modified from Ellis *et al*., 2010)

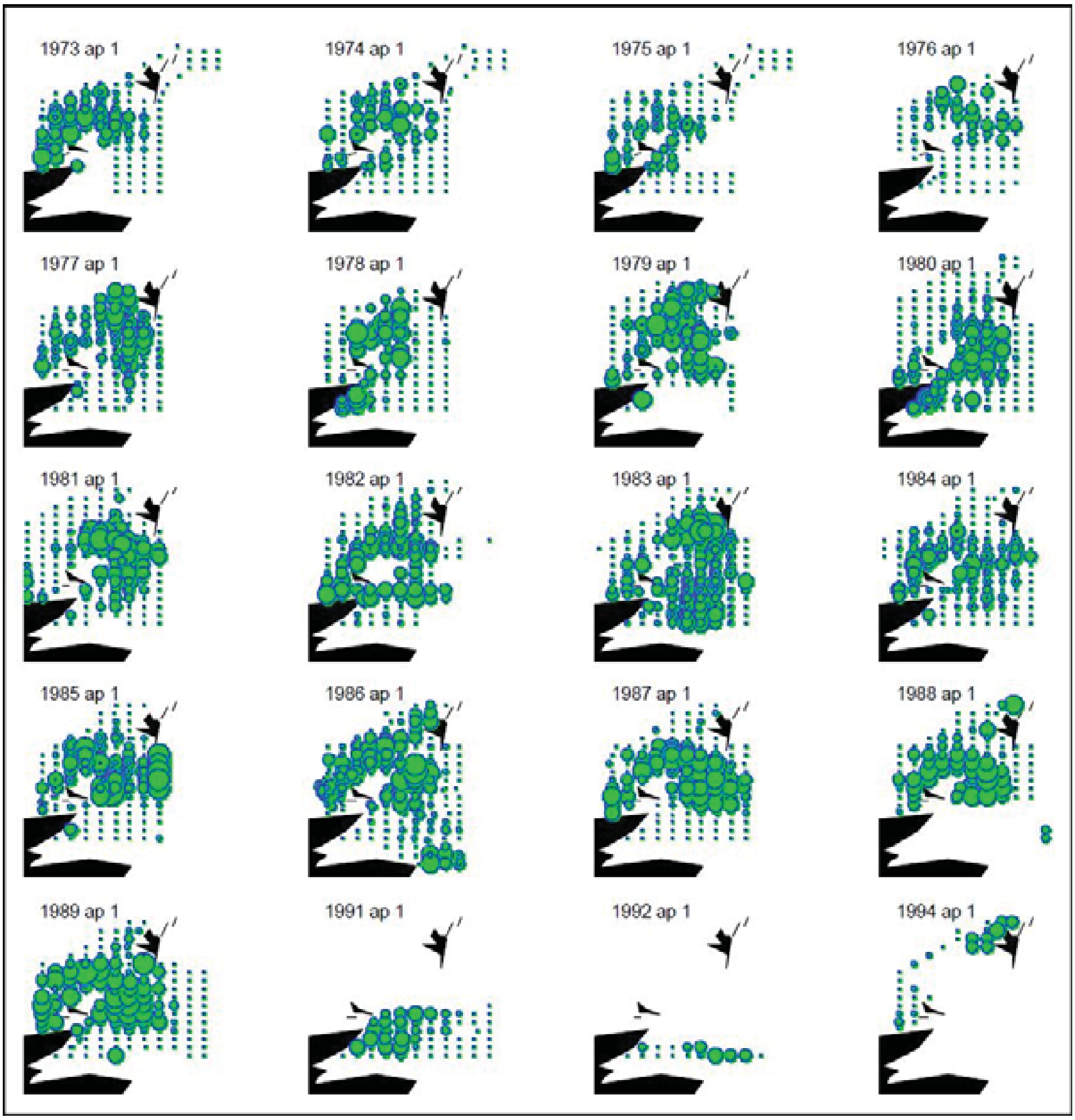

Figure 3.7 International Herring Larvae Surveys charts (1973-1994) of the Orkney/Shetland stock for the period 1 (1-15 September) (Source: Data MSS, 2011a)

Figure 3.8 International Herring Larvae Surveys charts (1973-2004) of the Orkney/Shetland stock for the period 2 (16-30 September) (Source: Data MSS, 2011)

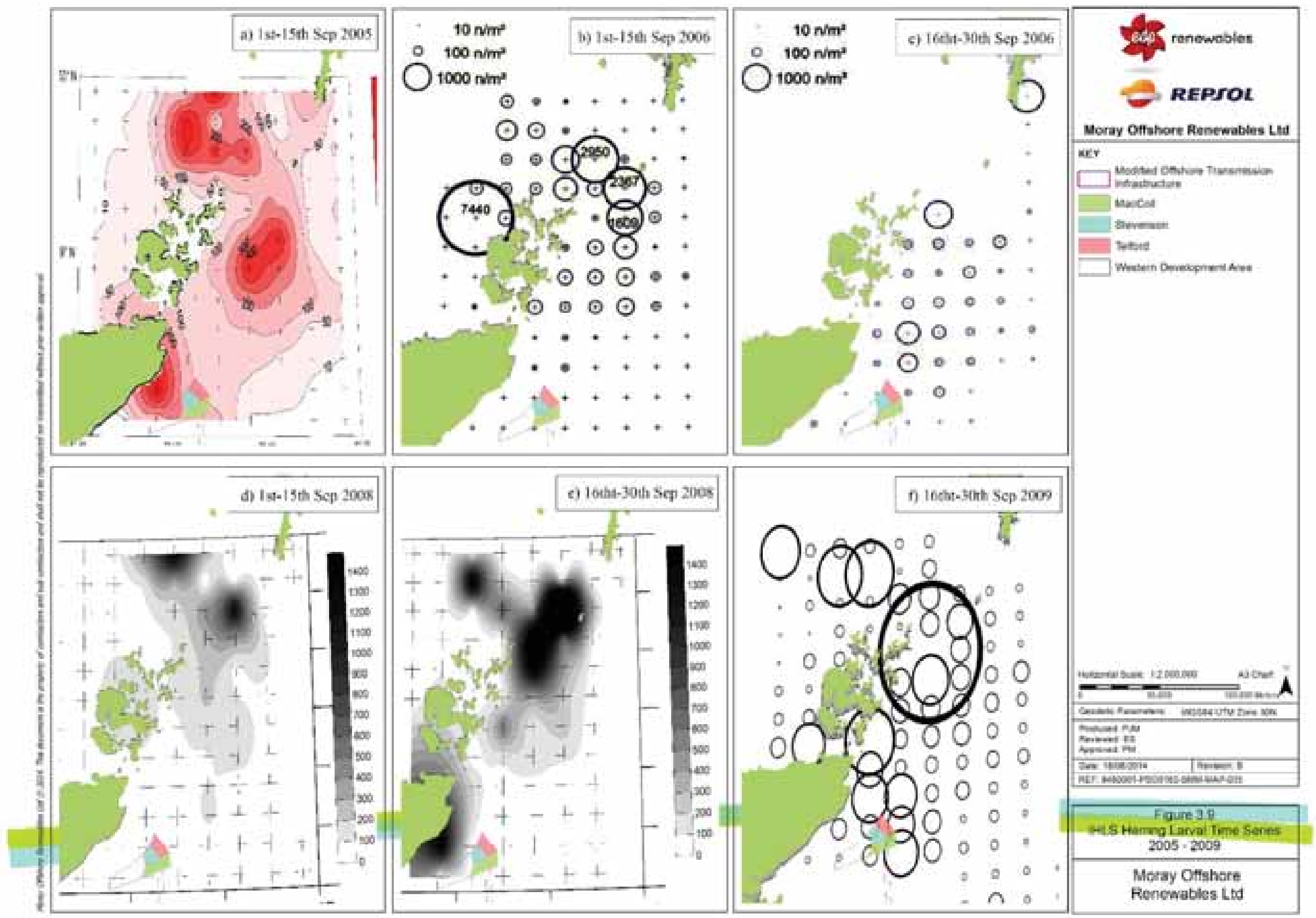

Figure 3.9 International Herring Larval Surveys charts (2005, 2006, 2008, 2009) of the Orkney/Shetland stock (Rohlf & Gröger, 2006, 2009, 2010; Schmidt *et al*., 2007, 2008)

3.3.4 Cod

The cod population of the Moray Firth is genetically distinct from other North Sea populations (Hutchinson *et al*., 2001). Spawning occurs between January and April, generally during hours of darkness and is at its highest intensity from February to March (ICES, 2005a; Coull *et al*., 1998). Spawning occurs within the water column and eggs remain pelagic hatching over a period of two to three weeks, dependant on water temperature (Wright *et al*., 2003). Male cod are known to produce a drumming sound during the spawning season (Nordeide & Kjellsby, 1999; Fudge and Rose, 2009) and it has been suggested that the sounds are used to defend territories and attract females during spawning (Brawn, 1961).

Figure 3.10 shows the extent of cod spawning and nursery grounds. Figure 3.10 also depicts egg and larval densities and juvenile catch rates recorded in ground fish surveys (Ellis *et al*., 2010a). As shown, the proposed location of the modified TI falls within a low intensity cod spawning area.

The Moray Firth has been defined as a high intensity nursery ground for cod. During the North Sea Egg Survey (2004), significant numbers of eggs were found off the Moray Firth and to the east of the Shetland Islands (Fox *et al*., 2008). It has been suggested that passive transport of early life history stages could lead to a substantial advection of cod eggs and larvae from Shetland south to the Scottish east coast (Heath & Gallego, 1997).

Potentially significant impacts on spawning cod were identified as a result of piling noise associated with the installation of the wid farms sites in the EIA submitted as part of the Environmental Statement (ES) detailing the Telford, Stevenson and MacColl Offshore Wind Farms in August 2012 (Chapter 7.2 - Biological Environment). The impact assessment took a precautionary approach, where conservative assumptions were applied due to the uncertainty regarding how cod may utilise the Moray Firth area. In consultation with MSS, MORL committed to undertake additional survey work and monitoring with the objective of increasing the confidence in the impact assessment and identifying whether further mitigation would be required.

Results of the survey are shown in Figure 3.11 and Figure 3.12. Cod were recorded in low numbers at 35 out of 58 stations with a maximum of 9 individuals caught at a single station (0T38, Trip B). A total of 23 spawning cod were caught throughout the survey, 12 in Trip A and 11 in Trip B. Further detail is provided in Appendix 1 (Cod Survey Report).

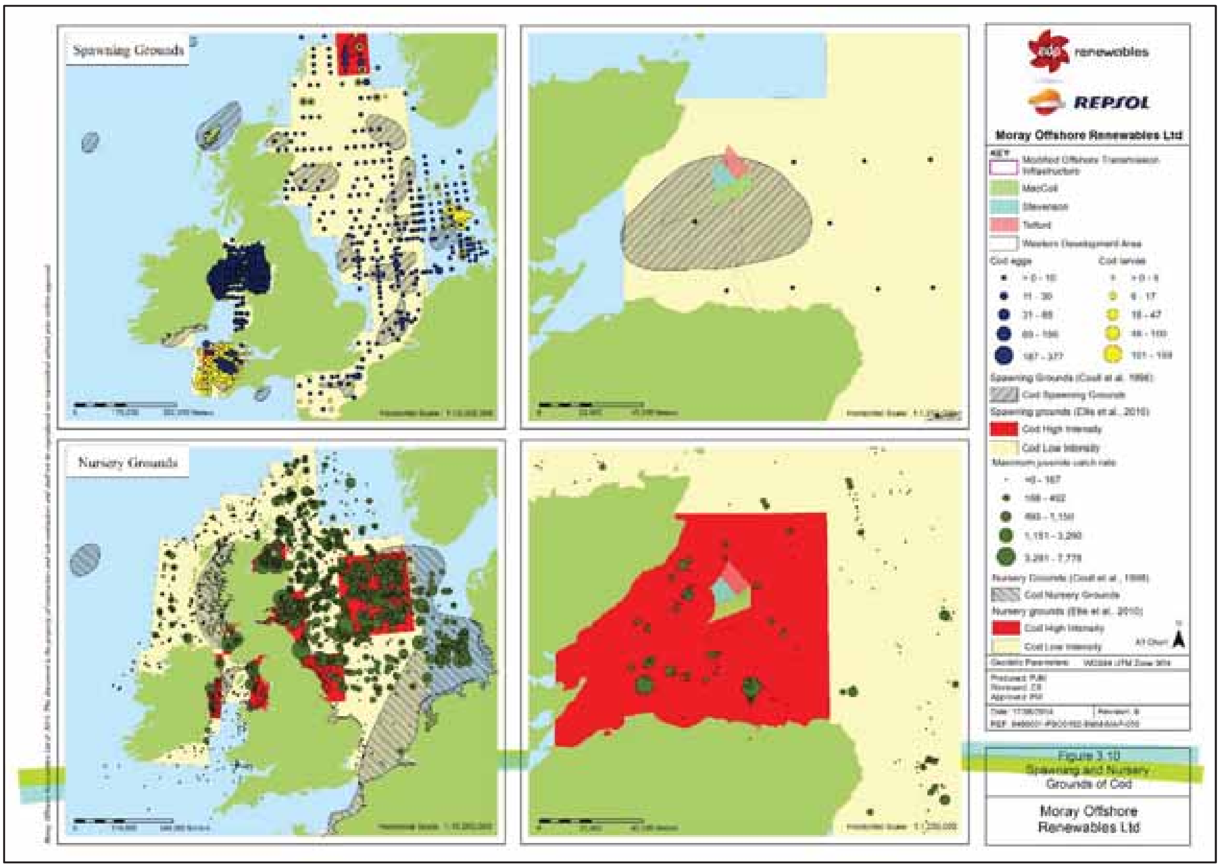

Figure 3.10 Cod spawning and nursery grounds (Modified from Ellis *et al*., 2010)

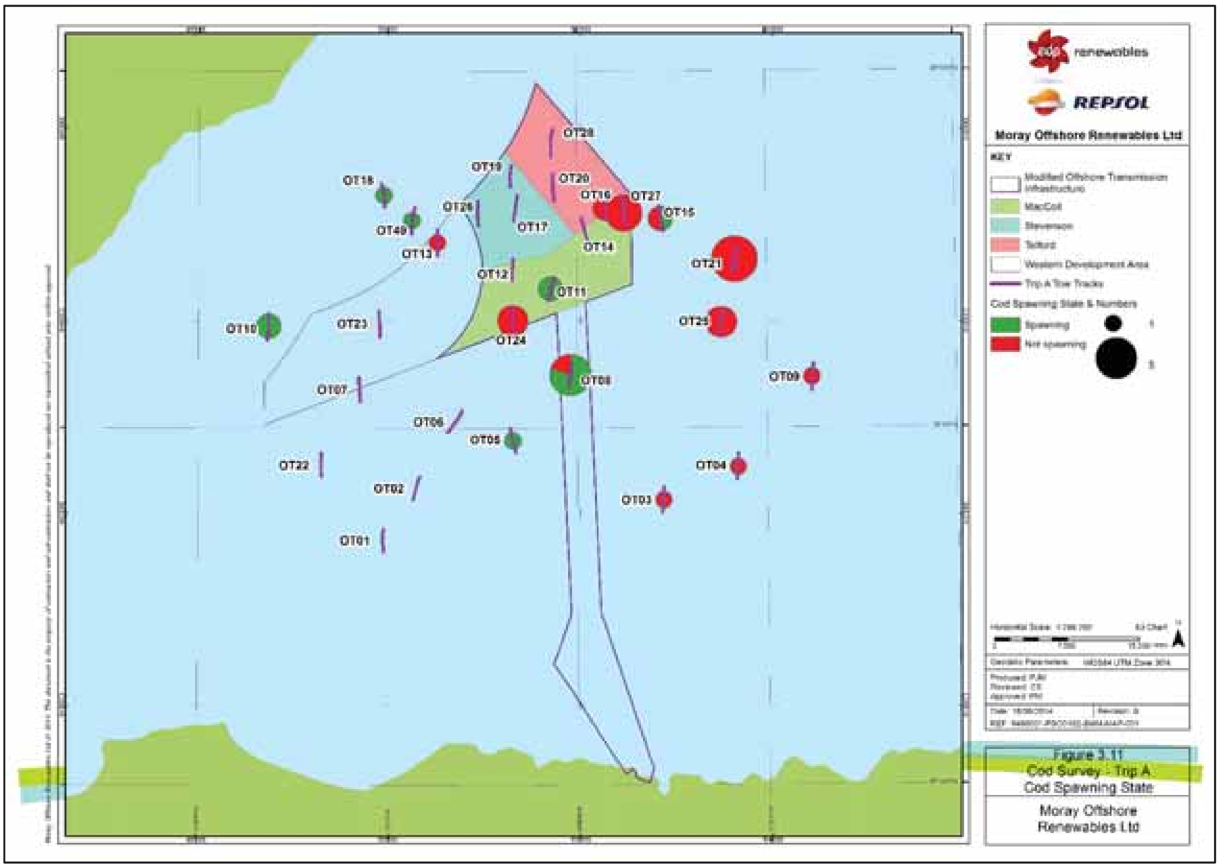

Figure 3.11 Cod survey (trip A) cod spawning state

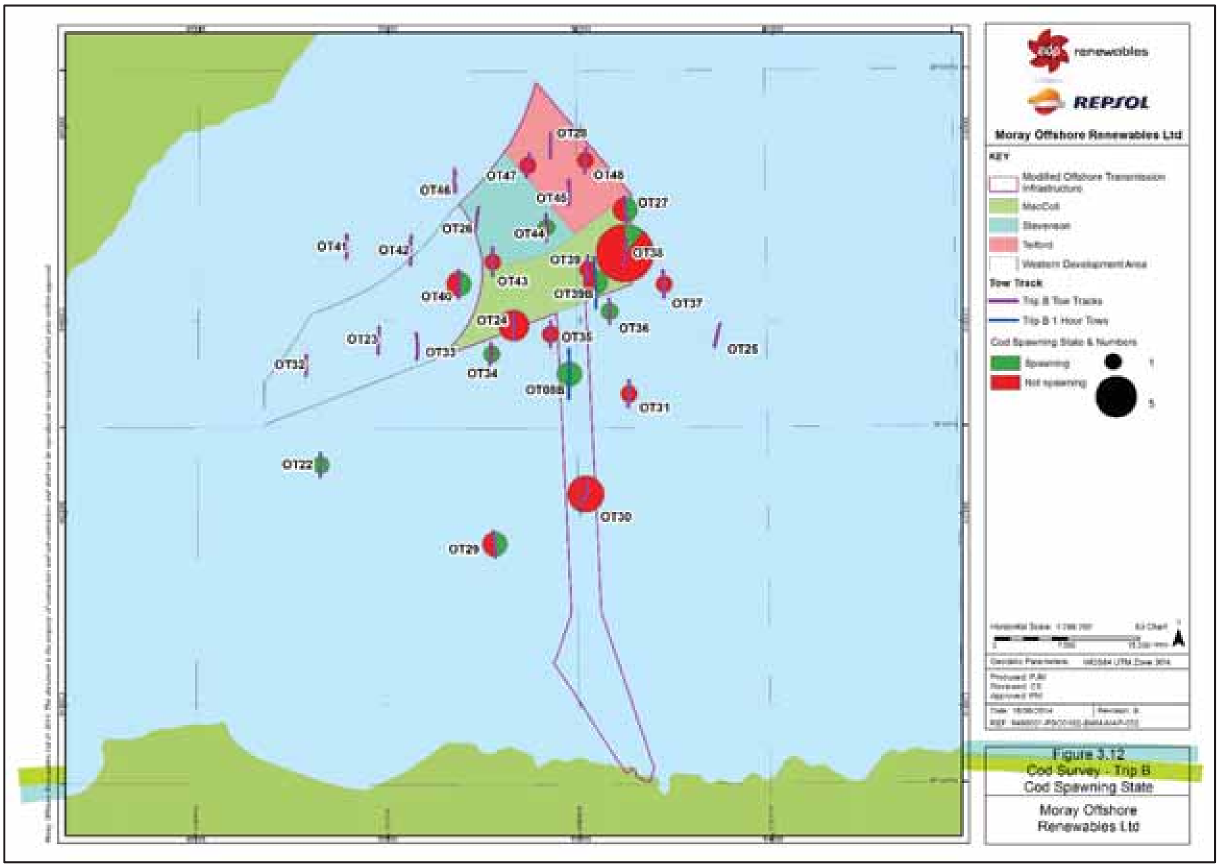

Figure 3.12 Cod survey (trip B) cod spawning state

3.3.5 Plaice

Figure 3.13 shows the distribution of plaice spawning grounds as defined by Coull *et al*. (1998). Figure 3.12 also provides larvae and egg densities as provided in Ellis *et al*. (2010a). A small area to the northwest and an area to the south of the plaice spawning grounds defined by Coull *et al*. (1998) are crossed by the modified TI. The area occupied by the modified TI has also been identified as a low intensity nursery ground.

Plaice spawn between December and March with a peak usually occurring in February/March (Harding *et al*., 1978; Simpson, 1959; Rijnsdorp, 1989;;). Plaice are pelagic spawners and rarely spawn beyond the 50 m depth contour (Harding *et al*., 1978; Rijnsdorp, 1989; Armstrong *et al*., 2001; Murua & Saborido-Rey, 2003). Females spawn over a period of 4-6 weeks (Rijnsdorp, 1989). Eggs hatch into pelagic larvae between 7 and 21 days dependant on water temperature (Fox *et al*., 2003).

The results of the North Sea Egg Survey (2004) showed that plaice eggs showed a patchy distribution with higher abundances in the areas of Flamborough Head, the Firth of Forth, the Moray Firth and to the east of the Shetland Isles (ICES, 2005b). Assuming spawning is relatively continuous, the centres of density of stage I eggs should be close to the sites of spawning although up to three days drift and dispersion may have occurred (ICES, 2005b).

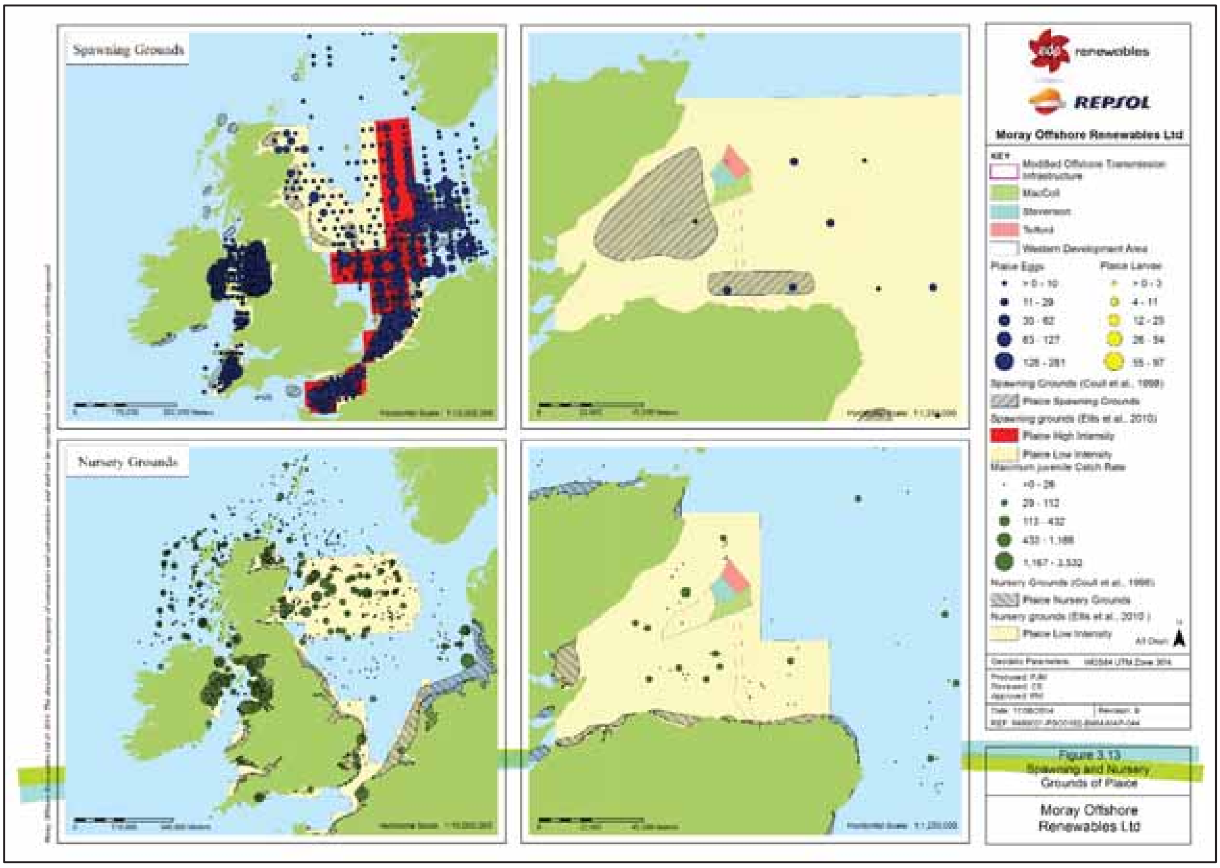

Figure 3.13 Plaice spawning and nursery grounds (Modified from Ellis *et al*., 2010)

3.3.6 Lemon sole

Figure 3.14 shows that the modified TI is situated within lemon sole spawning grounds defined by Coull *et al*. (1998). Lemon sole is widely distributed throughout the North Sea and is thought to spawn where it is found (Rogers & Stocks, 2001). Spawning occurs from April until September (Coull *et al*., 1998). Figure 3.14 shows that nursery grounds have been identified within the vicinity of the modified TI (Coull *et al*., 1998).

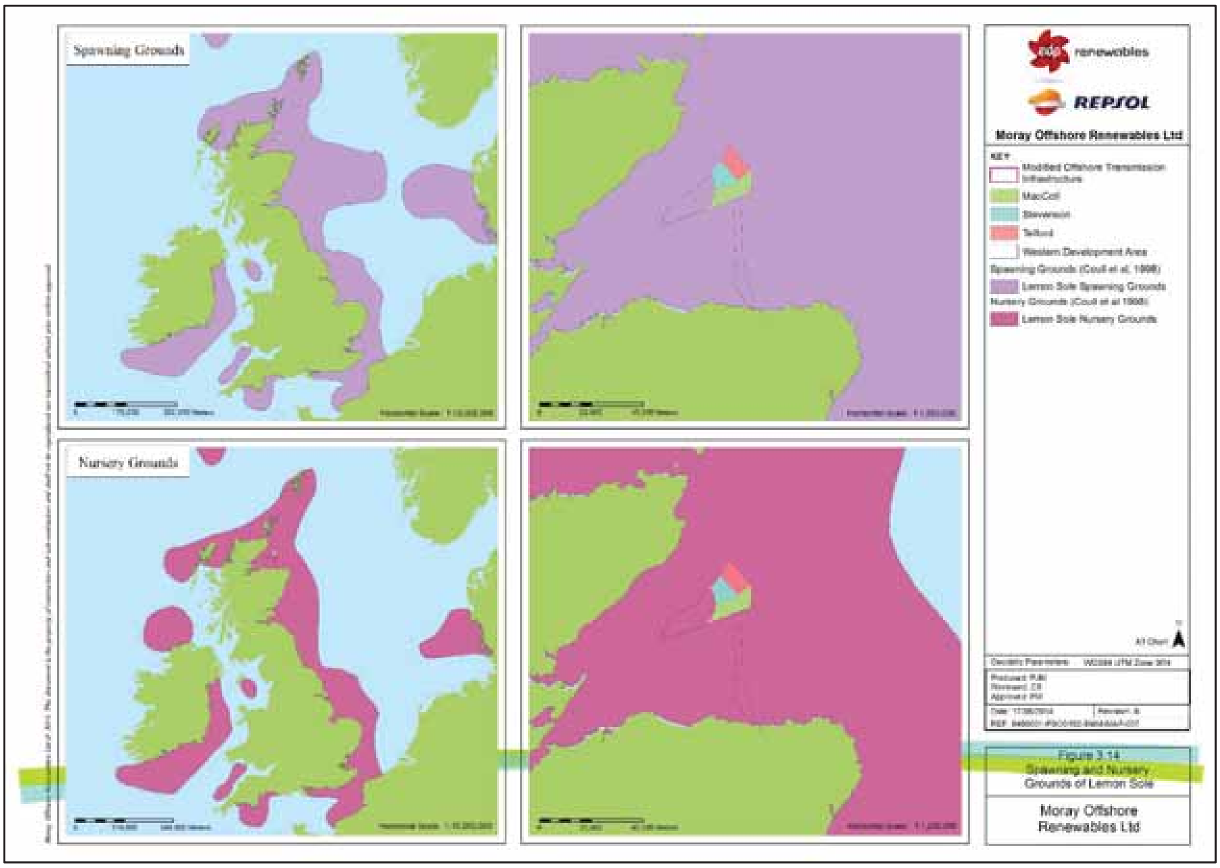

Figure 3.14 Lemon sole spawning and nursery grounds (Modified from Coull *et al*., 1998)

3.3.7 Sprat

Figure 3.15 shows that the modified TI falls within sprat spawning and nursery grounds defined by Coull *et al*. (1998). As shown, the spawning grounds of this species are widely distributed around the British Isles. Spawning takes place from May to August (Coull *et al*., 1998), peaking in May to early July (Kraus & Köster, 2001). Spawning occurs in both coastal and offshore waters up to 100 km from the shore (Whitehead, 1986; Nissling *et al*., 2003; FAO, 2011). Females spawn repeatedly in batches throughout the spawning season (Milligan, 1986). Eggs and larvae of sprat are pelagic and subject to larval drift, often moving into coastal nursery areas (Nissling *et al*., 2003; Hinrichsen *et al*., 2005). Feeding larvae are mainly found in the upper layers of the water column (Nissling *et al*., 2003).

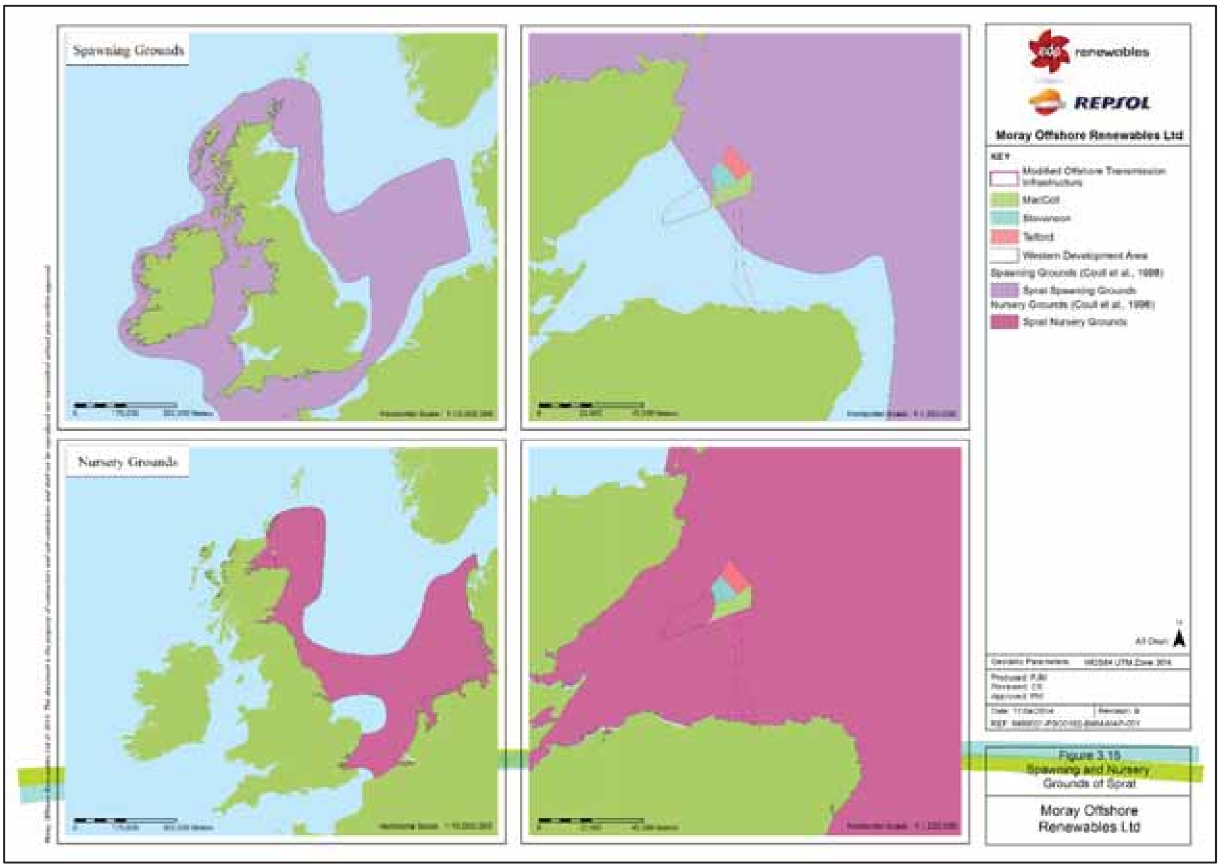

Figure 3.15 Sprat spawning and nursery grounds (Modified from Coull *et al*., 1998)

3.3.8 Haddock

Figure 3.16 shows that the modified TI does not overlap with haddock spawning grounds as defined by Coull *et al*. (1998) although a more recent publication (Barreto & Bailey, 2013) shows that spawning occurs in an additional location to the east of the Moray Firth. However, these grounds are located some distance away from the location of the modified TI. The modified TI does however fall within the haddock nursery grounds as defined by Coull *et al*. (1998).

Results of international ichthyoplankton surveys carried out in 2004 found high concentrations of haddock stage I eggs in and off the Moray Firth (ICES, 2005b) and surveys conducted by the Fisheries Research Services (FRS) in 1999 found haddock spawning in both coastal and offshore areas (Gibb *et al*., 2004). The highest densities of mature and spawning haddock were found in depths of around 100 m and most fish were associated with areas of mud or sand with abundance apparently reduced over areas of harder substrate (Gibb *et al*., 2004).

Haddock spawn between February and May (Coull *et al*., 1998), at depths of 50-150-m (Fillina *et al*., 2009; FAO, 2011), with the peak spawning occurring in March and April (Coull *et al*., 1998; Fillina *et al*., 2009). Haddock are serial spawners, releasing their eggs in batches over the spawning season (Gibb *et al*., 2004; Fillina *et al*., 2009). Haddock eggs are laid demersally and rise into the water column following fertilisation and develop into pelagic larvae (Page & Frank, 1989). Haddock are capable of producing a wide range of sounds (Wahlberg & Westerberg, 2005) and those produced by males during the spawning season are thought to serve to bring male and female fish together. In addition, it has been suggested that the sounds play a role in synchronising the reproductive behaviour of males and females (Hawkins & Amorim, 2000).

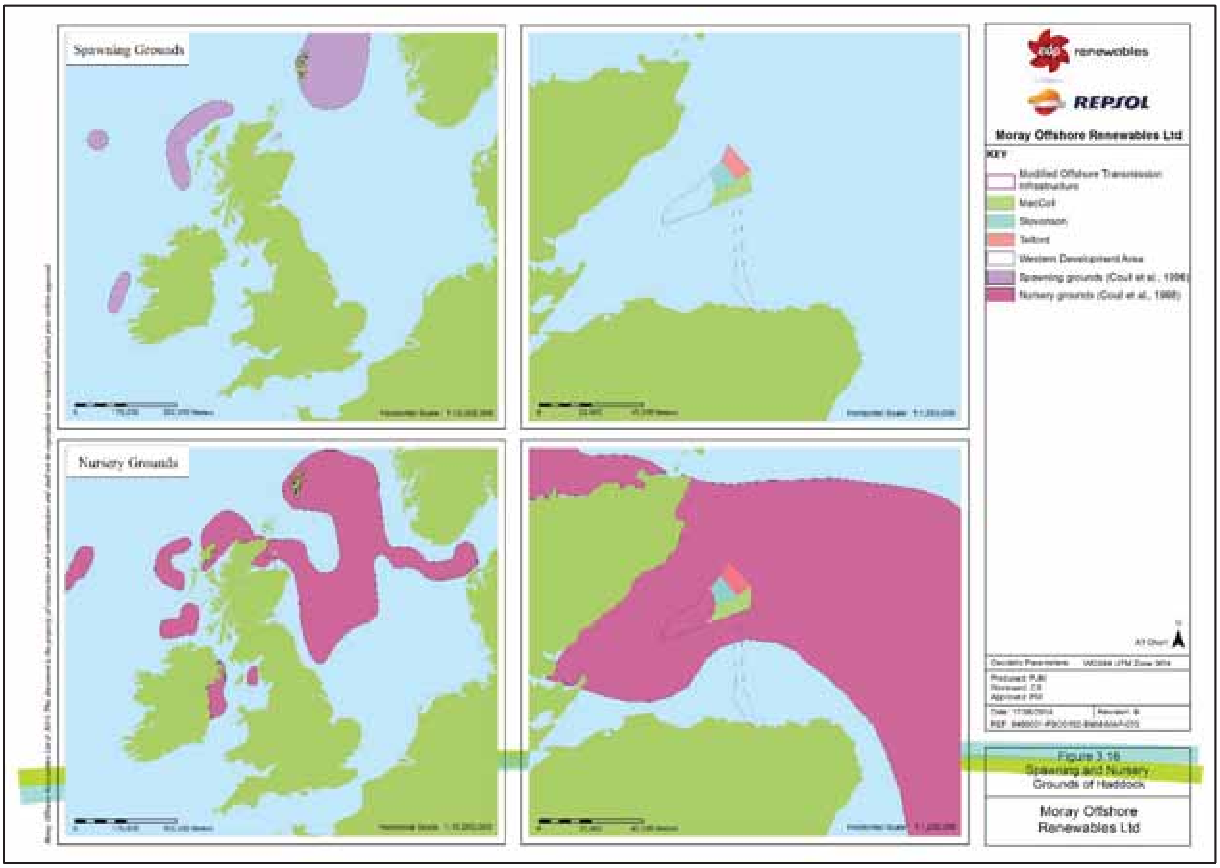

Figure 3.16 Haddock spawning and nursery grounds (Modified from Coull *et al*., 1998)

3.3.9 Whiting

Figure 3.17 shows that the modified TI occupies a small area of the whiting spawning grounds defined by Coull *et al*. (1998) along their western extent. The modified TI is defined as a low intensity spawning ground and high intensity nursery ground by Ellis *et al*. (2010a).

Whiting spawn between February and June with females releasing their eggs in numerous batches for up to fourteen weeks (Teal *et al*., 2009). Eggs are pelagic and take approximately ten days to hatch (Russel, 1976).

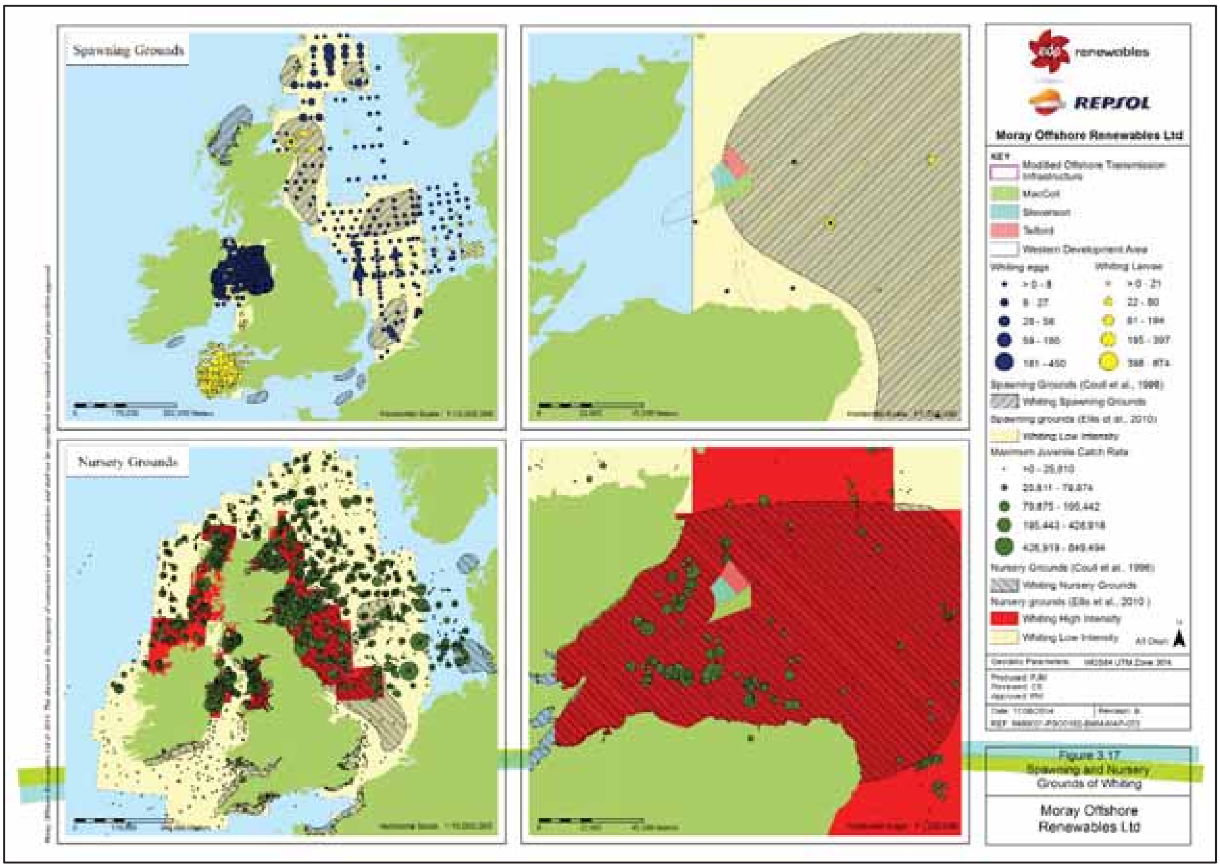

Figure 3.17 Whiting spawning and nursery grounds (Modified from Ellis *et al*., 2010)

3.3.10 Other Species with Nursery Grounds

Nursery grounds have been defined in the vicinty of the modified TI for a number of other species in addition to those described in the sections above (See Table 3.3). These are shown in Figure 3.18 and Figure 3.19 as defined by Coull *et al*. (1998) and Ellis *et al*. (2010a). Nursery grounds have not been identified in the vicinity of the modified TI for tope or ling (Figure 3.18 and Figure 3.19).

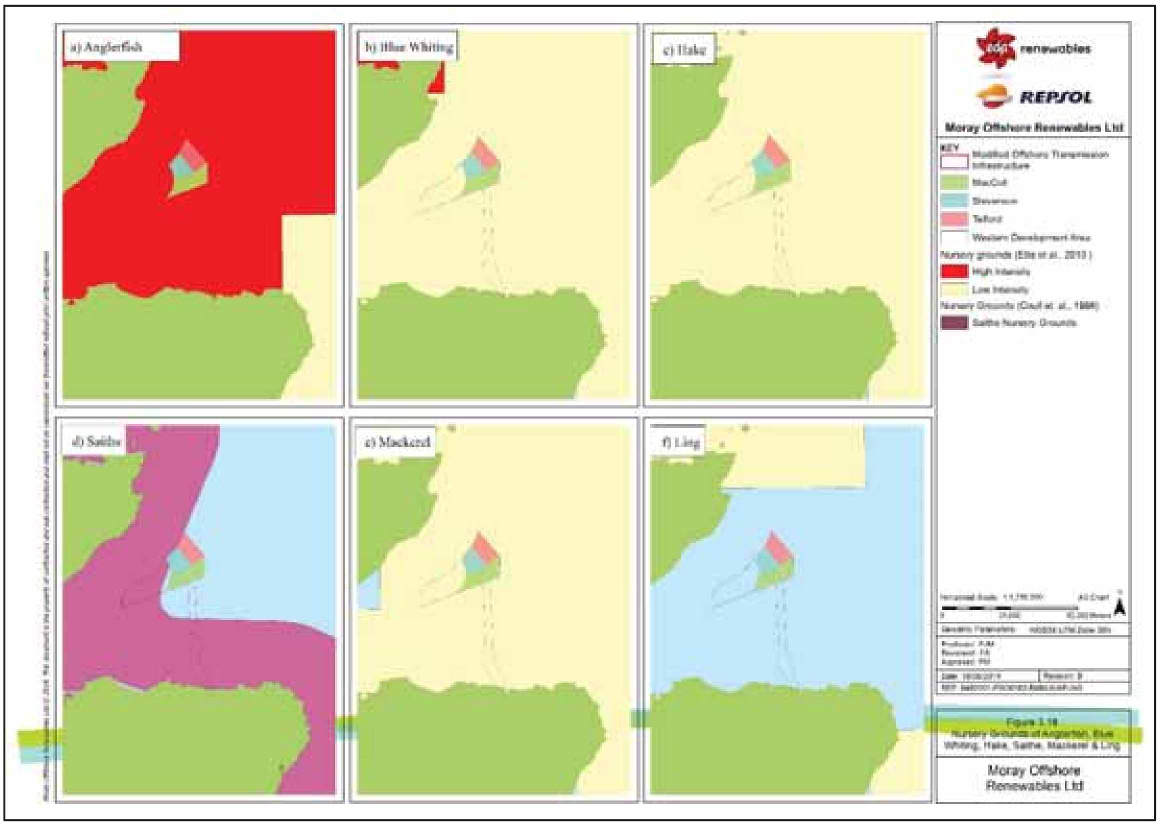

Figure 3.18 Nursery grounds of anglerfish, blue whiting, hake, saithe, mackerel and ling (Modified from Ellis *et al*., 2010 and Coull *et al*., 1998)

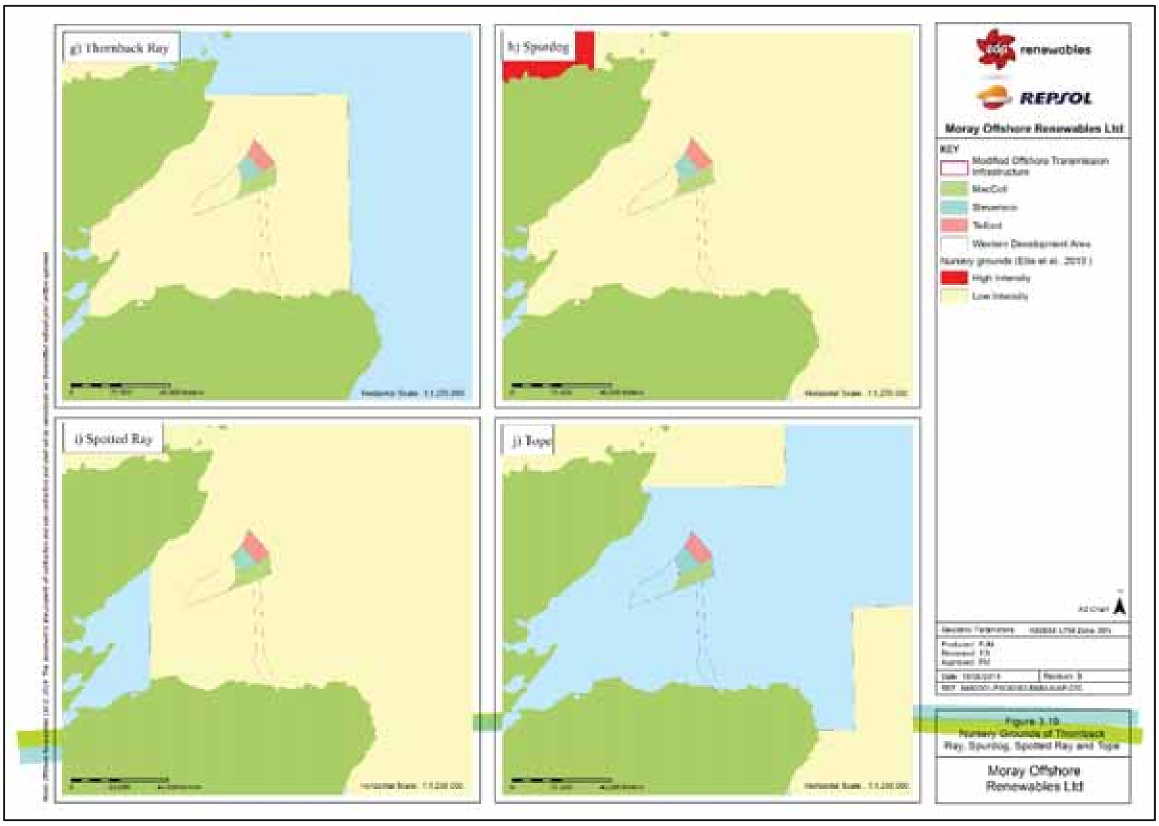

Figure 3.19 Nursery grounds of thornback ray, spurdog, spotted ray and tope (Modified from Ellis *et al*., 2010 and Coull *et al*., 1998)

3.4 Key Species in the Food-web

Abundant species with high biomass such as sandeels and clupeids (e.g. herring and sprat) play an important functional role in North Sea food web dynamics. These species occupy intermediate trophic levels, are significant predators of zooplankton and represent a key dietary component for a variety of aquatic predators.

Species of sandeels and Clupeidae are important prey for piscivorous fish such as elasmobranchs, gadoids, bass, mackerel, and diadromous salmonids, amongst others (ICES, 2005a; ICES, 2005b; ICES, 2006; ICES, 2008; ICES, 2009). Studies conducted by Greenstreet *et al*. (1998) in the inner Moray Firth showed that sandeels comprised the majority of the diet for whiting and haddock (all size classes) in June, whilst from October to January, the proportion of sandeels in the diet of whiting and haddock was gradually replaced by sprat.

In addition, the demersal egg mats of herring are known to aggregate fish predators (Richardson *et al*., 2011). The diets of marine mammals such as seals, harbour porpoise and Minke whales are also subsidised by sandeels and clupeids (Olsen & Holst, 2001; Santos and Pierce, 2003; Pierce *et al*., 2004). Sandeels and clupeids are also an important resource for seabirds (Wanless *et al*., 2005).

3.5 Species of Conservation Importance

A number of species of conservation importance have been identified as potentially present in the Moray Firth and the wider area. These include diadromous migratory species, elasmobranchs and a number of fish species which are targeted commercially.

Diadromous migratory species potentially present in the vicinity of the modified TI and their conservation status are given in Table 3.4. Species include European eel, allis and twaite shad, sea and river lamprey, smelt, salmon and sea trout.

Elasmobranchs have slow growth rates and low reproductive output compared to other species groups (Camhi *et al*., 1998). As a result, stock resilience to fishing mortality is low (Smith *et al*., 1998) and recovery rates are likely to be slow where directed fisheries have depleted abundance (Holden, 1974; Bonfil, 1994; Musick, 2005). A summary of the principal species with conservation status and /or declining stocks potentially present in the vicinity of the modified TI is provided in Table 3.5.

In addition to the above, a number of other fish species with conservation status may be present in the area of the modified TI. The majority of these are commercially exploited in the Moray Firth having been recorded in landings data within the study area and are given in Table 3.6.

Table 3.4 Diadromous species of conservation importance in the Moray Firth

Common Name	Scientific Name	Conservation Status								
		OSPAR	IUCN Red List	Bern Convention	Habitats Directive	The Wildlife & Countryside Act 1981	The Conservation (Natural Habitats, &c.) Regulations 1994	UK BAP species	Scottish Priority Marine Feature (PMF)	The Nature Conservation (Scotland) Act 2004
European eel	*Anguilla anguilla*	✓	Critically endangered	-	-	-	-	✓	✓	-
Allis shad	*Alosa alosa*	✓	Least concern	✓	✓	✓	✓	✓	-	-
Twaite shad	*Alosa fallax*	-	Least concern	✓	✓	✓	✓	✓	-	-
Sea Lamprey	*Petromyzon marinus*	✓	Least concern	✓	✓	-	-	✓	✓	-
River Lamprey	*Lampetra fluviatilis*	-	Least concern	✓	✓	-	✓	✓	✓	-
Smelt	*Osmerus eperlanus*	-	Least concern	-	-	-	-	✓	✓*	-
Salmon	*Salmo salar*	✓	Lower Risk/least concern	✓	✓	-	✓	✓	✓	-
Sea Trout	*Salmo trutta*	-	Least concern	-	-	-	-	✓	✓	-

Table 3.5 Principal elasmobranch species with conservation status recorded in the Moray Firth

Common Name	Latin Name	MMO Landings Data	Recorded in the Moray Firth (Ellis *et al.*, 2005)	Conservation Status						
				OSPAR	IUCN Red List	The Wildlife & Countryside Act 1981	The Conservation (Natural Habitats, &c.) Regulations 1994	UK BAP species	Scottish Priority Marine Feature (PMF)	The Nature Conservation (Scotland) Act 2004
Sharks										
Basking shark	*Cetorhinus maximus*	-	-	✓	Vulnerable	✓	-	✓	✓	✓
Blue shark	*Prionace glauca*	-	-	-	Near threatened	-	-	✓	-	-
Leafscale gulper shark	*Centrophorus squamosus*	✓	-	✓	Vulnerable	-	-	✓	-	-
Porbeagle	*Lamna nasus*	-	-	✓	Vulnerable	-	-	✓	-	-
Portuguese dogfish	*Centroscymnus coelolepis*	✓	-	✓	Near threatened	-	-	✓	-	-
Spurdog	*Squalus acanthias*	✓	✓	✓	Vulnerable	-	-	✓	✓	-
Skates and Rays										
Sandy ray	*Leucoraja circularis*	-	-	-	Vulnerable	-	-	✓	-	-
Spotted ray	*Raja montagui*	-	✓	✓	Least concern	-	-	-	-	-
Thornback ray	*Raja clavata*	✓	✓	✓	Near Threatened	-	-	-	-	-

Table 3.6 Conservation status of fish species recorded in landings data (2000 to 2009) of the study area

Common Name	Latin name	Scottish Priority Marine Feature	UK BAP Species	OSPAR	IUCN Red List
Anglerfish	*Lophius piscatorius*	✓ (juveniles)	✓	-	-
Atlantic halibut	*Hippoglossus hippoglossus*	-	✓	-	Endangered
Atlantic mackerel	*Scomber scombrus*	✓	✓	-	-
Black scabbardfish	*Aphanopus carbo*	-	✓	-	-
Blue ling	*Molva dypterygia*	-	✓	-	-
Cod	*Gadus morhua*	✓	✓	✓	Vulnerable
Greenland halibut	*Reinhardtius hippoglossoides*	-	✓	-	-
Hake	*Merluccius merluccius*	-	✓	-	-
Herring	*Clupea harengus*	✓ (juveniles and spawning adults)	✓	-	Least concern
Horse mackerel	*Trachurus trachurus*	-	✓	-	-
Ling	*Molva molva*	✓	✓	-	-
Plaice	*Peluronectes platessa*	-	✓	-	Least concern
Roundnose Grenadier	*Coryphaenoides rupestris*	-	✓	-	-
Saithe	*Pollachius virens*	✓ (juveniles)	-	-	-
Sandeels	*Ammodytes marinus*	✓	✓	-	-
	Ammodytes tobianus	✓	-	-	-
Whiting	*Merlangius merlangus*	✓ (juveniles)	✓	-	-

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Appendices

Appendix 1 – Cod Survey Report

Summary

The North Sea cod stock is assessed as a single unit however there is evidence of sub-stock structuring (ICES 2007; Fox *et al.,* 2008). The Moray Firth cod stock is reproductively isolated from other North Sea stocks. Spawning grounds for this species have been defined in the area of the MORL development (i.e. Coull *et al.,* 1998; Ellis *et al.,* 2010) however the degree of spawning activity currently taking place in this area is unknown. The objective of this survey was to determine whether significant cod spawning currently takes place in the area of the Moray Firth Round 3 and its vicinity.

The survey was carried out in two trips between 17th February and 19th March 2013 (Trip A from 17th February to 26th February and Trip B from 10th March to 19th March) coinciding with the peak spawning season. Sampling was undertaking using a commercial rock-hopper otter trawl with a 120 mm mesh cod end, fitted with a 20 mm blinder (provided by Marine Scotland Science, hereinafter referred to as MSS). Fifty-six tows of 30 minutes duration were undertaken within and adjacent to the MORL Round 3 Area to cover areas of the cod spawning grounds defined by Coull *et al.* (1998) where noise levels at which cod may exhibit strong avoidance reactions during the construction phase may occur (90dB$_{ht}$ (*Gadus morhua*) level). Two tows of 60 minutes duration were also carried at the request of MSS to determine whether larger cod were out-swimming the net in the 30 minute tows.

The catch from each otter trawl was emptied into the hopper, photographed, and sorted into baskets by species. The length, sex and spawning condition of all cod was identified and recorded. The gonads of each individual were photographed. In Trip A up to three male gonads and five female gonads of each maturity stage were fixed with 4% seawater buffered formalin solution. Gonad samples were delivered to MSS at the end of Trip A to verify the maturity stage analysis carried out at sea.

Cod were recorded in 35 out of 58 stations in relatively low numbers, with a maximum of nine individuals caught at a single station (OT38, Trip B). A total of 23 spawning cod were caught in the survey, 12 in Trip A and 11 in Trip B.

Cod catch rates will be calculated by MSS using the Scanmar outputs (swept area per tow) and used to determine whether significant cod spawning is taking place in the Moray Firth Round 3 Area and/or in adjacent locations.

All by-catch fish and commercial shellfish species were identified, counted, measured and returned to the sea; where necessary sub-sampling was carried out at sea by species. A total of 45 by-catch species were caught in the survey. Dab (*Limanda limanda*), plaice (*Pleuronectes platessa*), haddock (*Melanogrammus aeglefinus*) and whiting (*Merlangius merlangus*), to a lesser extent, were the principal species found during the survey. Introduction

The following report details the findings of the cod spawning survey undertaken between the 17th February and 19th March 2013 in the Moray Firth Round 3 Area which includes the following four development areas:

- The Telford wind farm;
- The MacColl wind farm;
- The Stevenson wind farm; and
- The Western development area (WDA).

The aim of this survey was to establish the potential degree of cod spawning activity currently taking place in the Moray Firth Round 3 Zone and in adjacent locations. As presented in MORL's Offshore

Generating Station Impact Assessment (Chapter 7.2 - Biological Environment), construction noise was identified as having potential to result in a significant effect on cod, particularly during the spawning season.

The impact assessment on this species, however, took a precautionary approach, where conservative assumptions had to be applied as a result of the uncertainty surrounding available information on the use that this species currently makes of the Moray Firth area. In order to mitigate this uncertainty, MORL committed, in consultation with MSS to undertake additional survey work and monitoring with the objective of increasing the confidence in the impact assessment and identifying whether mitigation is required, and if so, to define feasible measures in order to reduce the significance of the likely effects.

The survey methodology was designed in consultation with MSS. A dispensation from MSS, in accordance with the terms of Section 9 of the Sea Fish Conservation Act 1967 and Article 43 of Council Regulation No. 850/98, to fish in Area IVab, related to days at sea was obtained prior to commencement of this survey. A summary of the Health and Safety performance of the survey is provided in Section 0 -Appendix 1.

Background Information

Cod spawn throughout much of the northern North Sea however there is evidence of sub-stock structuring (ICES 2007; Fox *et al* 2008). In the particular case of the Moray Firth, the cod population has been found to be genetically distinct from other North Sea cod (Hutchinson *et al.,* 2001).

Cod spawn between January and April, with peak spawning taking place from February to March (Coull *et al.,* 1998). Eggs are pelagic and hatch over a period of two to three weeks, depending on water temperature (Wright *et al.,* 2003).

Recent information in relation to the potential use of the central Moray Firth for cod spawning is currently lacking. The assessment of construction noise presented in MORL's Offshore Generating Station Impact Assessment (Chapter 7.2 - Biological Environment) used the grounds depicted in Coull *et al.* (1998) and Ellis *et al.* (2010) in respect to cod spawning and nursery areas, as primary sources of information. According to these publications the Moray Firth Round 3 Area falls within a low intensity spawning and a high intensity nursery ground for cod (Coull *et al.,* 1998, Ellis *et al.,* 2010). The cod spawning and nursery areas as defined in Coull *et al.* (1998) and Ellis *et al.* (2010) are shown in Figure 4.1. In addition to the above, other sources of information (i.e Gibbs *et al.,* 2008) were used to further characterise the current state of knowledge in relation to the potential for the Moray Firth Round 3 Area to support spawning and juvenile cod.

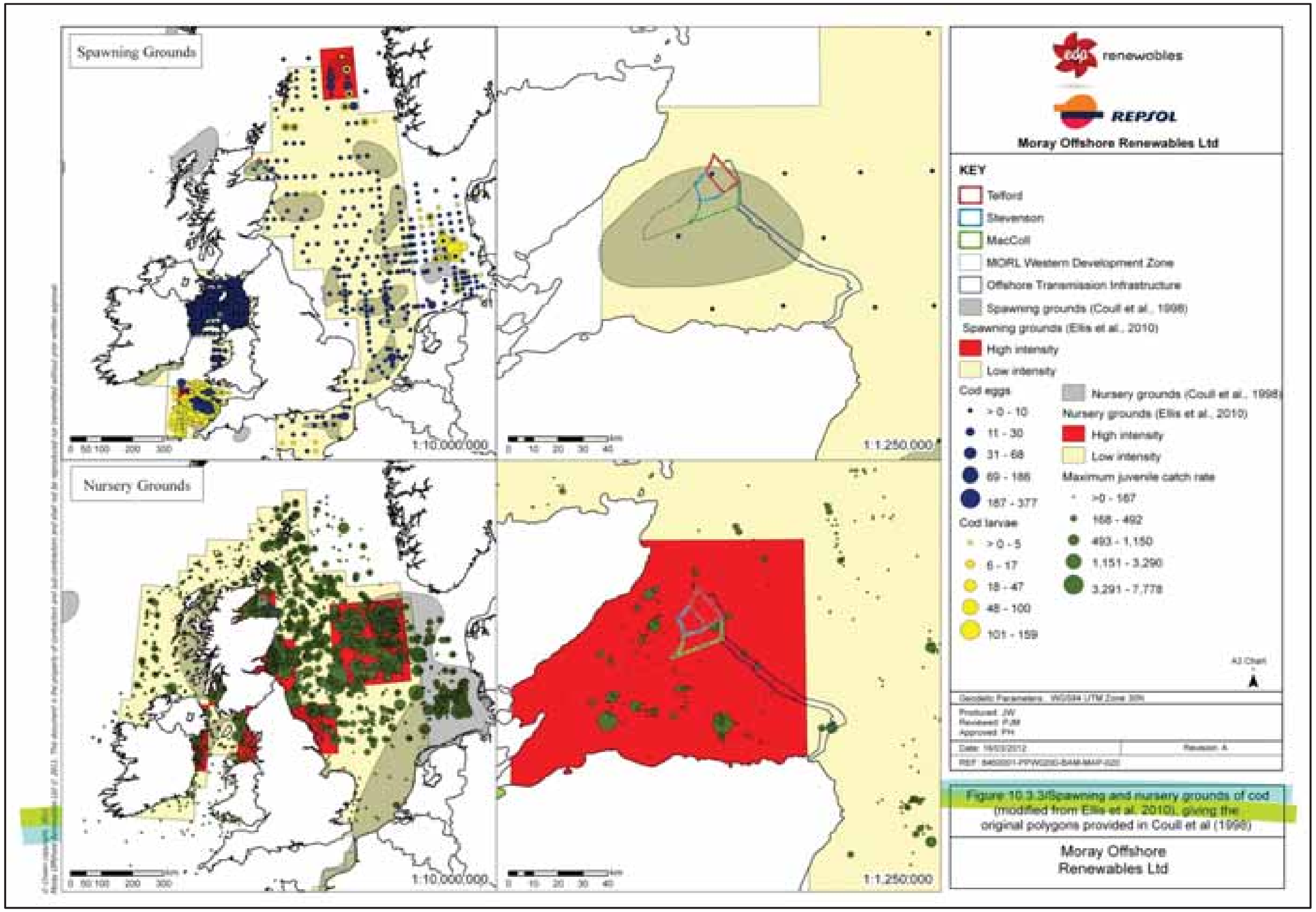

Figure 4.1 Cod Spawning and Nursery Grounds (Modified from Ellis *et al.*, 2010)

Survey Methodology

The survey was undertaken between 17th February and 19th March 2013 in order to cover the peak spawning period of this species. As previously mentioned cod spawning occurs between January and April, with peak spawning taking place from February to March.

Two sampling trips were undertaken: Trip A from 17th February to 26th February and Trip B from 10th March to 19th March. During these, a total of 58 stations were sampled using a commercial rock-hopper otter trawl with a 120 mm mesh cod end, fitted with a 20 mm blinder. A summarised log of events is given in Section 0- Appendix 2.

The sampling stations were located within the Moray Firth Round 3 Area and at adjacent locations overlapping both the cod spawning grounds defined in Coull *et al.* (1998) and areas expected to be affected by piling noise during the construction phase at the 90dB$_{ht}$[1](*Gadus morhua*) level).

The noise impact ranges used for selection of sampling stations are as presented in MORL's Offshore Generating Station Impact Assessment (Chapter 7.2 - Biological Environment).

Trip A

A total of 29 tows of 30 minutes duration were undertaken within and adjacent to the MORL Round 3 Area. OT49 was an additional tow to the north east of the Jackie oil field undertaken at the request of MSS.

The otter trawl tow tracks of Trip A are given in Figure 4.2. The start and end times, co-ordinates, depths and durations of each otter trawl tow are given in Section 0- Appendix 3.

Trip B

A total of 29 tows were undertaken, seven of which were repeated from Trip A (OT22-OT28). As in Trip A the tow duration was of 30 minutes with the exception of the tows undertaken at station OT08 and station OT39, which were of 60 minutes duration. These were carried out to determine whether larger cod were out-swimming the net in the 30 minute tows at the request of MSS.

The otter trawl tow tracks of Trip B are given in Figure 4.3. The start and end times, co-ordinates, depths and durations of each otter trawl are given in Section 0- Appendix 3.

[1] The dB$_{ht}$ (*Species)* metric takes account of the hearing ability and expected response to underwater noise on a species specific basis. The noise impact ranges defined at the 90dB$_{ht}$ (*Gadus morhua*) level represent sea areas where the majority of cod would be expected to exhibit strong avoidance reactions.

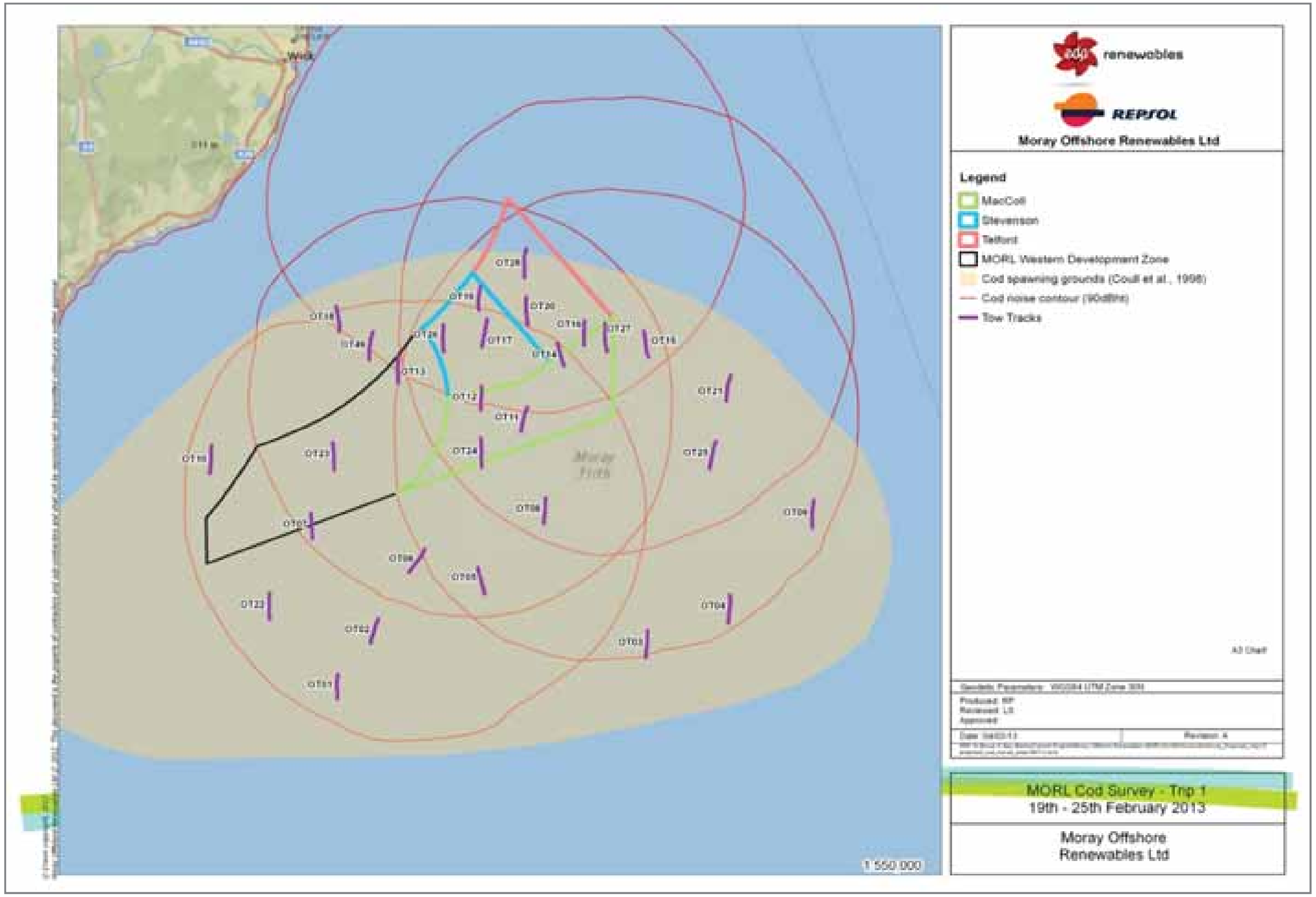

Figure 4.2 Trip A - Vessel Tracks whilst Towing the Otter Trawl

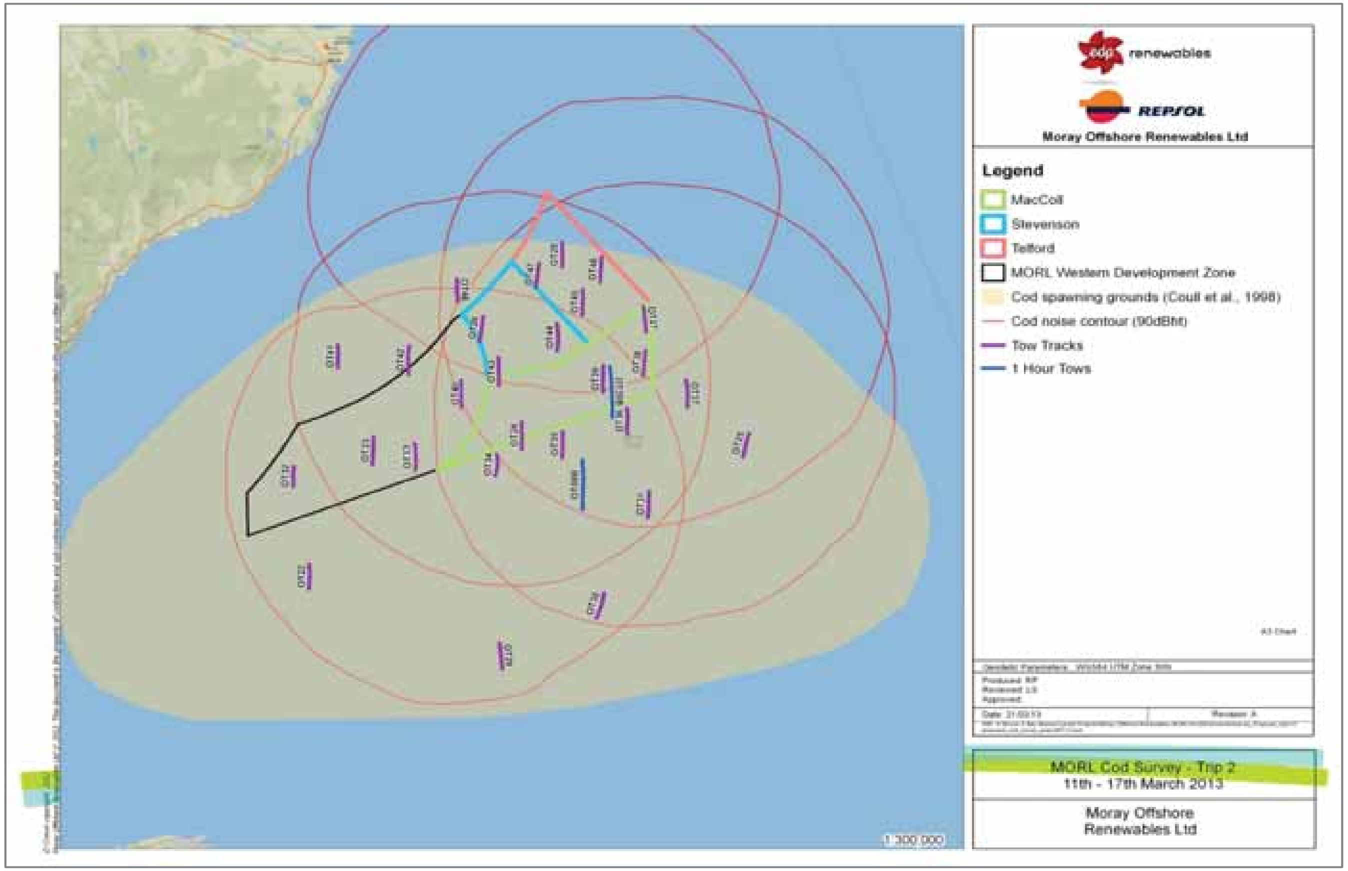

Figure 4.3 Trip B – Vessel Tracks whilst Towing the Otter Trawl

Survey Vessel

The vessel chartered for the survey (Figure 4.4), the “Seagull”, is a Peterhead-based commercial trawler. The specifications of the vessel are given below in Table 4.1.

Figure 4.4 Survey Vessel "Seagull"

Table 4.1 Survey Vessel Specifications

Survey Vessel Specifications	
Length	27.41 m
Beam	8.52 m
Draft	4.9 m
Main engine	Deutz MWM Marine TBD620 V12, 1340 kW
Gearbox	Hemidal HG47OF 7.07:1 reduction
Propeller	4 Blade Variable Pitch 2.9m diameter with a Kort Nozzle
GPS	1 x Dassault Sercel NR51, 1 x Furuno
Plotters	Sodena Plotter with Electronic Charts x 2
Sounder	Atlas 783 Colour
Scanmar	RX400 and Scanmate

Sampling Gear

A commercial rock-hopper otter trawl (Figure 4.5) with a 120 mm mesh cod end, fitted with a 20 mm blinder provided by MSS was used for cod sampling; the specifications of which are detailed below in Table 4.2.

In order to calculate trawl swept areas during each tow, a receiver and data processing unit (Scanmar RX400) was used to receive data from three Scanmar S400 sensors, two of which were fitted at the wing-ends and one in the headline.

Figure 4.5 Rock-hopper Otter Trawl Used

Table 4.2 Rock-hopper Otter Trawl Specifications

Rock-hopper Otter Trawl Specifications	
Towing warp	Steel core diaform 24 mm, 1463 m on each of three winches
Sweep Length	109.7 m with 27.43 m of split chain
Depth: payout ratio	3:1
Trawl Doors	Thyboron, 1 tonne, single tow point, 3 back attachments
Net	Seaway net with 120mm mesh bag and cod end (fitted with a 20 mm blinder)
Groundline	5121 cm, rock-hopper with 31 and 35.6 cm bobbins
Estimated headline height	6.4 m
Distance between trawl doors (est.)	73.1 m

Sampling Procedures

Positioning and Navigation

The position of the vessel was tracked at all times using a Garmin GPSMap 278 with an EGNOS differential connected to an external Garmin GA30 antenna. Otter trawl start times and positions were taken when the skipper advised that the gear was settled (i.e. the headline and wing end

Scanmar sensors showed little movement and had reached the appropriate spread). Otter trawl end times and positions were taken when hauling of the gear commenced.

Otter Trawl Sampling

The catch from each otter trawl was emptied into the hopper, photographed and sorted into baskets by species. The length, sex and spawning condition of all cod was identified and recorded. The gonads of each individual were photographed. In Trip A up to 3 male gonads and 5 female gonads of each maturity stage were fixed with 4% seawater buffered formalin solution. Gonad samples were delivered to MSS at the end of Trip A to verify the maturity stage analysis carried out at sea.

The gonadal maturity key used was as provided by MSS (Bucholtz *et al.*-Draft Manual to determine gonadal maturity of North Sea cod (*Gadus morhua L*)). The maturity stages used are described in Table 4.3 below. As shown, stage III cod is considered to be in spawning condition. Examples of spawning and spent individuals are provided in Section 0- Appendix 4.

Table 4.3 Cod maturity key (adapted from Bucholtz et al. Draft Manual)

Stage		Description of Appearance	
		Female	Male
I	**Juvenile/immature**	Ovaries small but easily distinguishable posterior in body cavity, soft with smooth surface, blurred translucent, reddish-orange	Testes small, but distinguishable along air bladder. Lobules small, blurred translucent reddish-white
II	**Maturing**	Ovaries occupy between half and 2/3 of the body cavity, plump and firm with prominent blood vessels, opaque, orange to creamy yellow. Oocytes clearly visible and densely packed	Testes enlarged and prominent dorsal in body cavity; lobules plump and brittle; reddish-white. Empty transparent spermatoducts with prominent blood vessels; no sperm release
III	**Spawning**	Ovaries fill most of body cavity; very distended and soft; appear granulated orange- to reddish-grey from mixture of opaque and glassy oocytes. Lumen containing viscous fluid in excess or hydrated eggs	Testes large and prominent in body cavity. Lobules still plump, but soft; completely opaque, whitish. Spermatoducts filled with fluid, milky semen that easily flows from vent
IV	**Spent**	Ovaries contracted; slack with greyish cast; rich in blood vessels; dim translucent reddish-grey. Vitollogenic oocytes absent but single hydrated eggs or atretic oocytes (opaque irregular granules) may occur	Testes contracted, close to air bladder; rich in blood vessels. Lobules empty, flabby, reddish potentially with a greyish cast. Spermatoducts with signs if previous distension, often with visible remains of semen
V	**Resting/Skip of spawning**	Ovaries small as in stage I but with signs of previous spawning; e.g. greyish cast and somewhat uneven walls; blurred translucent, reddish-grey, but more granulated and opaque than in stage I	Testes small but with signs of previous spawning; e.g. lobules slightly larger than in stage I; spermatoducts often with a greyish cast
VI	**Abnormal**	Stone roe. Ovary has a thick wall, grey-whitish cast and hard parts	Testes with adipose tissue formation; affected parts undeveloped, hard and yellowish

By-catch species were identified, counted, measured and returned to the sea; where necessary sub-sampling was carried out at sea by species.

Otter Trawl Results

Cod

Cod were caught in 35 of the 58 stations sampled, with a maximum of nine individuals recorded in a single station (OT38, trip B). In general terms, cod were found in very low numbers with a total of 73 individuals being caught during the survey (Trip A + Trip B).

A total of 48 juveniles (stage I) and 25 adults (23 of which were spawning -stage III and two spent - stage IV) were caught. Twelve spawning cod were recorded in Trip A and 11 in Trip B. A maximum of four spawning individuals were found at a single station (Trip A, OT08). The number of males and females was approximately even (36 females and 34 males).

The numbers of cod caught by station are shown in Table 4.4 and Table 4.5 for Trip A and Trip B, respectively. Catch rates will be calculated by MSS using the Scanmar outputs (swept area per tow) and used to determine whether significant cod spawning is taking place in the Moray Firth Round 3 Area and/or in adjacent locations.

Trip A

The numbers of cod caught by station during Trip A together with the length, sex and maturity stage of each individual is shown in Table 4.4.

The spatial distribution of the cod catch recorded in Trip A is given in Figure 4.6. The percentage contribution of spawning cod (maturity stage III) to the total catch in each sampling station is also shown.

Table 4.4 Numbers of Cod, Sex and Spawning Condition by Sampling Station (30 min duration tows) – Trip A

Trip A Station	Length (cm)	Sex	Spawning Condition	Total No. of Individuals	Total No. of Spawning Cod
OT03	22	F	I	1	0
OT04	17	F	I	1	0
OT05	46	M	III	1	1
OT08	18	M	I	5	4
	33	M	III		
	36	M	III		
	46	M	III		
	50	F	III		
OT09	37	F	I	1	0
OT10	54	M	III	2	2
	67	M	III		
OT11	46	F	III	2	2
	68	M	III		
OT13	56	M	I	1	
OT15	13	U	I	2	1
	42	M	III		
OT16	19	F	I	2	0
	20	F	I		
OT18	46	M	III	1	1
OT21	17	F	I	6	0
	18	F	I		
	19	F	I		
	19	U	I		
	21	M	I		
	26	U	I		
OT24	14	F	I	3	0
	15	F	I		
	15	M	I		
OT25	16	M	I	3	0
	18	F	I		
	22	F	I		

Trip A Station	Length (cm)	Sex	Spawning Condition	Total No. of Individuals	Total No. of Spawning Cod
OT27	20	M	I	4	0
	20	F	I		
	22	M	I		
	22	F	I		
OT49	49	M	III	1	1
Total No. of Individuals				**36**	**12**

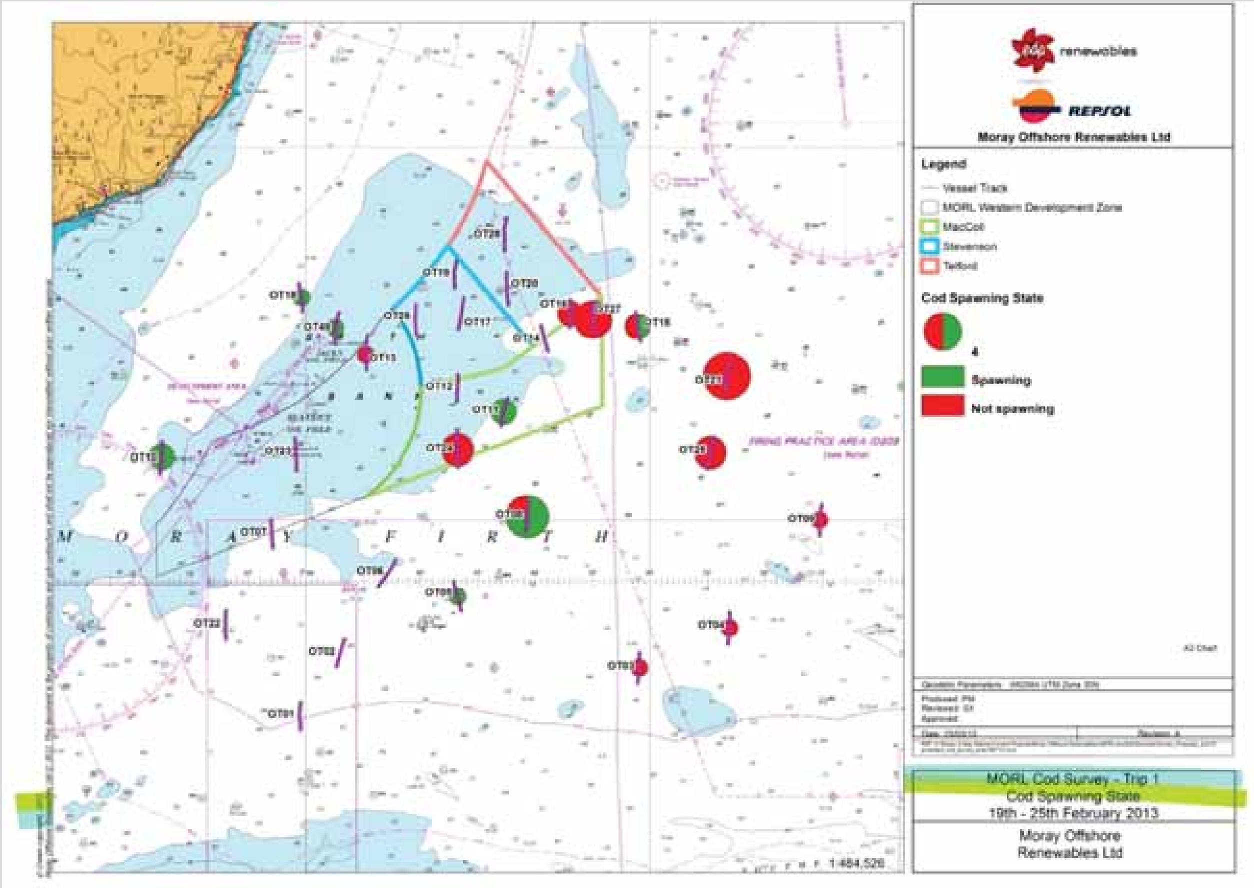

Figure 4.6 Cod catch by maturity stage (spawning/not spawning) recorded by stations during Trip A

Trip B

The number of cod caught by station during Trip B together with the length, sex and maturity stage of each individual is shown in Table 4.5. The spatial distribution of the cod catch recorded in Trip B is given in Figure 4.7. The percentage contribution of spawning cod (maturity stage III) to the total catch in each sampling station is also shown.

Table 4.5 Total Numbers of Cod, Sex and Spawning Condition by Sampling Station (30 min duration tows) – Trip B

Trip B Station	Length (cm)	Sex	Spawning Condition	Total No. of Individuals	Total No. of Spawning Cod
OT22	49	M	III	1	1
OT24	13	F	I	3	0
	14	F	I		
	16	M	I		
OT27	15	F	I	2	1
	43	M	III		
OT29	50	F	III	2	1
	55	F	IV		
OT30	16	M	I	4	0
	16	M	I		
	18	M	I		
	22	M	I		
OT31	21	M	I	1	0
OT34	37	F	III	1	1
OT35	18	M	I	1	0
OT36	43	F	III	1	1
OT37	25	F	I	1	0
OT38	14	F	I	9	1
	14	M	I		
	16	F	I		
	17	F	I		
	17	M	I		
	18	F	I		
	18	M	I		
	20	M	I		
	45	M	III		
OT39	17	M	I	1	0
OT40	39	M	I	2	1
	41	F	III		
OT43	43	F	I	1	0
OT44	74	F	III	1	1
OT47	55	F	IV	1	0
OT48	20	F	I	1	0
OT08_1hour	49	F	III	2	2
	57	M	III		
OT39_1hour	20	F	I	2	1
	54	F	III		
Total No. of Individuals				**37**	**11**

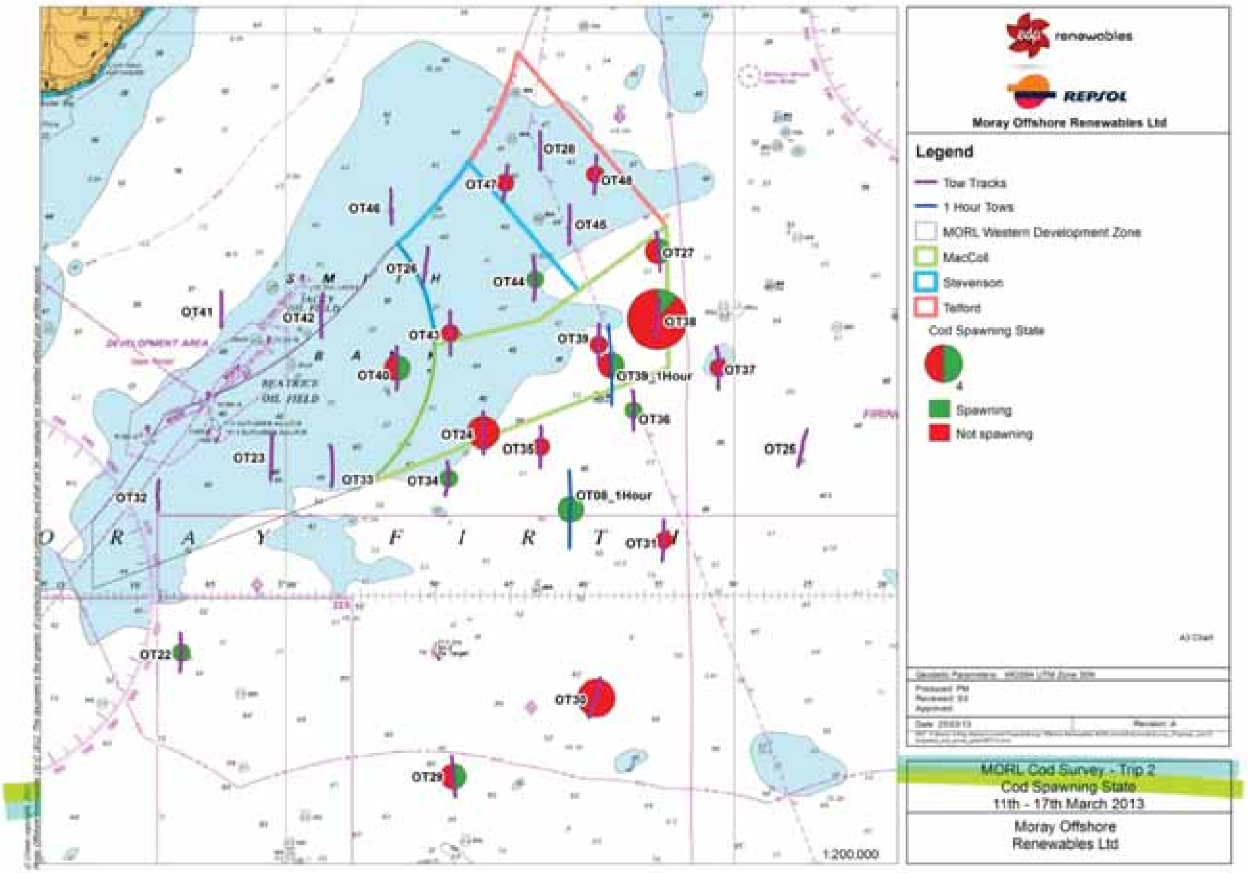

Figure 4.7 Cod catch by maturity stage (spawning/not spawning) recorded by stations during Trip B

By-catch

A total of 49,583 individuals of 45 fish and commercial shellfish species were caught in the survey.

The by-catch recorded in Trip A and Trip B is given by species in Table 4.6 and Table 4.7, respectively.

Dab, plaice, haddock, and whiting, to a lesser extent, were the principal species found during the survey.

Table 4.6 Numbers of Individuals Caught (By-Catch) in Trip A

Species		Total No. of Individuals Caught
Common Name	Scientific Name	
Dab	*Limanda limanda*	9,692
Plaice	*Pleuronectes platessa*	8,196
Haddock	*Melanogrammus aeglefinus*	6,230
Herring	*Clupea harengus*	1,449
Whiting	*Merlangius merlangus*	449
Long Rough Dab	*Hippoglossoides platessoides*	353
Grey Gurnard	*Eutrigla gurnardus*	203
Lemon Sole	*Microstomus kitt*	203
Poor Cod	*Trisopterus minutus*	202
Sprat	*Sprattus sprattus*	160
Saithe	*Pollachius virens*	133
Bullrout	*Myoxocephalus scorpius*	93
Queen Scallop	*Aequipecten opercularis*	86
Sandeel (indet.)	*Ammodytidae sp.*	51
Greater Sandeel	*Hyperoplus lanceolatus*	21
John Dory	*Zeus faber*	18
Sea Scorpion	*Taurulus bubalis*	17
Hake	*Merluccius merluccius*	14
Lesser Spotted Dogfish	*Scyliorhinus canicula*	12
Long-finned Squid	*Loligo forbesii*	10
Common Dragonet	*Callionymus lyra*	8
Nephrops	*Nephrops norvegicus*	6
Thickback Sole	*Microchirus variegatus*	5
Pogge	*Agonus cataphractus*	4
Mackerel	*Scomber scombrus*	3
Red Gurnard	*Aspitrigla cuculus*	3
Brill	*Scophthalmus rhombus*	2
Cuckoo Ray	*Raja naevus*	2
Flounder	*Platichthys flesus*	2
Ling	*Molva molva*	2
Edible Crab	*Cancer pagurus*	1
Fifteen Spined Stickleback	*Spinachia spinachia*	1
Lesser Weever	*Echiichthys vipera*	1
Lumpsucker	*Cyclopterus lumpus*	1
Norway Pout	*Trisopterus esmarkii*	1
Whelk	*Buccinum undatum*	1
Witch	*Glyptocephalus cynoglossus*	1
Juvenile Gadoid	Gadidae sp.	P
Total No. of Individuals		**27,636**

Table 4.7 Numbers of Individuals Caught (By-Catch) in Trip B

Species		Total No. of Individuals Caught
Common Name	Scientific Name	
Dab	*Limanda limanda*	7,295
Haddock	*Melanogrammus aeglefinus*	6,016
Plaice	*Pleuronectes platessa*	4,990
Whiting	*Merlangius merlangus*	988
Sprat	*Sprattus sprattus*	603
Long Rough Dab	*Hippoglossoides platessoides*	509
Lemon Sole	*Microstomus kitt*	369
Grey Gurnard	*Eutrigla gurnardus*	285
Nephrops	*Nephrops norvegicus*	254
Poor Cod	*Trisopterus minutus*	155
Bullrout	*Myoxocephalus scorpius*	125
Queen Scallop	*Aequipecten opercularis*	82
Greater Sandeel	*Hyperoplus lanceolatus*	41
Herring	*Clupea harengus*	37
Sandeel (indet.)	*Ammodytidae sp.*	30
Sea Scorpion	*Taurulus bubalis*	27
Common Dragonet	*Callionymus lyra*	26
Saithe	*Pollachius virens*	25
Long-finned Squid	*Loligo forbesii*	15
Lesser Spotted Dogfish	*Scyliorhinus canicula*	10
Pollack	*Pollachius pollachius*	9
Red Gurnard	*Aspitrigla cuculus*	9
John Dory	*Zeus faber*	8
Thickback Sole	*Microchirus variegatus*	7
Ling	*Molva molva*	6
Pogge	*Agonus cataphractus*	4
Spotted Dragonet	*Callionymus maculatus*	4
Hake	*Merluccius merluccius*	3
Lumpsucker	*Cyclopterus lumpus*	3
Anchovy	*Engraulis encrasicolus*	2
Norway Pout	*Trisopterus esmarkii*	2
Bib	*Trisopterus luscus*	1
Blue Mouth	*Helicolenus dactylopterus*	1
Brill	*Scophthalmus rhombus*	1
Cuckoo Ray	*Raja naevus*	1
Mackerel	*Scomber scombrus*	1
Scaldfish	*Arnoglossus laterna*	1
Starry Smoothhound	*Mustelus asterias*	1
Witch	*Glyptocephalus cynoglossus*	1
Juvenile Whiting	*Merlangius merlangus*	P
Total No. of Individuals		**21,947**

The spatial distribution of the catch of the principal species found in the survey (dab, plaice, haddock and whiting) is given in Figure 4.8 to Figure 4.15 below by survey trip.

In addition to the above, the spatial distribution of the sandeel and herring catch recorded in the survey is also shown (Figure 4.16 to Figure 4.19) as concerns in relation to these two species were raised during the EIA process. The limitations of the catch records for these two species are however fully recognised (i.e catchability in demersal trawls and timing of the survey).

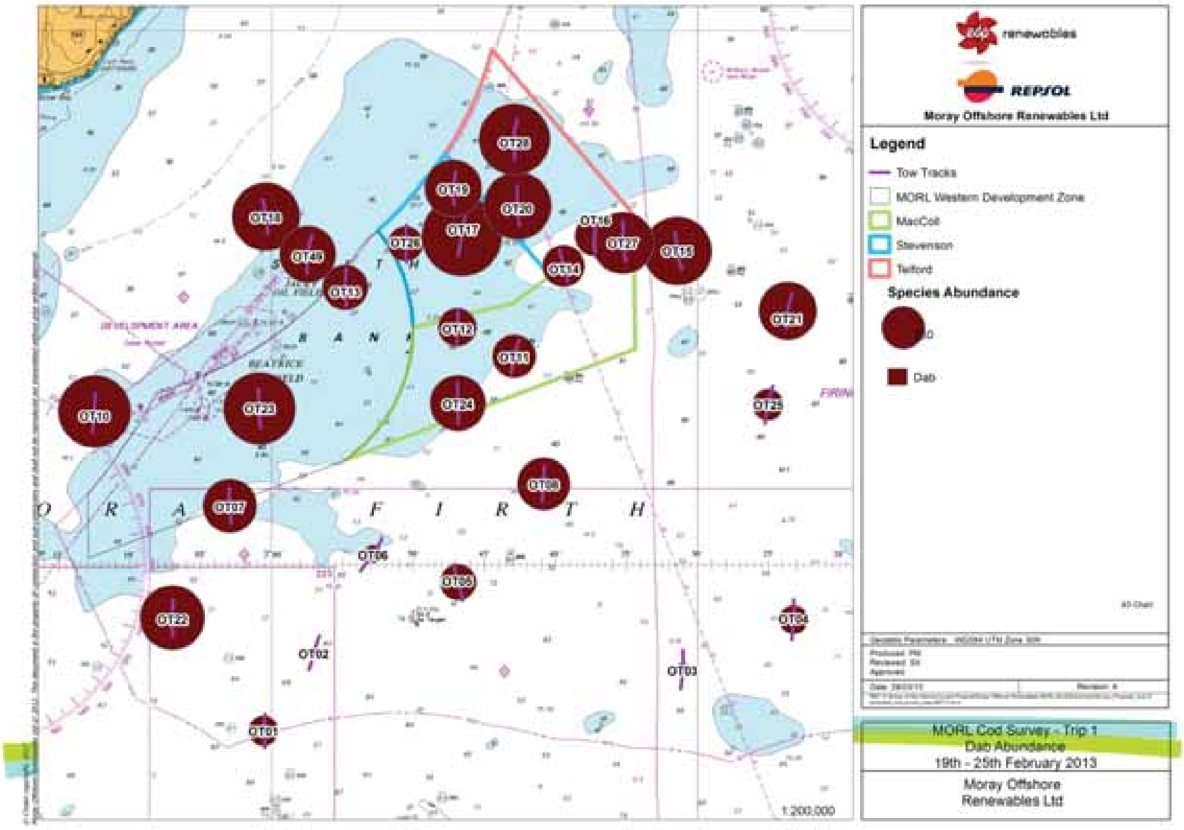

Figure 4.8 Spatial Distribution of Dab caught during Trip A

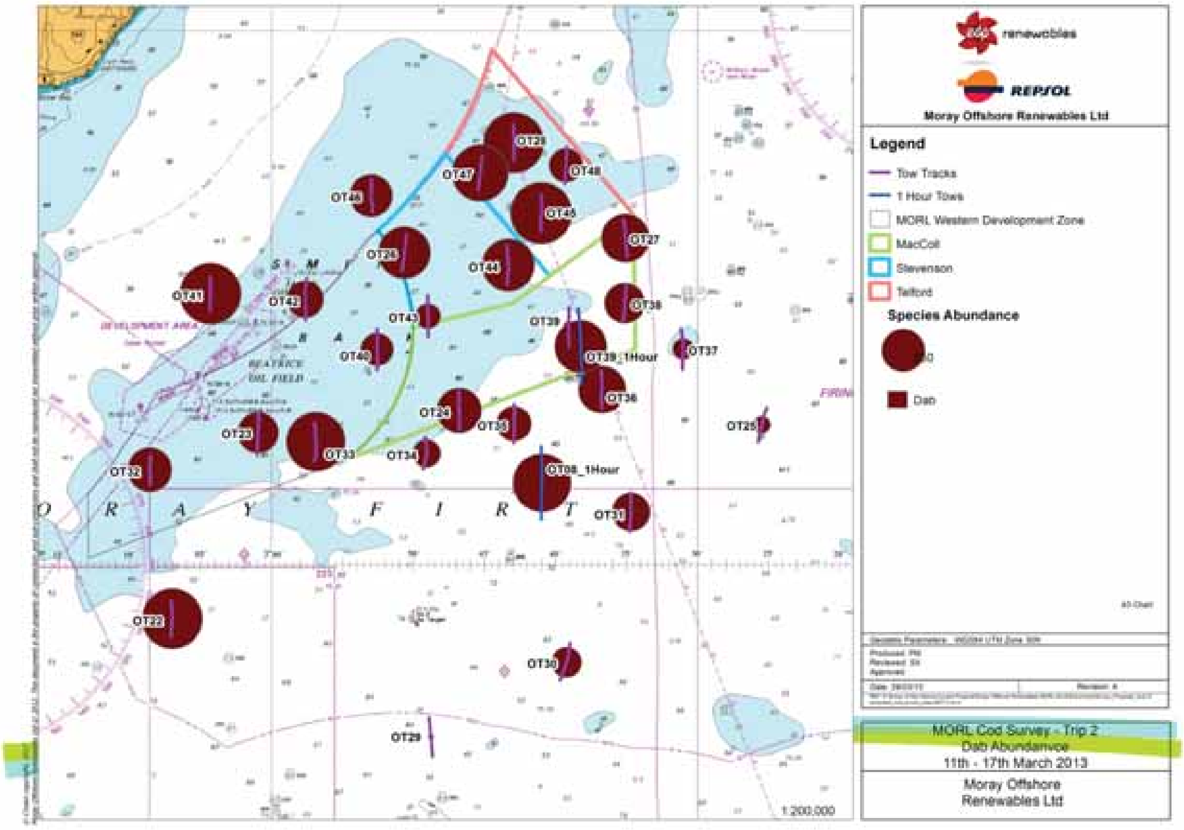

Figure 4.9 Spatial Distribution of Dab caught during Trip B

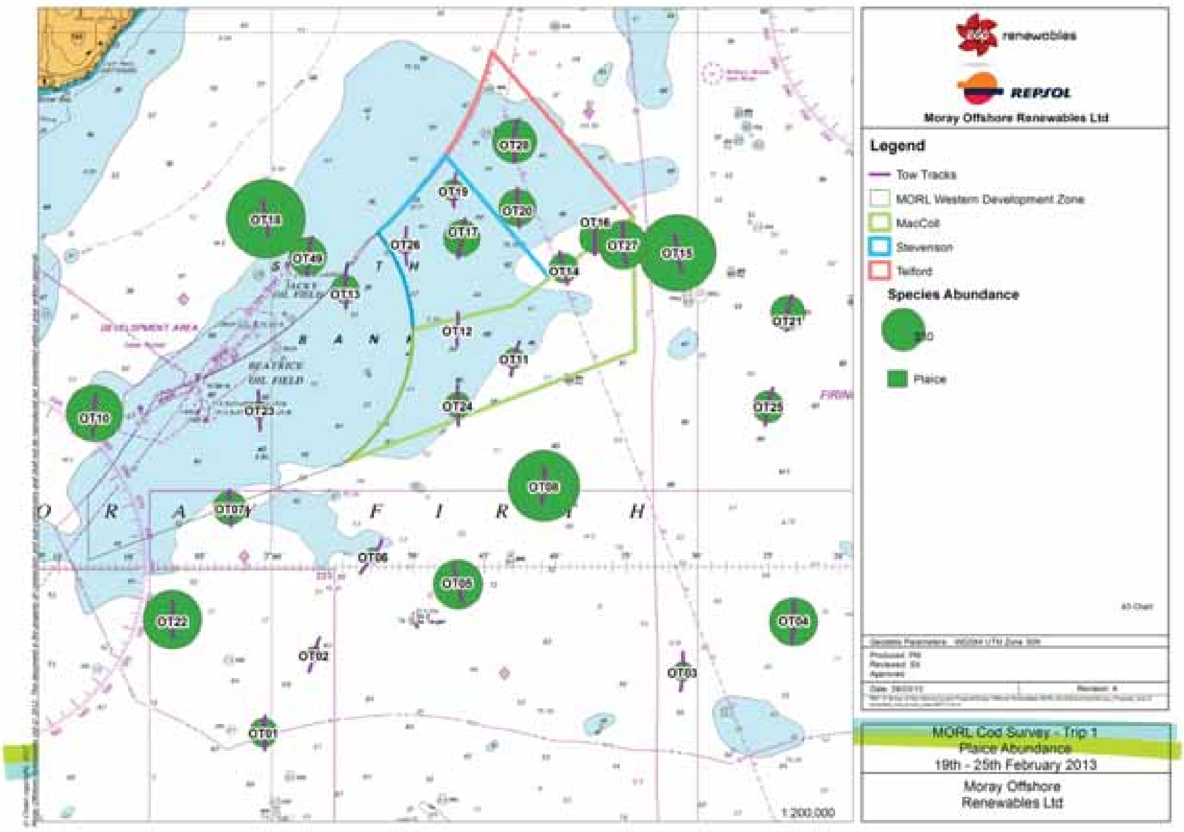

Figure 4.10 Spatial Distribution of Plaice caught during Trip A

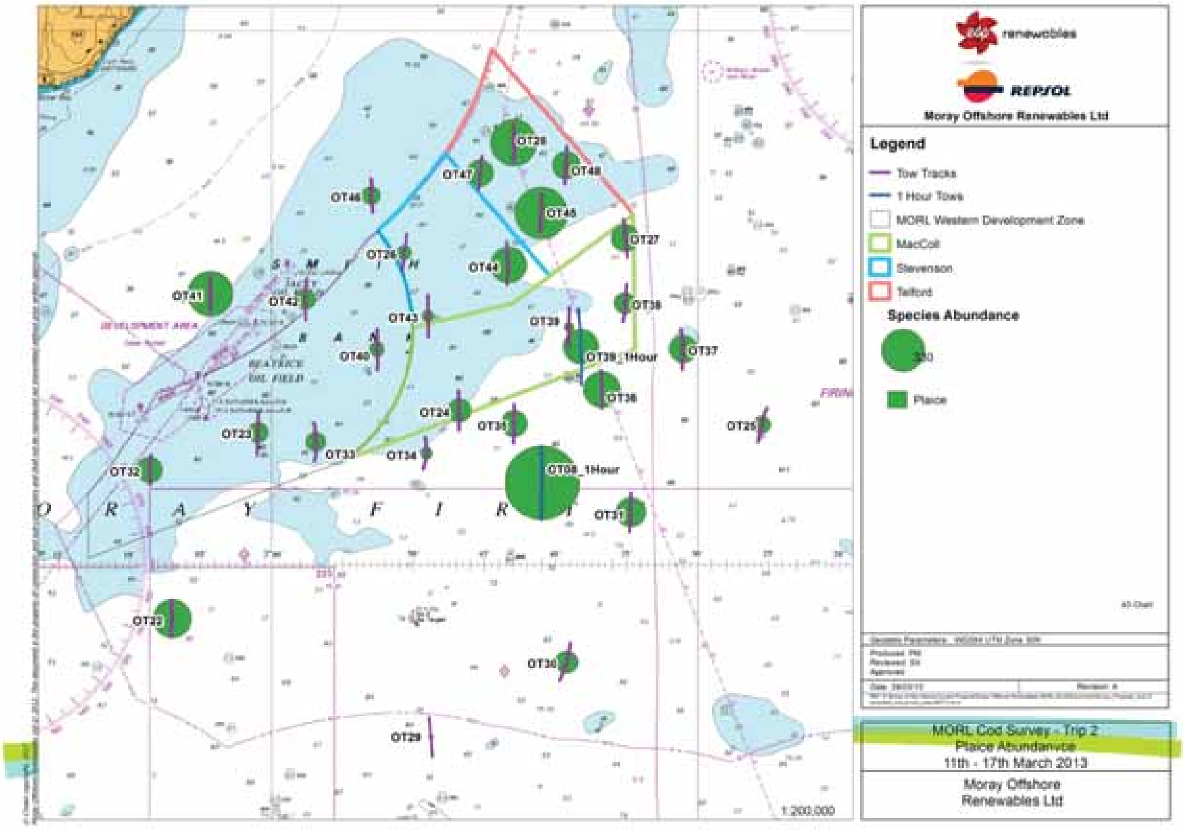

Figure 4.11 Spatial Distribution of Plaice caught during Trip B

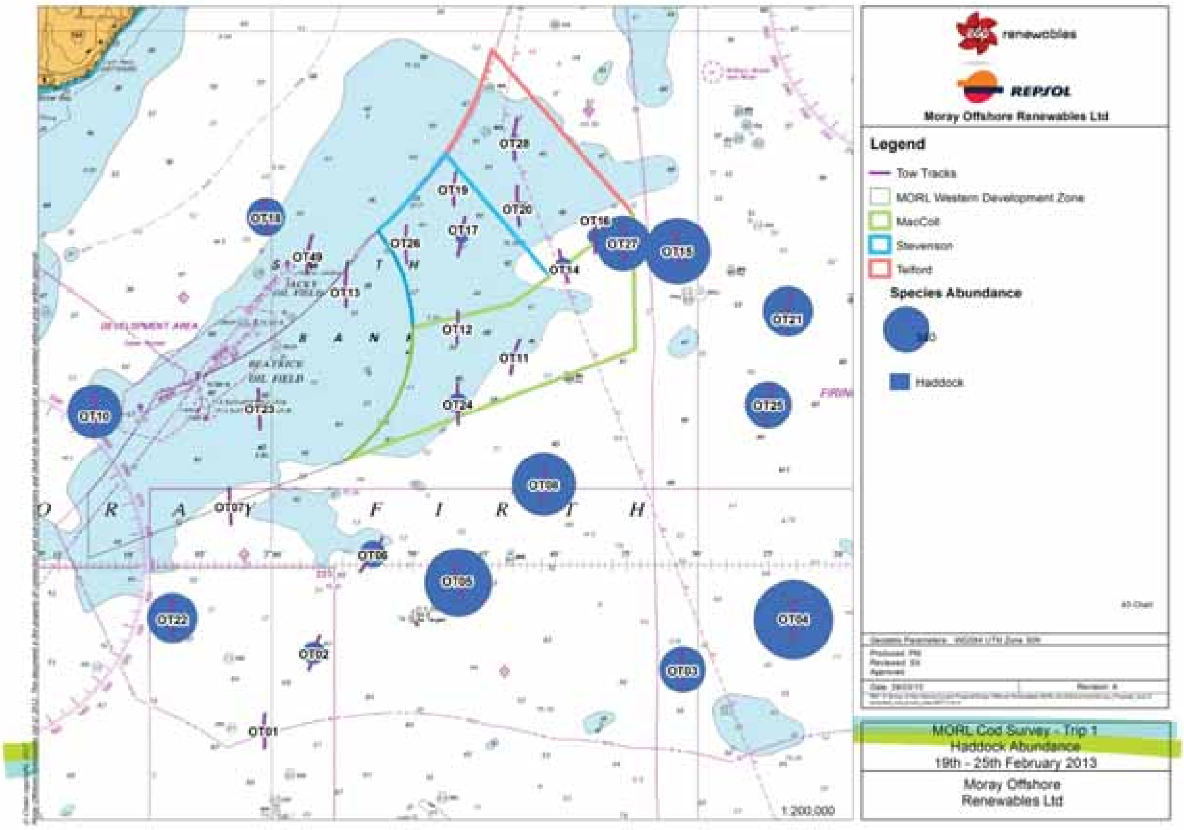

Figure 4.12 Spatial Distribution of Haddock caught during Trip A

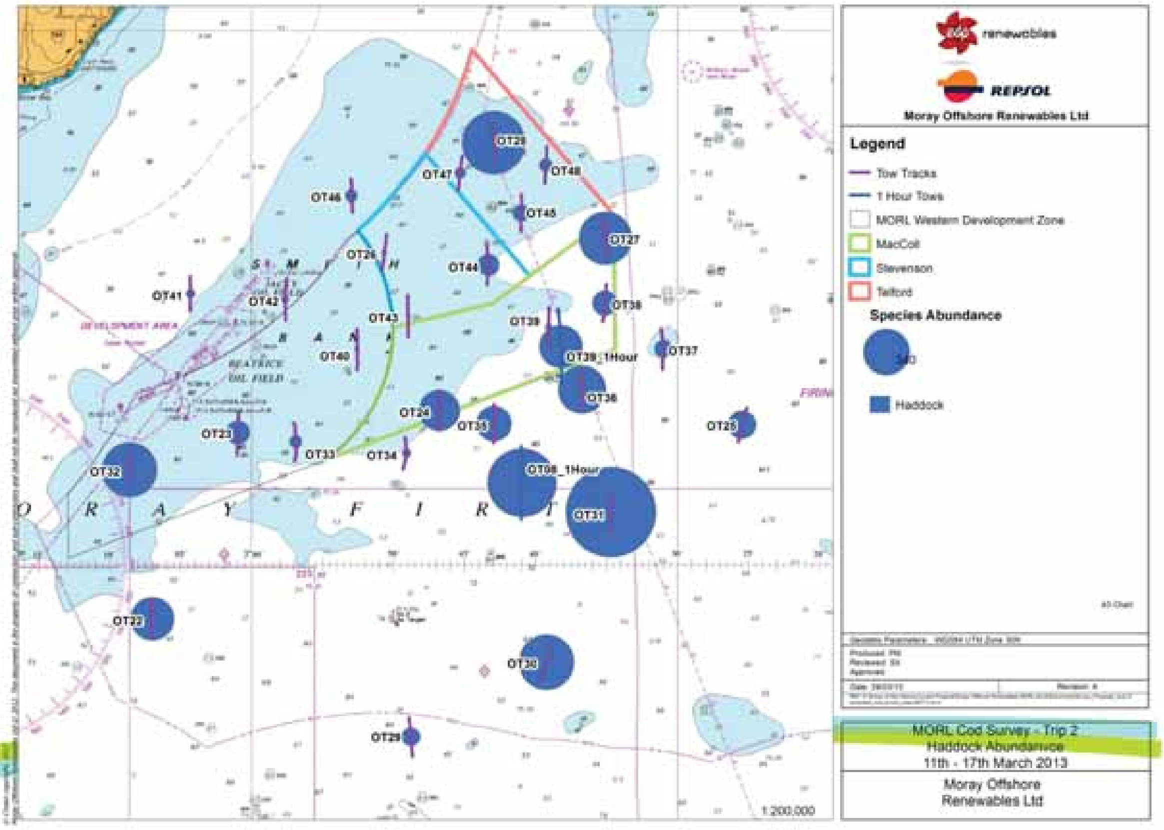

Figure 4.13 Spatial Distribution of Haddock caught during Trip B

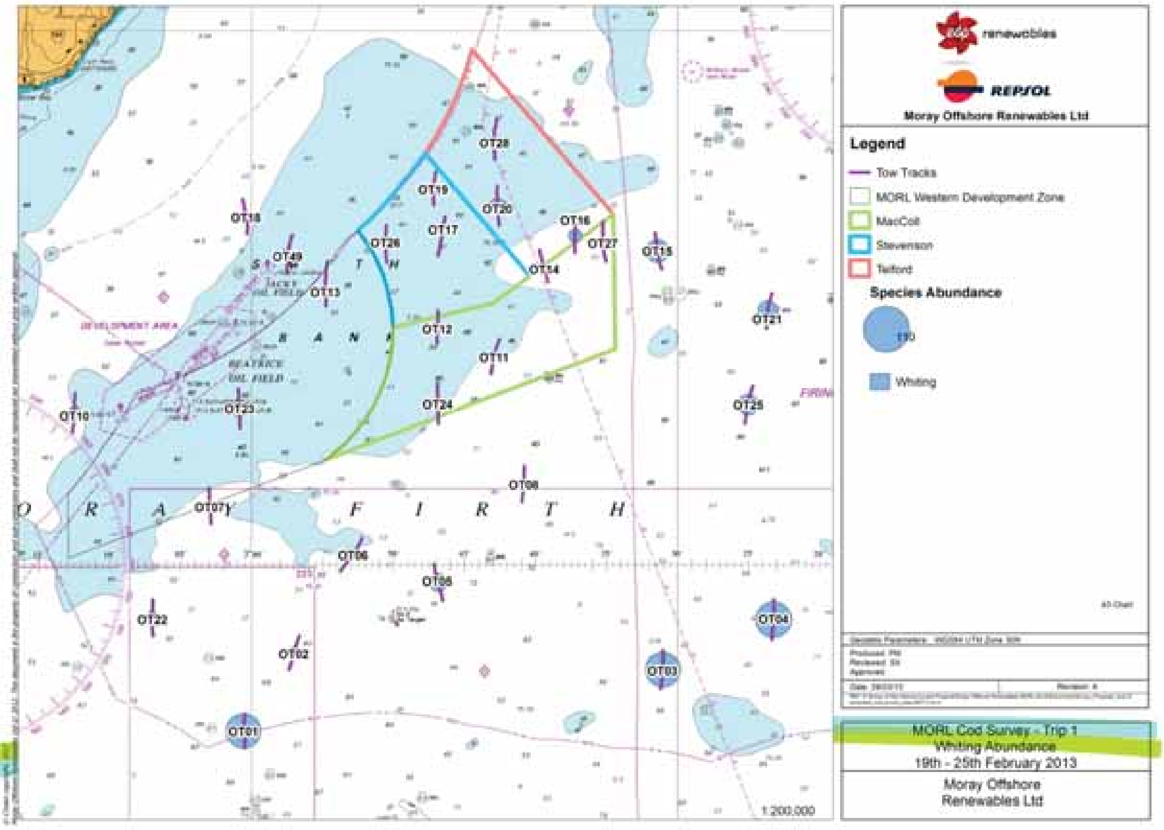

Figure 4.14 Spatial Distribution of Whiting caught during Trip A

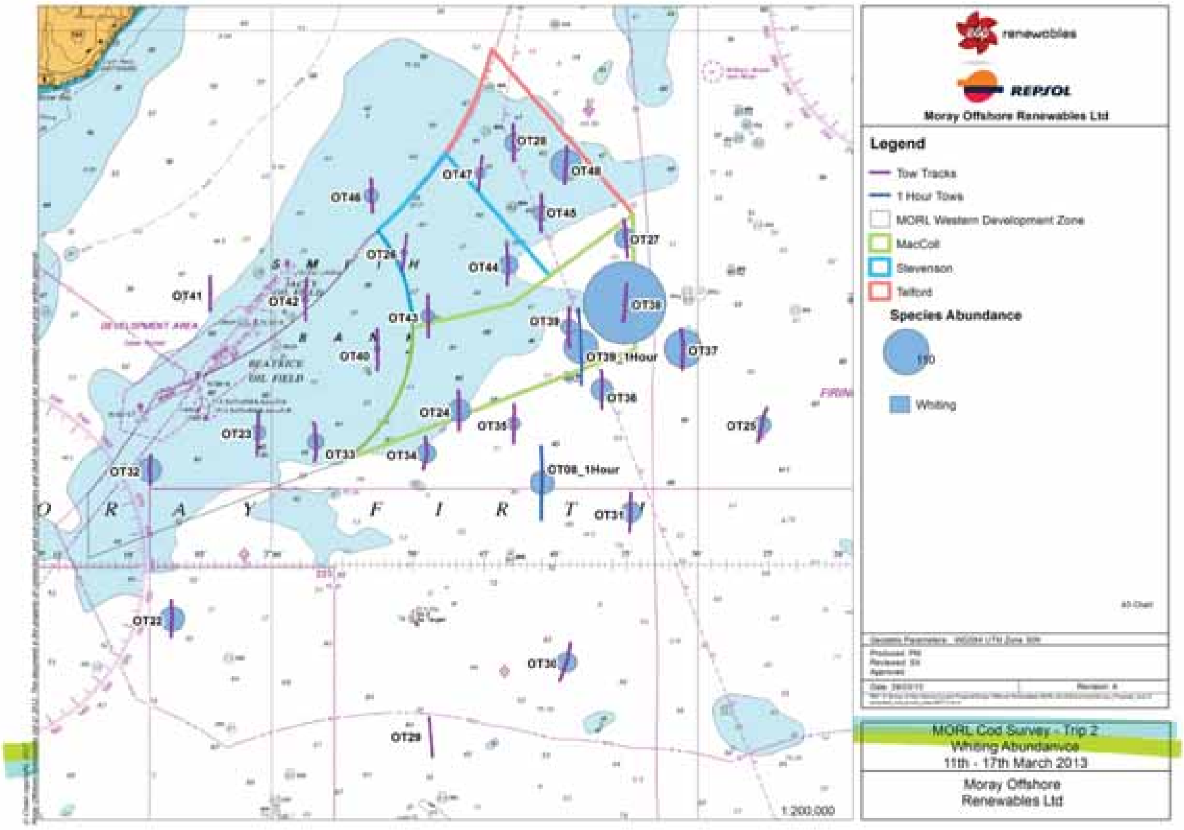

Figure 4.15 Spatial Distribution of Whiting caught during Trip B

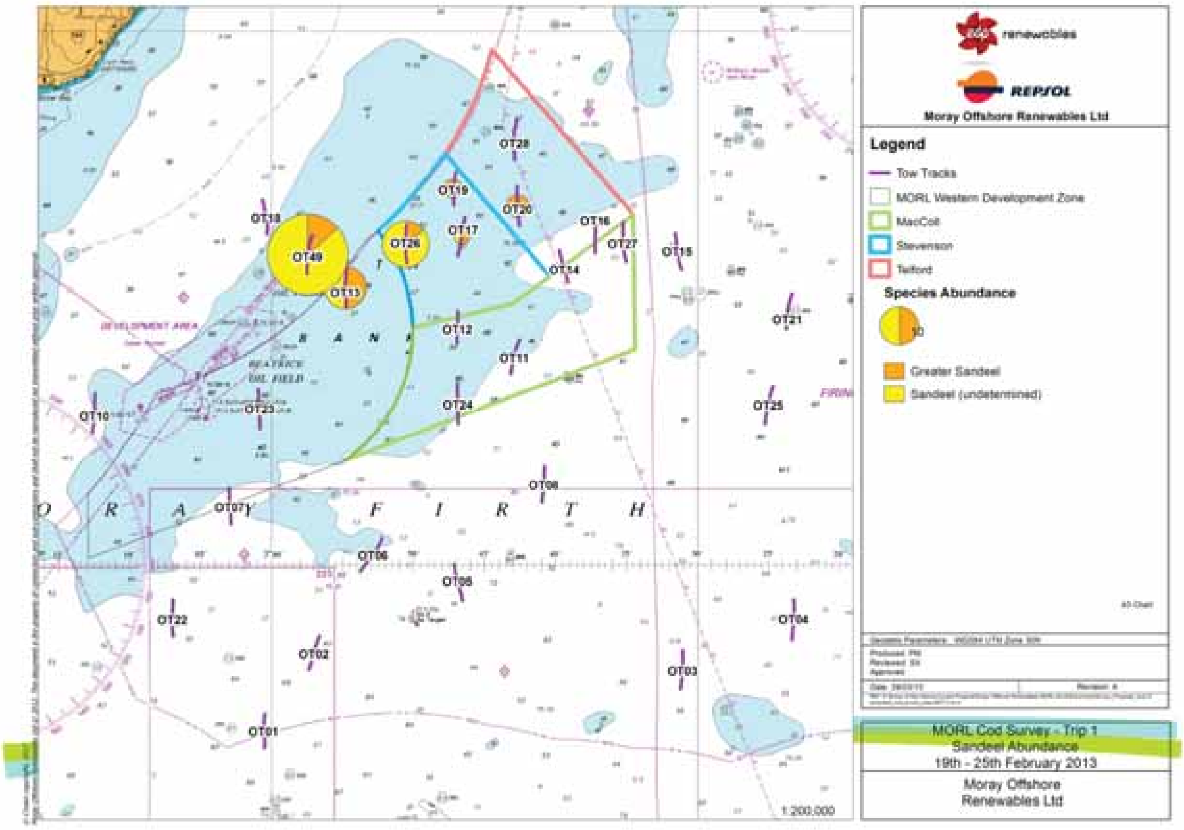

Figure 4.16 Spatial Distribution of Sandeels caught during Trip A

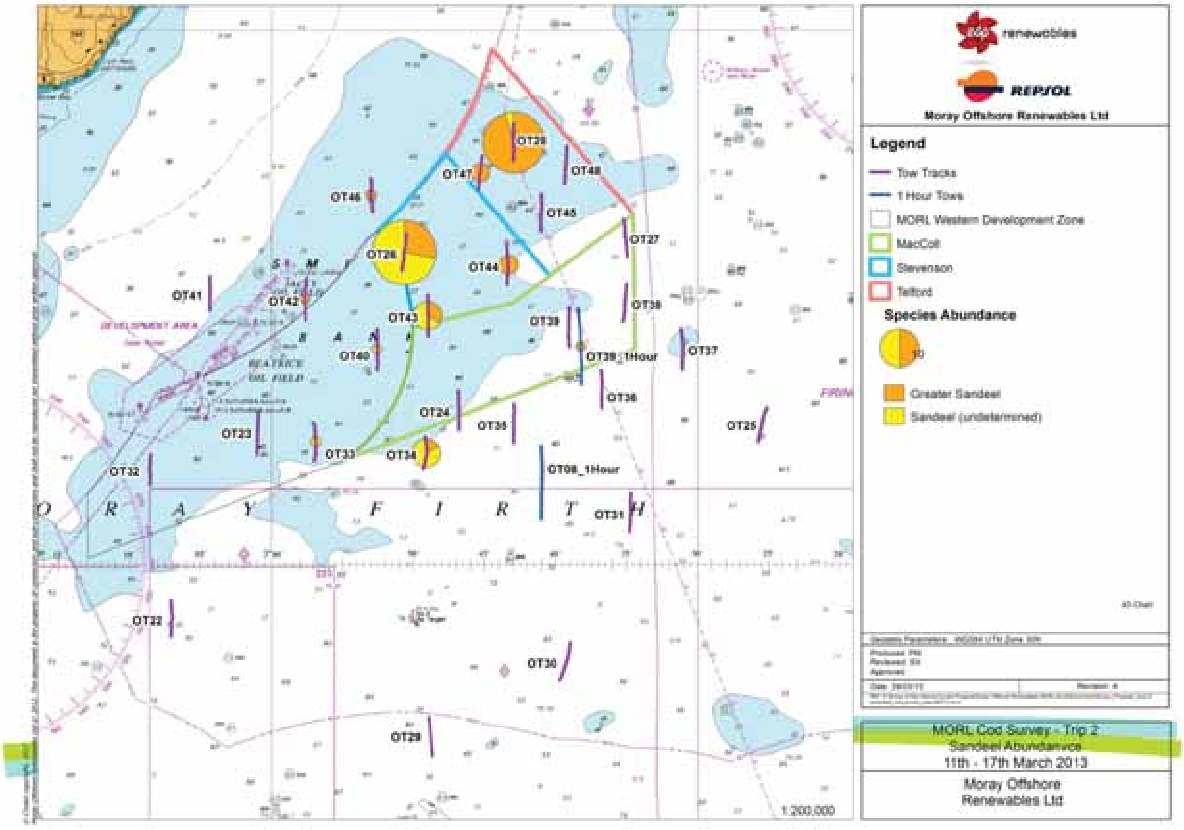

Figure 4.17 Spatial Distribution of Sandeels caught during Trip B

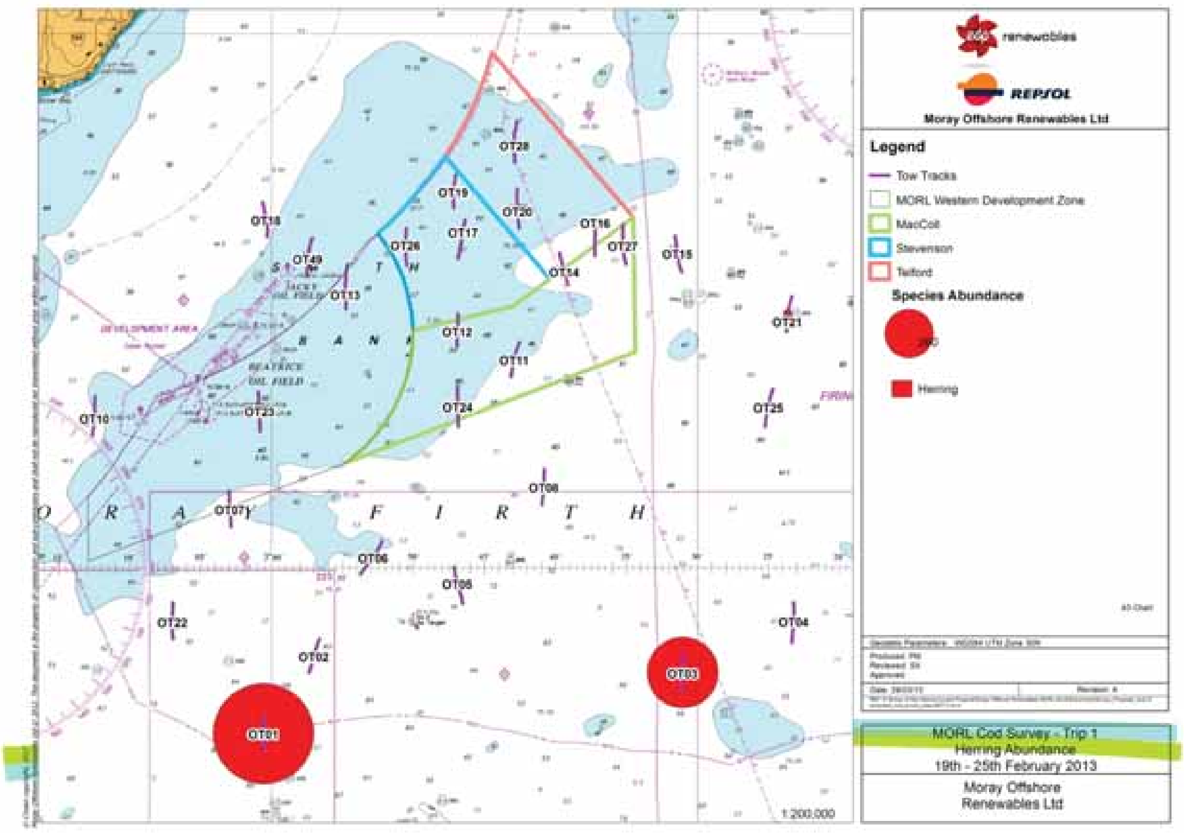

Figure 4.18 Spatial Distribution of Herring caught during Trip A

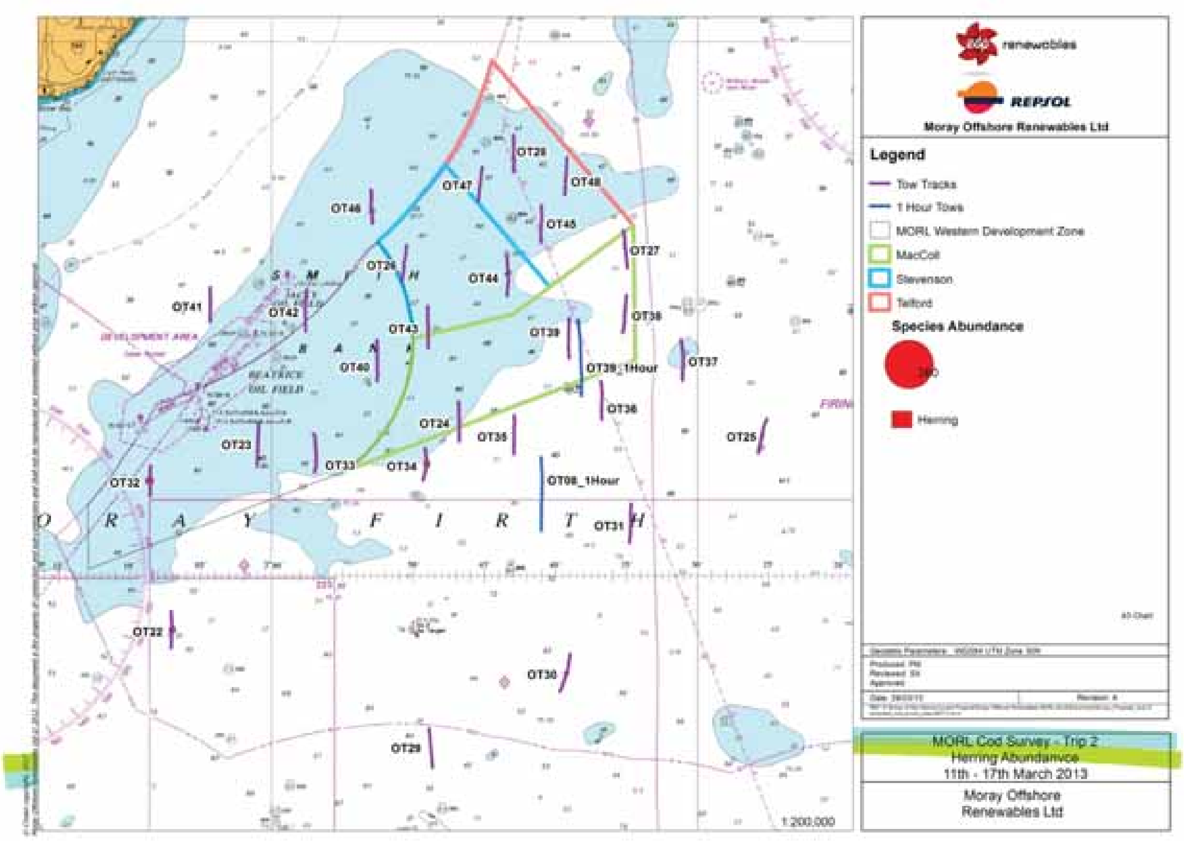

Figure 4.19 Spatial Distribution of Herring caught during Trip B

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Appendix 2 – Health and Safety

Personnel

Brown and May Marine (BMM) staff followed the standard health and safety protocol outlined in the BMM "Offshore Operational Procedures for Surveys using Commercial Fishing Vessels".

All BMM staff have completed a Sea Survival course approved by the Maritime and Coastguard Agency, meeting the requirements laid down in: **STCW 95 Regulation VI/1 para 2.1.1 and STCW Code section A- VI/1** before boarding any vessel conducting works for the company. Employees are also required to have valid medical certificates (ENG1), Safety Awareness, Basic Fire Fighting and Basic First Aid certificates before participating in offshore works.

Vessel Induction

Before boarding the survey team were shown how to safely board and disembark the vessel. Prior to departure the skipper briefed surveyors on the whereabouts of the safety equipment, including the life raft, emergency flares and fire extinguishers, and the location of the emergency muster point. The safe deck areas, man-overboard procedures and emergency alarms were also discussed. The survey team was warned about the possible hazards, such as slippery decks and obstructions whilst aboard. Surveyors were briefed about trawling operations and the need to keep clear of all winches when operational. All hazards were assessed prior to the survey in the BMM health and safety risk assessment.

Daily Safety Checks

The condition of the life jackets, EPIRB's, and life raft were inspected daily. Also checked were the survey team working areas, including the fish room and the wheelhouse to ensure these areas were clear of hazards such as clutter and obstructions.

Post Trip Survey Review

Upon completion of the survey a "Post Trip Survey Review" was filled, see Table 4.8 below.

Table 4.8 Post Trip Survey Review

Project: MORL Cod Survey February/March 2013	**Vessel:** Seagull
Surveyors: Lucy Shuff, Jose Peiro	**Skipper:** Gary Mutch
Survey Area: Moray Firth	**Total Time at Sea:** 16 Days
Dates at Sea: 18/02/13 – 25/02/13, 11/03/13 – 18/03/13	

	Comments	Actions
Did vessel comply with pre trip safety audits?	Yes (audited by Noble Denton 15/02/13)	N/A
Skipper and crew attitude to safety?	Good	N/A
Vessel machinery failures?	None	N/A
Safety equipment failures?	None	N/A
Accidents?	None	N/A
Injuries?	None	N/A

Appendix 3 – Survey Log

A summarized log of events is given below in Table 4.9 for Trip A and in Table 7.3 overleaf for Trip B.

Table 4.9 Summarised Log of Events for Trip A, 17th to 26th February 2013

Friday 15th February 2013
Vessel audit completed by Noble Denton
Sunday 17th February 2013
Surveyors depart BMM, travel to South Queensferry, Edinburgh
Monday 18th February 2013
Travel to Peterhead, mobilise vessel (Gareth Jones, Phil (MSS), John Watt, Stephen Appleby and Peter Moore in attendance)
Depart Peterhead at 2315 hrs, steam to survey area overnight
Overnight at sea
Tuesday 19th February 2013
Otter Trawls: OT09 (1 x stage I cod), OT25 (3 x stage I cod), OT21 (6 x stage I cod), OT15 (1 x stage I and 1 x stage III cod), OT27 (4 x stage I cod)
Weather:BF1-3, smooth/slight
Overnight at sea
Wednesday 20th February 2013
Otter Trawls: OT05 (1 x stage III cod), OT06, OT02, OT01
Steam inshore at 1530 hrs to shelter under the land
Weather: BF6/7, moderate to rough
Overnight at sea
Thursday 21st February 2013
Otter Trawls: OT22, OT07, OT23, OT10 (2 x stage III cod), OT18 (1 x stage III cod)
Weather: BF5/6, moderate
Overnight at sea
Friday 22nd February 2013
Otter Trawls: OT49 (1 x stage III cod, 37 x sandeel), OT13 (1 x stage I cod, 12 x sandeel), OT26 (14 x sandeel), OT17 (2 x sandeel), OT19 (3 x sandeel)
Weather: BF3/4, slight
Overnight at sea
Saturday 23rd February 2013
Otter Trawls: OT28, OT20 (4 x sandeel), OT16 (2 x stage I cod), OT14, OT11 (2 x stage III cod, 1 x sandeel)
Weather: BF3/4, slight
Overnight at sea
Sunday 24th February 2013
Otter Trawls: OT12, OT24 (3 x stage I cod), OT08 (1 x stage I and 4 x stage III cod), OT03 (1 x stage I cod)
Weather: BF2/3, slight
Overnight at sea
Monday 25th February 2013
Otter Trawls: OT04 (1 x stage I cod)
Steam to Peterhead, arrive at 1230 hrs
Land samples and take to Marine Scotland, surveyors travel to South Queensferry, Edinburgh
Weather: BF2, slight
Tuesday 26th February 2013
Demobilise survey vessel
Surveyors return to BMM

Table 4.3 Summarised Log of Events for Trip B, 10th to 19th March 2013

Sunday 10th March 2013
Surveyors depart BMM, travel to South Queensferry, Edinburgh
Monday 11th March 2013
Travel to Peterhead, collect survey equipment from Marine Scotland, mobilise vessel
Client Representative arrived at vessel at approximately 2300 hrs
Depart Peterhead at 0000 hrs, steam to survey area overnight
Overnight at sea
Tuesday 12th March 2013
Otter Trawls: OT34 (1 x stage III cod), OT33 (repeated due to Scanmar error, OT32, OT22 (1 x stage III cod)
Weather:BF4/5, moderate
Overnight at sea
Wednesday 13th March 2013
Otter Trawls: OT41, OT23, OT40 (1 x stage I and 1 x stage III cod, 1 x sandeel), OT42, OT46
Weather: BF3-5, moderate, decreasing
Overnight at sea
Thursday 14th March 2013
Otter Trawls: OT26 (25 x sandeel), OT43 (1 x stage I cod, 6 x sandeel), OT24 (3 x stage I cod), OT35 (1 x stage I cod), OT08B (1 hour, 2 x stage III cod)
Weather: BF2/3, slight
Steam into Macduff, arrive at 2330 hrs, client representative disembarked vessel
Return to survey area
Overnight at sea
Friday 15th March 2013
Otter Trawls: OT30 (4 x stage I cod), OT31, OT36 (1 x stage III cod), OT39 (1 x stage I cod), OT39B (1 hour, 1 x stage III and 1 x stage I cod, 1 x sandeel)
Weather: BF2-4, slight
Overnight at sea
Saturday 16th March 2013
Otter Trawls: OT44 (1 x stage III cod, 3 x sandeel), OT45, OT47 (1 x stage IV cod, 3 x sandeel), OT28 (24 x sandeel), OT48 (1 x stage I cod)
Weather: BF2/3, slight
Overnight at sea
Sunday 17th March 2013
Otter Trawls: OT27 (1 x stage I and 1 x stage III cod) OT38 (8 x stage I and 1 x stage III cod), OT37 (1 x stage I cod), OT25
Weather: BF5/6, moderate
Overnight at sea
Monday 18th March 2013
Otter Trawls: OT29 (1 x stage III and 1 x stage IV cod)
Steam to Macduff due to poor weather conditions, arrive at 1530 hrs
Take survey equipment to Marine Scotland, surveyors travel to South Queensferry, Edinburgh
Weather: BF6-8, moderate to rough
Tuesday 19th March 2013
Demobilise survey vessel
Surveyors return to BMM

Appendix 4 – Times and Coordinates

Trip A Otter Trawls

Table 4.10 Start and End Times, Co-ordinates and Duration of Each Otter Trawl during Trip A

Station	Date	Start				End				Duration (hh:mm:ss)
		Time (GMT)	UTM30N		Depth (m)	Time (GMT)	UTM30N		Depth (m)	
			Easting	Northing			Easting	Northing		
OT01	20/02/2013	13:18:57	499,521.7	6,418,304.5	91.6	13:48:58	499,499.3	6,415,935.1	89.4	00:30:01
OT02	20/02/2013	11:41:58	503,323.4	6,423,729.6	84.5	12:12:11	502,594.9	6,421,373.7	90.5	00:30:13
OT03	24/02/2013	15:33:26	528,664.2	6,422,689.7	74.0	16:03:26	528,506.5	6,420,044.7	68.4	00:30:00
OT04	25/02/2013	07:35:26	536,381.1	6,426,277.9	83.4	08:05:37	536,259.7	6,423,494.1	85.4	00:30:11
OT05	20/02/2013	07:58:27	513,305.9	6,426,202.5	80.4	08:28:30	512,669.7	6,428,759.5	74.4	00:30:03
OT06	20/02/2013	09:58:05	507,677.6	6,430,593.0	54.1	10:28:31	506,175.3	6,428,280.7	71.5	00:30:26
OT07	21/02/2013	09:40:00	497,136.3	6,431,578.6	55.7	10:10:01	497,019.6	6,434,062.6	53.4	00:30:01
OT08	24/02/2013	12:14:29	519,013.1	6,435,606.6	68.4	12:44:29	518,830.4	6,433,099.6	71.3	00:30:00
OT09	19/02/2013	08:09:03	544,193.7	6,435,600.7	68.2	08:39:04	544,045.0	6,432,866.7	116.5	00:30:01
OT10	21/02/2013	13:51:12	487,475.3	6,437,960.6	56.1	14:21:12	487,679.6	6,440,666.3	58.7	00:30:00
OT11	23/02/2013	16:13:42	517,261.1	6,444,438.7	52.8	16:43:42	516,668.9	6,442,056.7	54.1	00:30:00
OT12	24/02/2013	08:13:42	512,910.4	6,444,138.6	49.9	08:43:42	512,953.8	6,446,439.7	44.6	00:30:00
OT13	22/02/2013	09:14:13	505,158.2	6,446,769.4	44.2	09:44:12	505,165.5	6,449,396.2	46.8	00:29:59
OT14	23/02/2013	14:40:35	520,058.8	6,450,681.2	57.0	15:10:35	520,650.3	6,448,477.2	55.6	00:30:00
OT15	19/02/2013	14:36:51	528,580.4	6,449,377.0	56.5	15:06:51	528,106.9	6,451,899.5	57.6	00:30:00
OT16	23/02/2013	12:11:01	522,543.6	6,452,860.7	59.4	12:41:01	522,532.6	6,450,511.5	59.0	00:30:00
OT17	22/02/2013	12:15:42	512,993.4	6,450,305.9	48.4	12:45:42	513,449.0	6,452,992.7	49.5	00:30:00
OT18	21/02/2013	16:05:36	499,644.0	6,451,808.1	64.2	16:34:35	499,367.5	6,454,206.8	67.6	00:28:59
OT19	22/02/2013	14:44:39	512,801.0	6,456,148.6	48.4	15:14:38	512,694.2	6,453,851.6	49.5	00:29:59
OT20	23/02/2013	09:51:18	517,105.7	6,455,164.3	47.3	10:21:18	517,251.1	6,452,401.1	55.7	00:30:00
OT21	19/02/2013	12:09:53	535,875.9	6,445,196.4	72.6	12:39:54	536,259.0	6,447,667.4	61.0	00:30:01
OT22	21/02/2013	07:52:24	493,117.5	6,423,738.7	57.8	08:22:23	493,093.8	6,426,261.6	58.8	00:29:59
OT23	21/02/2013	11:13:35	499,169.4	6,438,253.5	51.4	11:43:36	499,055.0	6,440,976.5	47.9	00:30:01
OT24	24/02/2013	09:40:22	512,936.6	6,441,422.2	52.6	10:10:22	513,015.2	6,438,586.8	58.5	00:30:00
OT25	19/02/2013	10:09:49	534,375.2	6,438,567.0	73.7	10:39:50	534,922.9	6,441,182.3	67.3	00:30:01
OT26	22/02/2013	10:45:17	509,406.3	6,449,816.9	45.0	11:15:16	509,367.5	6,452,431.4	42.4	00:29:59
OT27	19/02/2013	16:00:45	524,628.4	6,450,126.9	55.4	16:30:45	524,481.7	6,452,679.0	58.8	00:30:00
OT28	23/02/2013	08:14:29	517,092.7	6,459,821.5	51.9	08:44:30	516,922.0	6,457,021.5	50.3	00:30:01
OT49	22/02/2013	07:43:47	502,815.7	6,451,726.9	43.7	08:13:48	502,448.7	6,449,028.3	42.0	00:30:01

Trip B Otter Trawls

Table 4.11 Start and End Times, Co-ordinates and Duration of Each Otter Trawl during Trip B

Station	Date	Start				End				Duration (hh:mm:ss)
		Time (GMT)	UTM30N		Depth (m)	Time (GMT)	UTM30N		Depth (m)	
			Easting	Northing			Easting	Northing		
OT22	12/03/2013	17:32:51	492,985.1	6,426,215.2	57.0	18:02:52	492,957.4	6,423,665.3	54.8	00:30:01
OT23	13/03/2013	10:37:59	499,076.5	6,439,357.5	49.5	11:07:59	498,976.5	6,436,519.3	54.6	00:30:00
OT24	14/03/2013	12:06:43	513,032.1	6,440,858.4	53.4	12:36:43	513,061.7	6,438,105.0	59.0	00:30:00
OT25	17/03/2013	17:16:55	534,515.0	6,439,651.4	67.6	17:46:55	533,917.3	6,437,299.9	65.1	00:30:00
OT26	14/03/2013	09:23:33	509,041.1	6,449,217.1	42.6	09:53:33	509,396.7	6,451,790.5	44.2	00:30:00
OT27	17/03/2013	09:11:31	524,492.7	6,452,818.9	57.9	09:41:31	524,784.3	6,450,194.6	54.6	00:30:00
OT28	16/03/2013	14:15:47	516,846.6	6,456,911.7	51.0	14:45:53	516,838.7	6,459,448.6	52.6	00:30:06
OT29	18/03/2013	08:14:58	511,006.1	6,417,994.0	100.0	08:44:58	511,196.4	6,415,350.2	96.0	00:30:00
OT30	15/03/2013	09:39:10	520,803.6	6,423,232.1	88.8	10:09:12	520,074.9	6,420,632.7	71.7	00:30:02
OT31	15/03/2013	11:50:00	524,931.1	6,431,025.2	75.7	12:22:40	525,052.9	6,433,745.1	76.2	00:32:40
OT32	12/03/2013	15:36:48	491,487.5	6,434,298.6	49.2	16:06:50	491,580.4	6,436,431.4	47.7	00:30:02
OT33	12/03/2013	13:03:39	502,981.3	6,435,951.8	54.6	13:33:40	502,884.9	6,438,632.6	53.0	00:30:01
OT34	12/03/2013	09:24:54	510,560.4	6,435,378.3	53.4	09:55:09	510,666.6	6,437,626.5	52.1	00:30:15
OT35	14/03/2013	14:24:14	516,886.2	6,439,890.1	58.1	14:54:13	516,859.7	6,437,238.4	59.9	00:29:59
OT36	15/03/2013	14:32:52	523,010.1	6,439,642.6	61.0	15:03:01	522,958.4	6,442,241.2	60.1	00:30:09
OT37	17/03/2013	13:30:46	528,533.4	6,445,191.6	56.3	14:00:44	528,649.3	6,442,365.6	61.8	00:29:58
OT38	17/03/2013	10:40:19	524,714.0	6,448,293.3	55.7	11:10:20	524,464.9	6,445,676.2	55.9	00:30:01
OT39	15/03/2013	16:10:59	520,730.3	6,443,925.8	55.9	16:40:58	520,731.9	6,446,683.6	55.0	00:29:59
OT40	13/03/2013	13:14:31	507,321.8	6,442,338.3	44.6	13:44:32	507,316.3	6,445,167.7	44.6	00:30:01
OT41	13/03/2013	08:37:15	495,693.3	6,446,458.2	55.0	09:07:18	495,703.8	6,448,833.0	64.7	00:30:03
OT42	13/03/2013	14:44:26	502,348.5	6,445,777.3	42.0	15:14:26	502,421.6	6,448,716.0	41.3	00:30:00
OT43	14/03/2013	10:46:05	510,863.8	6,447,528.5	44.8	11:16:06	510,880.0	6,444,625.5	47.9	00:30:01
OT44	16/03/2013	08:30:18	516,393.1	6,448,261.1	51.4	09:00:47	516,369.4	6,451,028.8	52.3	00:30:29
OT45	16/03/2013	10:08:16	518,747.2	6,451,986.8	51.7	10:38:16	518,789.8	6,454,576.2	53.4	00:30:00
OT46	13/03/2013	16:30:25	506,915.6	6,455,662.7	42.6	17:00:35	507,004.3	6,453,318.5	40.7	00:30:10
OT47	16/03/2013	11:40:45	514,378.0	6,454,876.4	49.5	12:10:45	514,662.1	6,457,250.1	44.8	00:30:00
OT48	16/03/2013	16:39:08	520,569.6	6,457,908.1	53.4	17:09:10	520,415.9	6,455,319.6	54.8	00:30:02
OT08 1 Hour	14/03/2013	15:48:53	518,762.0	6,436,998.2	65.4	16:48:53	518,790.6	6,431,869.9	70.9	01:00:00
OT39 1 Hour	15/03/2013	17:05:47	521,352.7	6,446,580.4	55.6	18:05:46	521,568.1	6,441,309.5	58.7	00:59:59

Appendix 5 – Examples of Spawning and Spent Cod

Stage III Spawning

Trip A

Figure 4.20 OT05 Male 46 cm

Figure 4.21 OT10 Male 54 cm

Figure 4.22 OT10 Male 67 cm

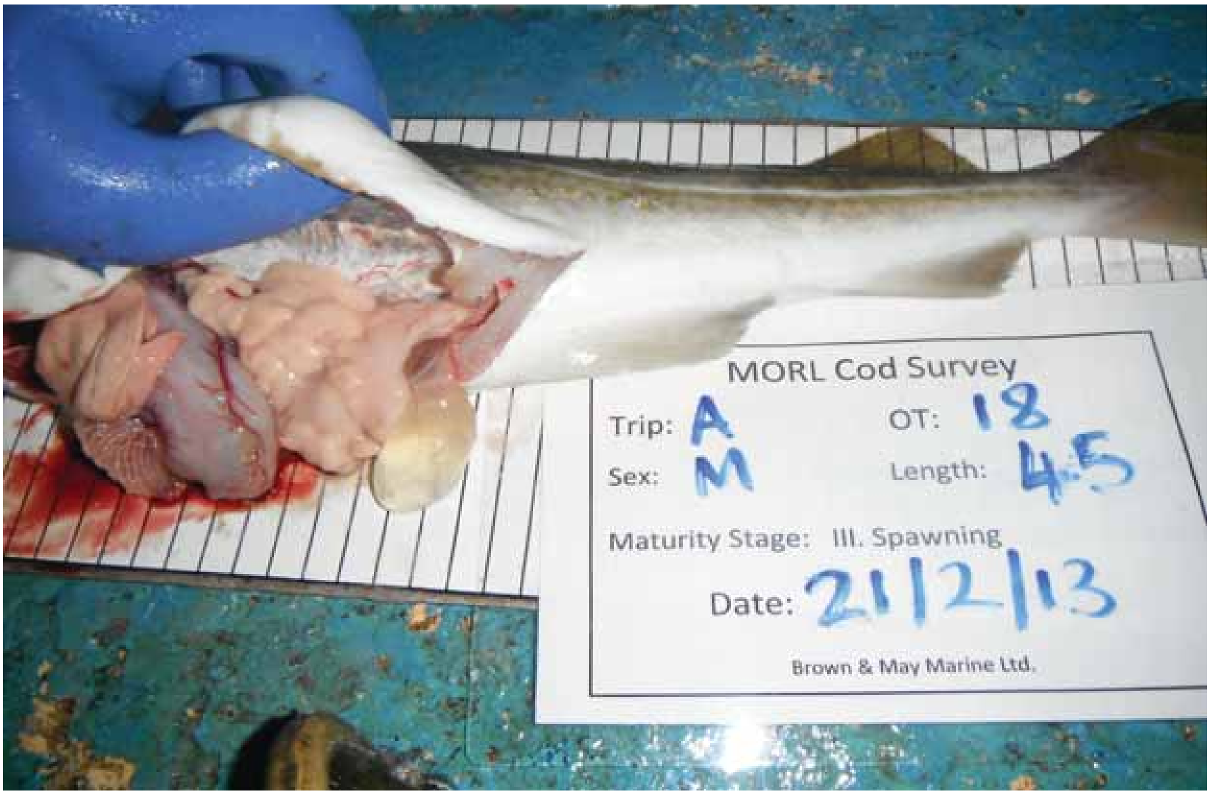


Figure 4.23 OT18 Male Length 45 cm

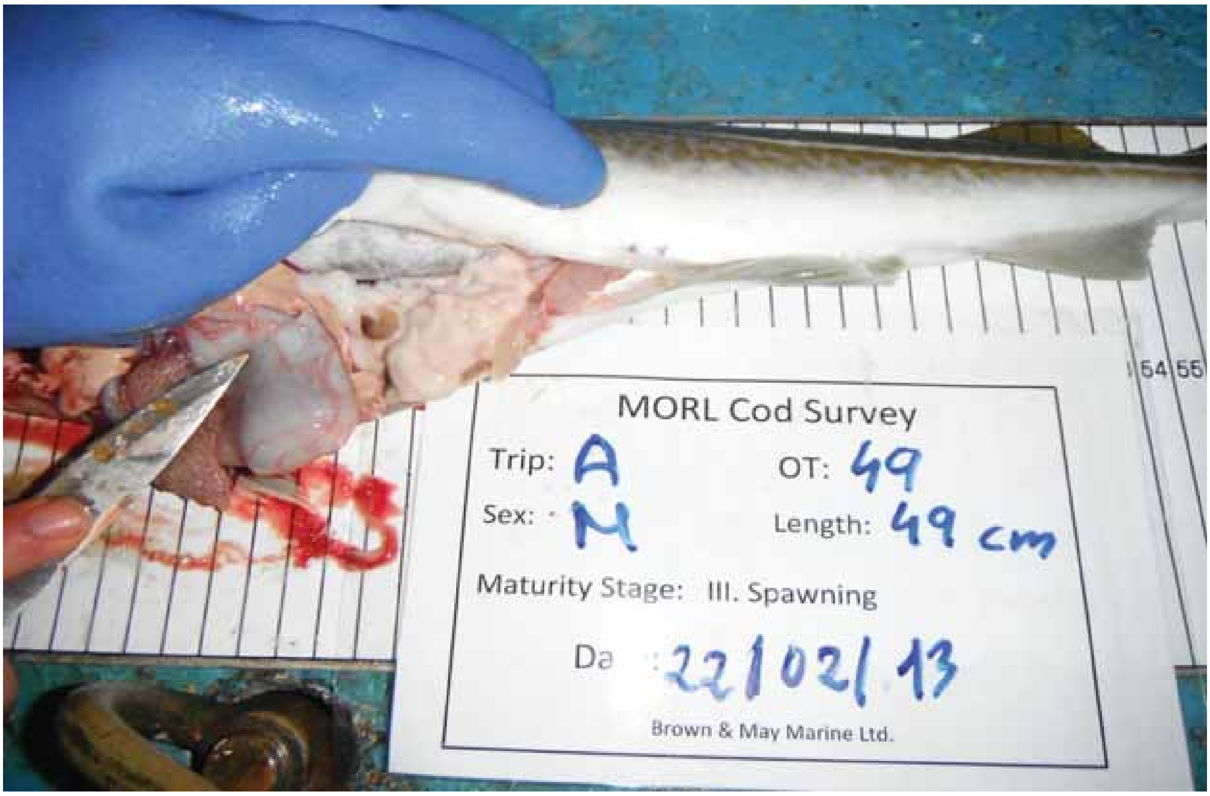


Figure 4.24 OT49 Male Length 49 cm

Figure 4.25 OT11 Female 46 cm

Figure 4.26 OT11 Male 68 cm

Figure 4.27 OT08 Male 33 cm

Figure 4.28 OT08 Male 46 cm

Figure 4.29 OT08 Female 50 cm

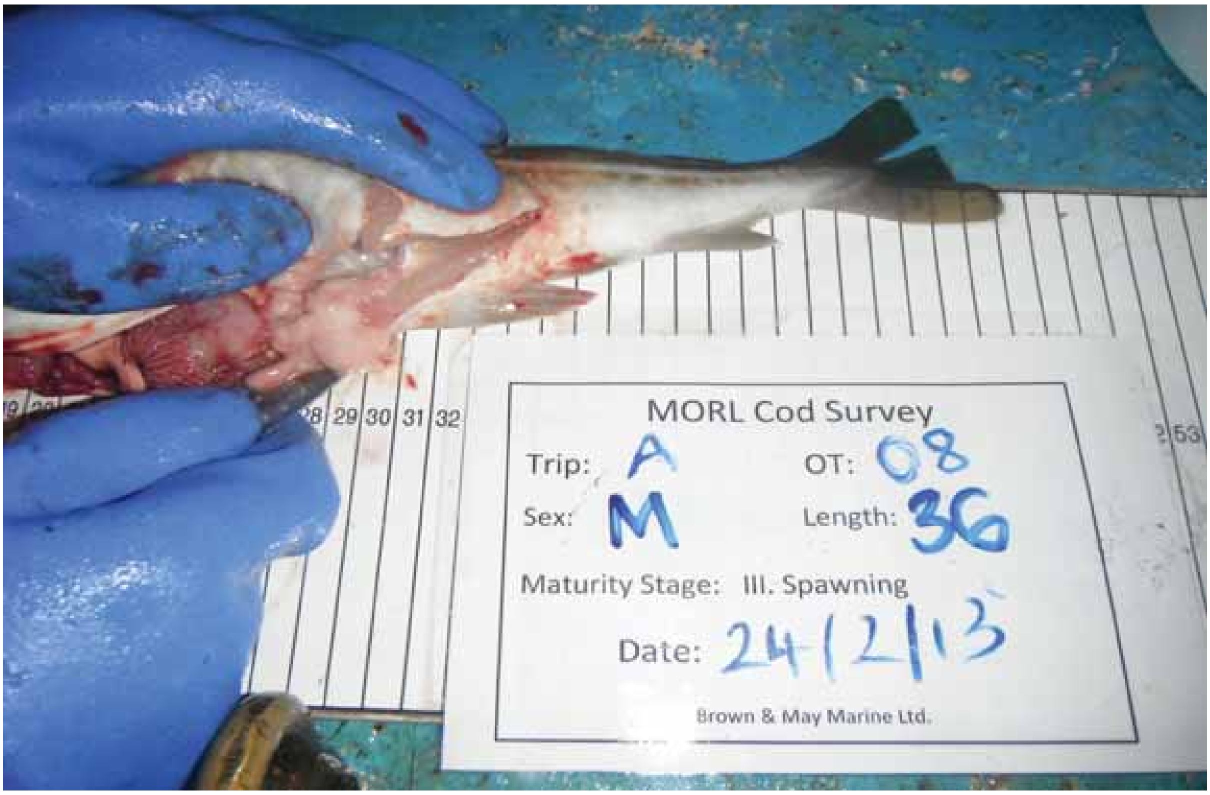


Figure 4.30 OT08 Male 36 cm

Trip B

Figure 4.31 OT34 Female 34 cm

Figure 4.32 OT22 male 49 cm

Figure 4.33 OT40 Female 41 cm

Figure 4.34 OT08 58 cm_1hour

Figure 4.35 OT08_1hour Female 50 cm

Figure 4.36 OT36 female 43 cm

Figure 4.37 OT39_1hour Female 54 cm

Figure 4.38 OT27 male 43 cm

Figure 4.39 OT38 Male 45 cm

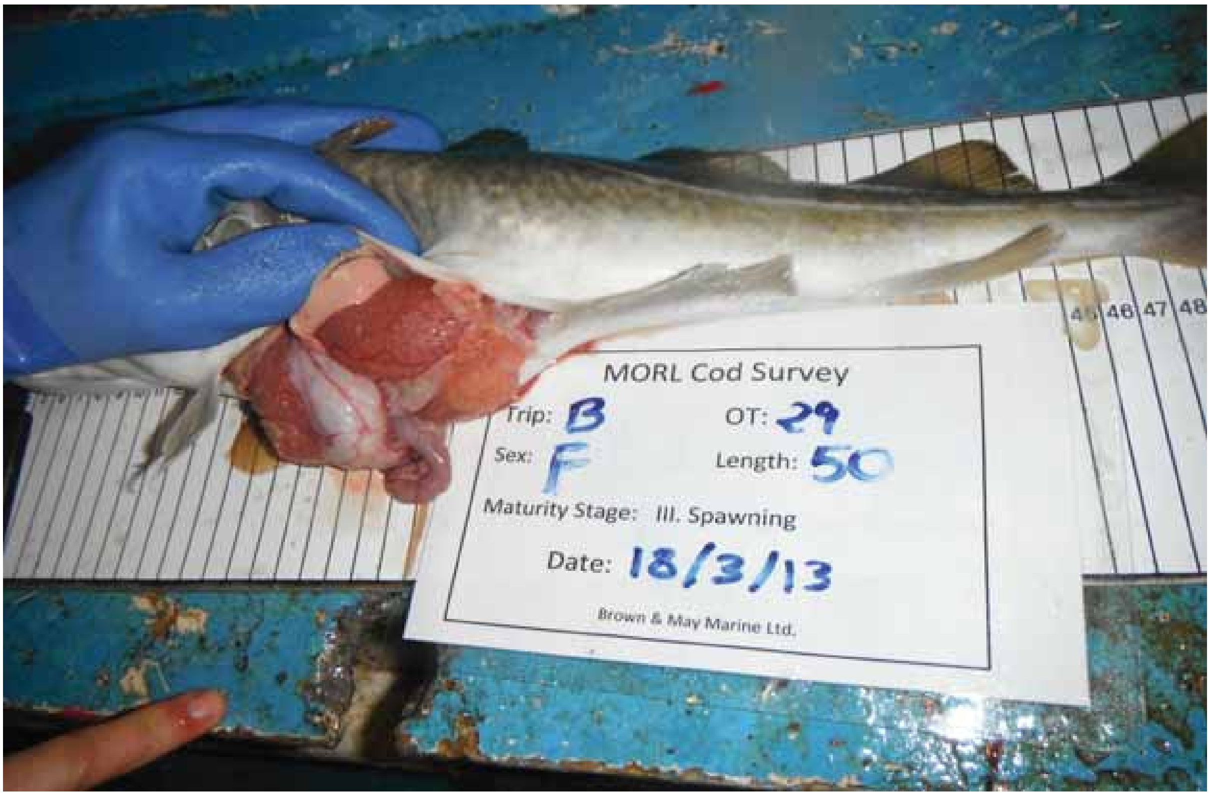


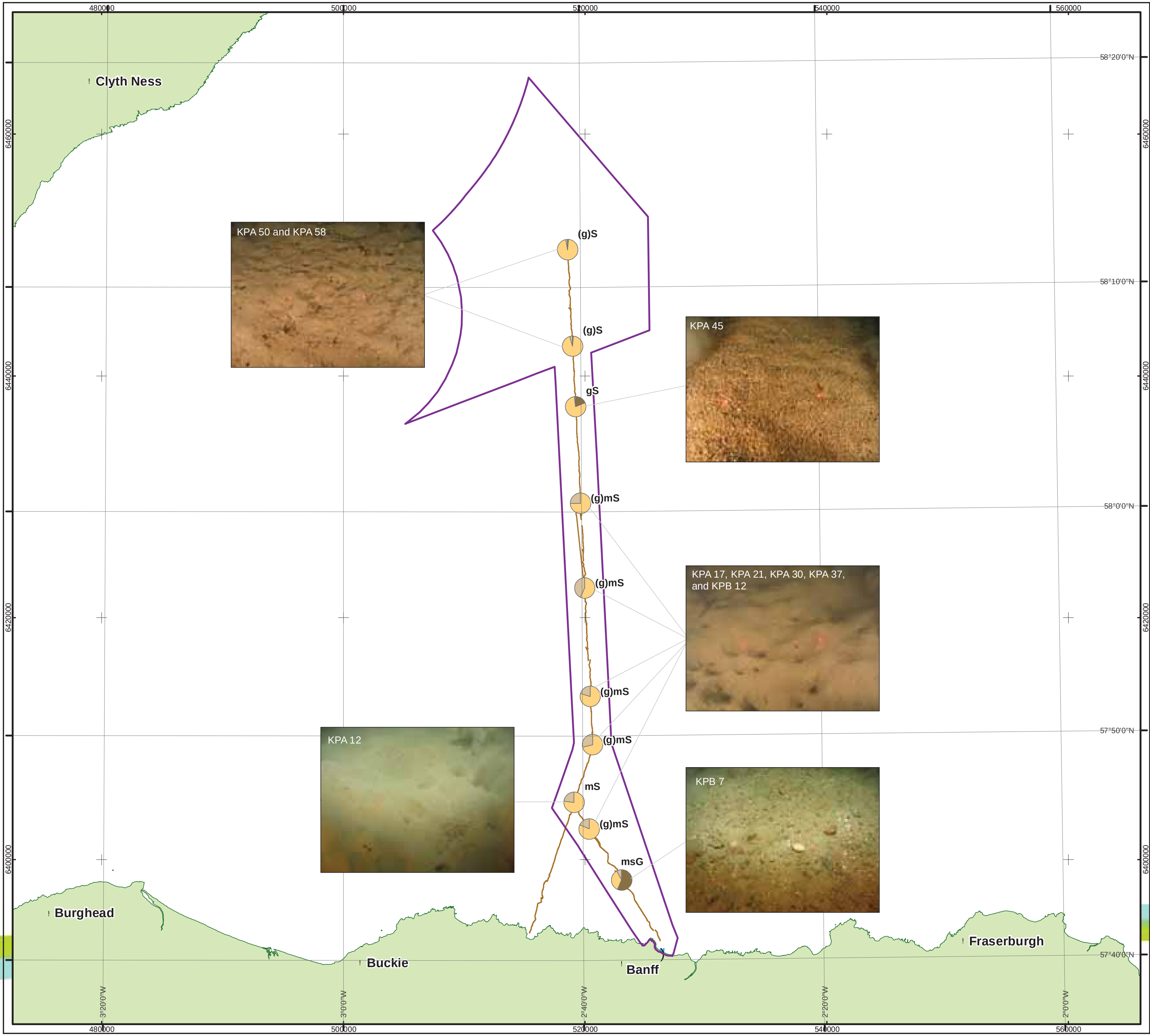
Figure 4.40 OT29 Female 50 cm

Stage IV spent

Trip B

Figure 4.41 OT29 Female 55 cm

Figure 4.42 OT47 Female 55 cm



edp renewables

REPSOL

Moray Offshore Renewables Ltd

KEY

Modified OfTI

Cable Route Landing Site

Video Transect

Principal Sediment Components (%)

Gravel

Sand

Mud

Sediment Classification according to Folk, 1954.

Horizontal Scale: 1:300,000 A3 Chart

0 5,000 10,000 Metres

Geodetic Parameters: WGS84 UTM Zone 30N

Produced: IMR
Reviewed: ES
Approved: CR

Date: 13/06/2014 Revision: A

REF: 8460001-PSO0131-EMU-MAP-010

Figure 3.3
Principal Sediment Components

Moray Offshore Renewables Ltd