

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 4.5 A

Intertidal Ecology Characterisation



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



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

moray offshore renewables limited

4th Floor
 40 Princes Street
 Edinburgh
 EH2 2BY

Tel: +44 (0)131 556 7602

Table of Contents

1	Introduction	5
1.1	Project Background	5
1.2	Aims of the Study	5
1.3	Study Overview	5
2	Background	6
2.1	Regional Physical Environment	6
2.2	Regional Biological Context.....	6
3	Methods.....	7
3.1	Survey Design	7
3.2	Sampling Survey	7
3.3	Biotope Classification	8
4	Results.....	9
4.1	General Information.....	9
4.2	Biotope Mapping.....	9
4.3	Summary of Habitats and Communities at Inverboyndie Bay.....	16
5	Discussion	19
6	Conclusions	20
7	References	21

List of Appendices

Appendix 1	Site Description and Species List - Inverboyndie.....	22
Appendix 2	Intertidal Photo Log - Inverboyndie	27
Appendix 3	Intertidal Photographs - Inverboyndie	30
Appendix 4	Figures	52

List of Tables

Table 4.1	Summary and classification (Connor <i>et al.</i> , 2004) of the observed intertidal biotopes within the survey area at Inverboyndie Bay.....	9
Table 4.2	LS.LSa.MoSa.BarSa observed biotope at Inverboyndie Bay.	10
Table 4.3	LS.LSa.FiSa.Po observed biotope at Inverboyndie Bay.....	11
Table 4.4	LR.FLR.Eph.Ent observed biotope at Inverboyndie Bay.	12
Table 4.5	LR.FLR.Eph.EntPor observed biotope at Inverboyndie Bay.....	13
Table 4.6	LR.MLR.BF.Fser.R observed sub-biotope at Inverboyndie Bay.	14
Table 4.7	IR.MIR.KR.Ldig.Bo observed sub-biotope at Inverboyndie Bay.....	15

List of Plates

Plate 4.1	Existing pipe present to the west of the proposed cable route	16
Plate 4.2	Gravel/pebble rock armour on the eastern side of the survey area.....	16
Plate 4.3	Boulder rock armour on the western side of the survey area	17
Plate 4.4	Sand martin nesting site in the western side of the survey area	17

List of Figures

Figure 1	Location of the proposed cable route landfall site of the Moray Firth R3 Offshore Wind Farm Development.....	Error! Bookmark not defined.
Figure 2	Inverboyndie Bay intertidal biotope and features map	Error! Bookmark not defined.

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; Eleftheriou 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 *Scolecopsis 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.

Biotores 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=JNCCMNCR000002182
9	LR.FLR.Eph.Ent <i>Enteromorpha</i> 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 <i>Porphyra purpurea</i> and <i>Enteromorpha</i> 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 <i>Fucus serratus</i> 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 <i>Laminaria digitata</i> 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			
<p>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.</p> <p>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.</p>			

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
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Waypoint 13 Close-up on lugworm casts in rippled sand beside existing pipe.</p> </div> <div style="text-align: center;">  <p>Waypoint 12 View of the existing pipe running down shore across the sand. Photo taken facing north.</p> </div> </div>		
<p>Description of Observed Biotope</p> <p>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 <i>Arenicola marina</i> were noted to be occasional/common in abundance. Upon the pipe, <i>Enteromorpha</i> spp. and <i>Porphyra</i> spp. algae were recorded.</p> <p>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 <i>A. marina</i> may be similar to the depauperate nature of shore where boulders are not present.</p>		

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	<i>Enteromorpha</i> 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 <i>Enteromorpha</i> spp. Photo taken facing north.	Waypoint 9 Close-up of <i>Enteromorpha</i> spp. on bare sand and boulders within the freshwater stream.
<p>Description of Observed Biotope</p> <p>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 <i>Enteromorpha</i> 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.</p> <p>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 <i>Enteromorpha</i> spp.</p>		

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	<i>Porphyra purpurea</i> and <i>Enteromorpha</i> 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 taken facing south.	Waypoint 17 Close-up on boulders and sand with <i>Enteromorpha</i> spp. and <i>Porphyra</i> spp.
<p>Description of Observed Biotope</p> <p>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 <i>Enteromorpha</i> 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 <i>Enteromorpha</i> spp. and <i>Porphyra</i> spp., as well as <i>Arenicola marina</i> 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.</p> <p>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.</p>		

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	<i>Fucus serratus</i> on moderately exposed lower eulittoral rock
Sub-biotope	R	<i>Fucus serratus</i> 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 <i>Semibalanus balanoides</i> , <i>Nucella lapillus</i> , <i>Patella vulgata</i> , <i>Fucus serratus</i> , <i>Enteromorpha</i> spp. and <i>Mastocarpus stellatus</i> .
		
Waypoint 27 Close-up on <i>Semibalanus balanoides</i> , <i>Mastocarpus stellatus</i> , <i>Enteromorpha</i> spp. and <i>Cladophora</i> on boulders.	Waypoint 22 Close-up on <i>Fucus serratus</i> on boulders.	Waypoint 23 Close-up on <i>Fucus serratus</i> , <i>Corallina officinalis</i> and <i>Mastocarpus stellatus</i> .
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 <i>Fucus serratus</i> , <i>Corallina officinalis</i> , <i>M. stellatus</i> , <i>Cladophora</i> spp., <i>Enteromorpha</i> spp. and <i>Porphyra</i> spp., as well as <i>Semibalanus balanoides</i> , <i>Patella vulgata</i> . and <i>N. lapillus</i> .		
The biotope LR.MLR.BF.Fser.R description focuses on the sense mosaic of algae species, predominantly brown and red seaweeds, including <i>C. officinalis</i> and <i>M. stellatus</i> . 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	<i>Laminaria digitata</i> on moderately exposed sublittoral fringe rock
Sub-biotope	Bo	<i>Laminaria digitata</i> 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 <i>Laminaria digitata</i> , <i>Fucus serratus</i> and <i>Palmaria palmata</i> between the boulders.
<p>Description of Observed Biotope</p> <p>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 <i>Laminaria digitata</i>., rather than the mixed seaweed of the LR.MLR.BF.Fser.R biotope.</p> <p>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 <i>Laminaria digitata</i>, sometimes with other species present, like <i>F. serratus</i>. The noted community includes these species, as well as the presence of <i>P. palmata</i> under the canopy and barnacles like <i>Semibalanus balanoides</i> on the boulders.</p>		

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.

7 References

Aberdeenshire Council, 2014. *Aberdeenshire Council Beaches* [online] Available from: <http://www.aberdeenshire.gov.uk/beaches/> Accessed Jun 2014.

Barne, J.H., Robson, C.F., Kaznowska, S.S., Doody, J.P. and Davidson, N.C., eds. (1996) *Coasts and seas of the United Kingdom. Region 3 North-east Scotland: Cape Wrath to St. Cyrus*. Coastal Directories Series. Peterborough, Joint Nature Conservation Committee.

Connor, D.W., Allen, J.H., Golding, N., Howell, K.L., Lieberknecht, L.M., Northen, K.O. and Reker, J.B. (2004) *The marine habitat classification for Britain and Ireland, version 04.05* [online] Joint Nature Conservation Committee. Available from: <http://jncc.defra.gov.uk/MarineHabitatClassification> Accessed June 2014.

Eleftheriou, A., Basford, D., and Moore, D.C. (2004) *Synthesis of information on the benthos area SEA 5*. Report for the Department of Trade and Industry, SEA 5, 145 pp.

Eleftheriou, A. and Robertson, M.R. (1988) *The intertidal fauna of sandy beaches – a survey of the east Scottish coast*. Department of Agriculture and Fisheries for Scotland, Aberdeen (Scottish Fisheries Research Report, No. 38).

Hooper, G.J., Barfield, P.D., Thomas N.S. and Capasso, E. (2011) *Redefining biotopes at a regional scale and development of a new MNCR biotope decision support tool*. Published by the MALSF. EMU Limited Report No. 1/J/1/03/1552/1103. ISBN No. 978 0 907545 58 3.

SEPA (Scottish Environmental Protection Agency) and Natural Scotland, 2014. *Bathing water profile: Inverboyndie* [online] Available from: http://www.sepa.org.uk/water/bathing_waters/idoc.ashx?docid=45bf3064-363c-47d1-ae71-8b83e6dd3938&version=-1 Accessed Jun 2014.

Terry, L.A. and Sell, D., 1986. Rocky shores in the Moray Firth. *Proceedings of the Royal Society of Edinburgh*, **91B**, 169–191.

Wyn, G. and Brazier, P. (2001) *Procedural Guideline No. 3-1. In situ biotope recording*. IN: Davies, J., Baxter, J., Bradley, M., Connor, D., Khan, J., Murray, E., Sanderson, W., Turnbull, C. and Vincent, M., eds. *Marine Monitoring Handbook*, 405 pp.

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)	57°40.239'N	2°33.242'W	Rock dump at top of shore extends for 10 m. No obvious species.	n/a	
2	57°40.241'N	2°33.235'W	Edge of rock dump, barren sand. Small amount of drift algae present.	n/a	
3	57°40.265'N	2°33.242'W	Mid shore barren sand with occasional pebble. No obvious species.	n/a	
4	57°40.316'N	2°33.259'W	Lower shore - barren sand with small rippled patches. No obvious species.	n/a	
30	57°40.344'N	2°33.263'W	Low water mark - barren sand. No obvious species.	n/a	
T2 (Proposed Cable route)	57°40.294'N	2°33.464'W	Rock dump at top of shore extends for 11.8 m - no obvious species.	n/a	
5	57°40.299'N	2°33.463'W	Edge of rock dump, barren sand. Small amount of drift algae present.	n/a	
6	57°40.335'N	2°33.479'W	Mid shore barren sand with occasional pebble, slight ripples. No obvious species.	n/a	
7	57°40.380'N	2°33.493'W	Fresh water stream running down shore. No obvious species	n/a	
8	57°40.335'N	2°33.575'W	Fresh water stream - top of shore. No obvious species.	n/a	
9	57°40.349'N	2°33.571'W	Green filamentous algae on sand and boulders beside fresh water stream	<i>Enteromorpha</i>	A
10	57°40.399'N	2°33.499'W	Edge of rocky outcrop. Assortment of brown, red and green seaweeds. Obvious	<i>Semibalanus balanoides</i> <i>Nucella lapillus</i> <i>Littorina</i> 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.	<i>Enteromorpha</i> spp.	C
				<i>Porphyra</i> spp.	C
				<i>Mastocarpus stellatus</i>	C
				<i>Fucus serratus</i>	C
				<i>Patella vulgata</i>	O
11	57°40.406'N	2°33.501'W	Lower shore at edge of rocky outcrop. Barren sand beside large boulders.	<i>Semibalanus balanoides</i>	S
				<i>Nucella lapillus</i>	F
				<i>Patella vulgata</i>	O
				<i>Mastocarpus stellatus</i>	C
				<i>Littorina</i> sp.	O
				<i>Fucus serratus</i>	C
				<i>Enteromorpha</i> spp.	C
				<i>Porphyra</i> spp.	C
27	57°40.406'N	2°33.493'W	Rocky outcrop. Mixed algae and fauna present.	<i>Semibalanus balanoides</i>	S
				<i>Patella vulgata</i>	O
				<i>Nucella lapillus</i>	C
				<i>Littorina</i> sp.	O
				<i>Mastocarpus stellatus</i>	C
				<i>Enteromorpha</i> spp.	C
				<i>Porphyra</i> spp.	O
				<i>Cladophora</i> spp.	O
28	57°40.406'N	2°33.493'W	Rocky boulders with patches of sand in-between. Beginning of kelp zone.	<i>Rhodothamniella floridula</i>	F
				<i>Semibalanus balanoides</i>	F
				<i>Patella vulgata</i>	O
				<i>Nucella lapillus</i>	F
				<i>Littorina</i> sp.	O
				<i>Mastocarpus stellatus</i>	C
				<i>Enteromorpha</i> spp.	O
				<i>Porphyra</i> spp.	O
				<i>Cladophora</i> spp.	O
				<i>Fucus serratus</i>	A
				<i>Laminaria digitata</i>	A
29	57°40.419'N	2°33.496'W	Rocky boulders with patches of sand in-	<i>Rhodothamniella floridula</i>	F
				<i>Semibalanus balanoides</i>	F

Waypoint no.	Position WGS84 DD° mm.mmm'		Description of site	Taxa and Abundance (SACFOR scale)	
	Longitude	Latitude			
			between. Beginning of kelp zone.	<i>Patella vulgata</i>	O
				<i>Nucella lapillus</i>	F
				<i>Littorina</i> sp.	O
				<i>Mastocarpus stellatus</i>	C
				<i>Enteromorpha</i> spp.	O
				<i>Porphyra</i> spp.	O
				<i>Cladophora</i> spp.	O
				<i>Fucus serratus</i>	A
				<i>Laminaria digitata</i>	A
12	57°40.381'N	2°33.538'W	Area of sand with <i>Arenicola</i> casts	<i>Arenicola marina</i>	O
13	57°40.381'N	2°33.580'W	Pipeline running down shore - covered in turf of green and red algae. Sandy area beside pipe rippled with <i>Arenicola</i> casts present.	<i>Enteromorpha</i> spp.	C
				<i>Porphyra</i> spp.	A
				<i>Arenicola marina</i>	C
14	57°40.361'N	2°33.673'W	Sand Martin nesting area at top of shore.	n/a	
T1 (West of cable route)	57°40.364'N	2°33.700'W	Rock dump at top of shore extends for 11.9 m - no obvious species.	n/a	
15	57°40.369'N	2°33.698'W	Edge of rock dump, barren sand with occasional pebbles. Small amount of drift algae present.	n/a	
16	57°40.377'N	2°33.707'W	Small strip of rippled sand. No obvious species.	n/a	
17	57°40.400'N	2°33.720'W	Area of boulders and rippled sand patches covered with red and green algae. <i>Arenicola</i> casts present on sand patches.	<i>Enteromorpha</i> spp.	A
				<i>Porphyra</i> spp.	C
				<i>Arenicola marina</i>	O
18	57°40.421'N	2°33.721'W	Large patch of slightly rippled sand between boulders. <i>Arenicola</i> casts present.	<i>Arenicola marina</i>	O
19	57°40.434'N	2°33.720'W	Low tide mark at edge of sand patch.	<i>Enteromorpha</i> spp.	A
				<i>Porphyra</i> spp.	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. <i>Arenicola</i> casts present on sandy patches between boulders.	<i>Arenicola marina</i>	O
20	57°40.424'N	2°33.655'W	Edge of large rocky outcrop. Boulders covered in red and green algae with areas of sand in-between.	<i>Enteromorpha</i> spp. <i>Porphyra</i> spp.	A C
21	57°40.421'N	2°33.641'W	Mid shore area of rocky outcrop dominated by large brown seaweeds.	<i>Fucus vesiculosus</i> <i>Fucus serratus</i> <i>Cladophora</i> spp. <i>Littorina</i> sp. <i>Semibalanus balanoides</i> <i>Nucella lapillus</i> <i>Patella vulgata</i>	C C O O C O O
22	57°40.432'N	2°33.628'W	Mid shore area of rocky outcrop. Mixed turf of seaweeds.	<i>Fucus serratus</i> <i>Osmundia hybrida</i> <i>Mastocarpus stellatus</i> <i>Patella vulgata</i> <i>Nucella lapillus</i> <i>Littorina</i> sp. <i>Semibalanus balanoides</i>	A F C O F O C
23	57°40.433'N	2°33.629'W	Lower shore area of rocky outcrop - kelp zone. Some <i>Pomatoceros</i> tubes visible on rocks.	<i>Corallina officinalis</i> <i>Laminaria digitata</i> <i>Fucus serratus</i> <i>Osmundia hybrida</i> <i>Mastocarpus stellatus</i> <i>Nucella lapillus</i> <i>Littorina</i> sp. <i>Semibalanus balanoides</i> <i>Patella vulgata</i>	F C A F C F O C O

Waypoint no.	Position WGS84 DD° mm.mmm'		Description of site	Taxa and Abundance (SACFOR scale)	
	Longitude	Latitude			
24	57°40.444'N	2°33.622'W	Lower shore area of rocky outcrop - kelp zone.	<i>Fucus serratus</i>	A
				<i>Mastocarpus stellatus</i>	F
				<i>Patella vulgata</i>	O
				<i>Nucella lapillus</i>	O
				<i>Cladophora</i> spp.	O
				Red calcareous encrusters	O
				<i>Corallina officinalis</i>	F
				<i>Palmaria palmata</i>	F
				<i>Laminaria digitata</i>	A
26	57°40.462'N	2°33.565'W	Low water mark on rocky outcrop.	<i>Palmaria palmata</i>	C
				Red calcareous encrusters	O
				<i>Laminaria digitata</i>	A
				<i>Fucus serratus</i>	C
				<i>Mastocarpus stellatus</i>	F
				<i>Patella vulgata</i>	O
				<i>Semibalanus balanoides</i>	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)	57°40.239'N	2°33.242'W	P5200001	North
			P5200002	East
			P5200003	West
2	57°40.241'N	2°33.235'W	P5200004	North
			P5200005	East
			P5200006	West
			P5200007	Close-up
3	57°40.265'N	2°33.242'W	P5200008	North
			P5200009	East
			P5200010	West
			P5200011	Close-up
4	57°40.316'N	2°33.259'W	P5200012	East
			P5200013	West
			P5200014	South
			P5200015	Close-up
30	57°40.344'N	2°33.263'W	P5200085	South
			P5200086	Close-up
Start of T2 (Proposed cable route)	57°40.294'N	2°33.464'W	P5200016	North
			P5200017	East
			P5200018	West
5	57°40.299'N	2°33.463'W	P5200019	North
			P5200020	East
			P5200021	West
6	57°40.335'N	2°33.479'W	P5200022	North
			P5200023	East
			P5200024	South
			P5200025	West
			P5200026	Close-up
7	57°40.380'N	2°33.493'W	P5200027	North
8	57°40.335'N	2°33.575'W	P5200028	North
9	57°40.349'N	2°33.571'W	P5200029	North
			P5200030	Close-up



Waypoint no.	Position WGS84 Z30N DD° m.mmm'		Photo no.	Direction
	Longitude	Latitude		
10	57°40.399'N	2°33.499'W	P5200031 P5200032 P5200033 P5200034	North Close-up Close-up Close-up
11	57°40.406'N	2°33.501'W	P5200035 P5200036 P5200037 P5200038	South East West Close-up
27	57°40.406'N	2°33.493'W	P5200080 P5200081 P5200082	North South Close-up
28	57°40.412'N	2°33.495'W	P5200083	Close-up
29	57°40.419'N	2°33.496'W	P5200084	South
12	57°40.381'N	2°33.538'W	P5200039	Close-up
13	57°40.381'N	2°33.580'W	P5200040 P5200041 P5200042	North Close-up Close-up
14	57°40.361'N	2°33.673'W	P5200043	Close-up
Start of T1 (West of proposed cable route)	57°40.364'N	2°33.700'W	P5200044 P5200045 P5200046	North East West
15	57°40.369'N	2°33.698'W	P5200047 P5200048 P5200049 P5200050	North East West South
16	57°40.377'N	2°33.707'W	P5200051	Close-up
17	57°40.400'N	2°33.720'W	P5200052 P5200053 P5200054 P5200055 P5200056 P5200057 P5200058	North East South West Close-up Close-up Close-up
18	57°40.421'N	2°33.721'W	P5200059 P5200060 P5200061 P5200062	North East South West

Waypoint no.	Position WGS84 Z30N DD° m.mmm'		Photo no.	Direction
	Longitude	Latitude		
19	57°40.434'N	2°33.720'W	P5200063 P5200064 P5200065 P5200066	North East South West
20	57°40.424'N	2°33.655'W	P5200067 P5200068	West Close-up
21	57°40.421'N	2°33.641'W	P5200069	Close-up
22	57°40.432'N	2°33.628'W	P5200070 P5200071	Close-up Close-up
23	57°40.433'N	2°33.629'W	P5200072	Close-up
24	57°40.444'N	2°33.622'W	P5200073 P5200074	Close-up Close-up
26	57°40.462'N	2°33.565'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




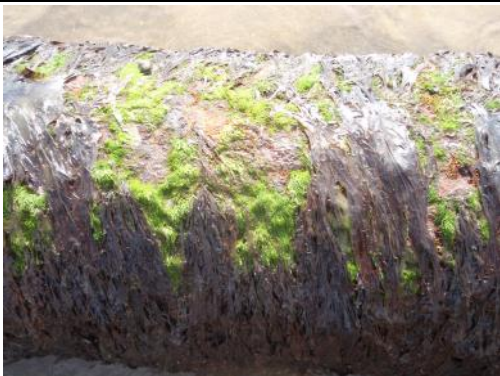
Waypoint	Direction	Photo no.	Photograph	Comments / Description
6	East	P5200023		Mid shore - barren sand
6	South	P5200024		Mid shore - barren sand
6	West	P5200025		Mid shore - barren sand
6	Close-up	P5200026		Zoomed in - barren sand





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 <i>Enteromorpha</i> spp.
9	Close-up	P5200030		Zoomed in - <i>Enteromorpha</i> 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 <i>Semibalanus balanoides</i> , <i>Porphyra</i> spp. and <i>Enteromorpha</i> spp.
10	Close-up	P5200033		<i>Semibalanus balanoides</i> , <i>Enteromorpha</i> spp. and <i>Porphyra</i> spp.
10	Close-up	P5200034		<i>Semibalanus balanoides</i> , <i>Mastocarpus stellatus</i> , <i>Fucus serratus</i> and <i>Enteromorpha</i> 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		<i>Semibalanus balanoides</i> , <i>Nucella lapillus</i> , <i>Patella vulgata</i> , <i>Fucus serratus</i> , <i>Enteromorpha</i> spp. and <i>Mastocarpus stellatus</i>





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		<i>Semibalanus balanoides</i> , <i>Mastocarpus stellatus</i> , <i>Enteromorpha</i> spp., and <i>Cladophora</i> spp.
28	Close-up	P5200083		<i>Mastocarpus stellatus</i> , <i>Laminaria digitata</i> , <i>Enteromorpha</i> spp. and <i>Fucus serratus</i>





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		<i>Porphyra</i> spp. and <i>Enteromorpha</i> 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, <i>Enteromorpha</i> spp.
17	Close-up	P5200057		Boulders and sand with <i>Enteromorpha</i> spp. and <i>Porphyra</i> spp.


Waypoint	Direction	Photo no.	Photograph	Comments / Description
17	Close-up	P5200058		Boulders and sand with <i>Enteromorpha</i> spp. and <i>Porphyra</i> 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 <i>Enteromorpha</i> spp. and <i>Porphyra</i> spp.
21	Close-up	P5200069		Boulders with <i>Fucus vesiculosus</i> , <i>Fucus serratus</i> , <i>Nucella lapillus</i> , <i>Patella vulgata</i> and <i>Semibalanus balanoides</i>

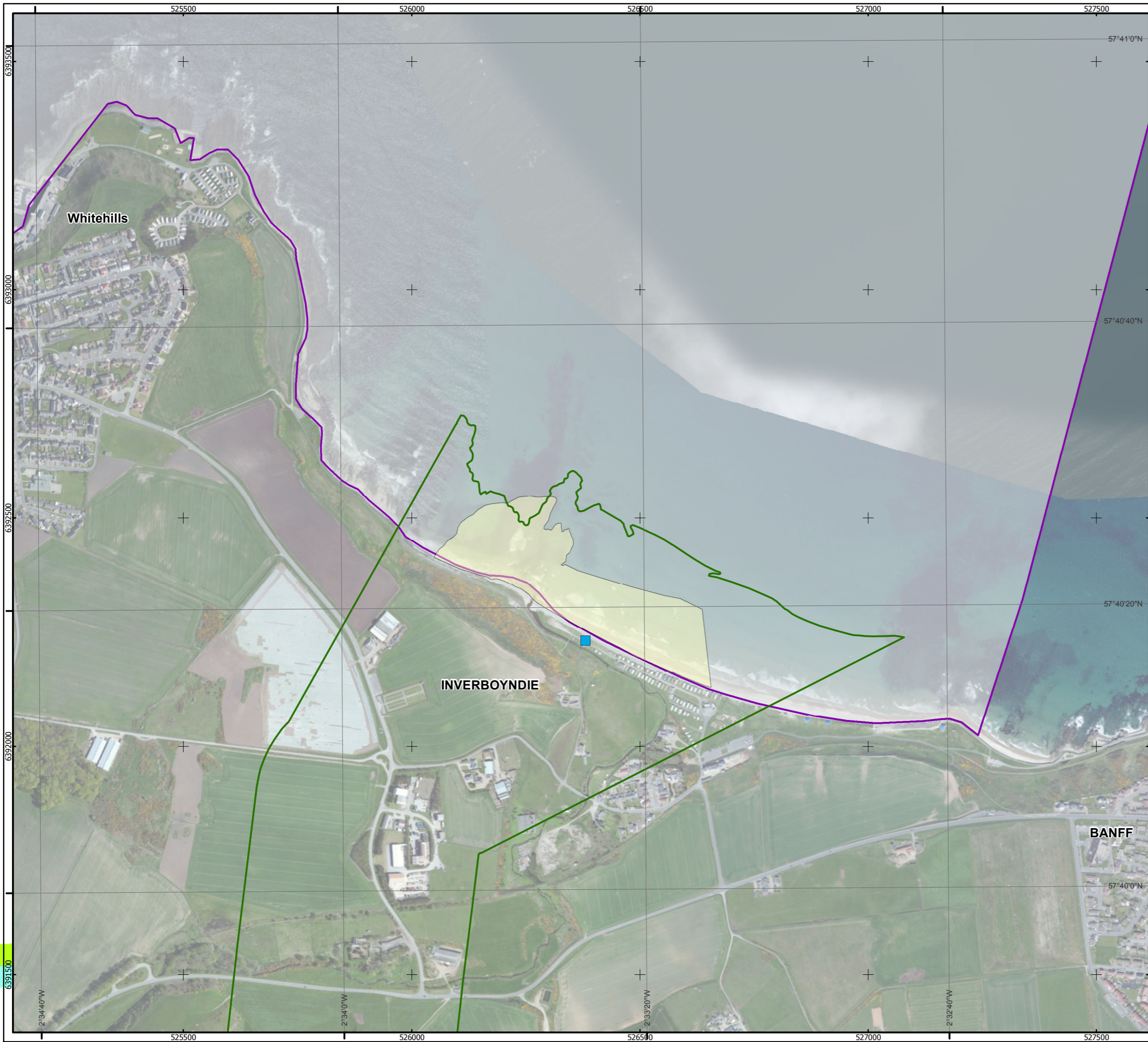
Waypoint	Direction	Photo no.	Photograph	Comments / Description
22	Close-up	P5200070		<i>Osmundea hybrida</i> , <i>Fucus serratus</i> , <i>Enteromorpha</i> spp. and <i>Semibalanus balanoides</i>
22	Close-up	P5200071		<i>Fucus serratus</i>
23	Close-up	P5200072		<i>Fucus serratus</i> , <i>Corallina officinalis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

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

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

Appendix 4 Figures

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Moray Offshore Renewables Ltd © 2014. This document is the property of contractors and sub-contractors and shall not be reproduced nor transmitted without prior written approval.



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 N

Geodetic Parameters: WGS84 UTM Zone 30N

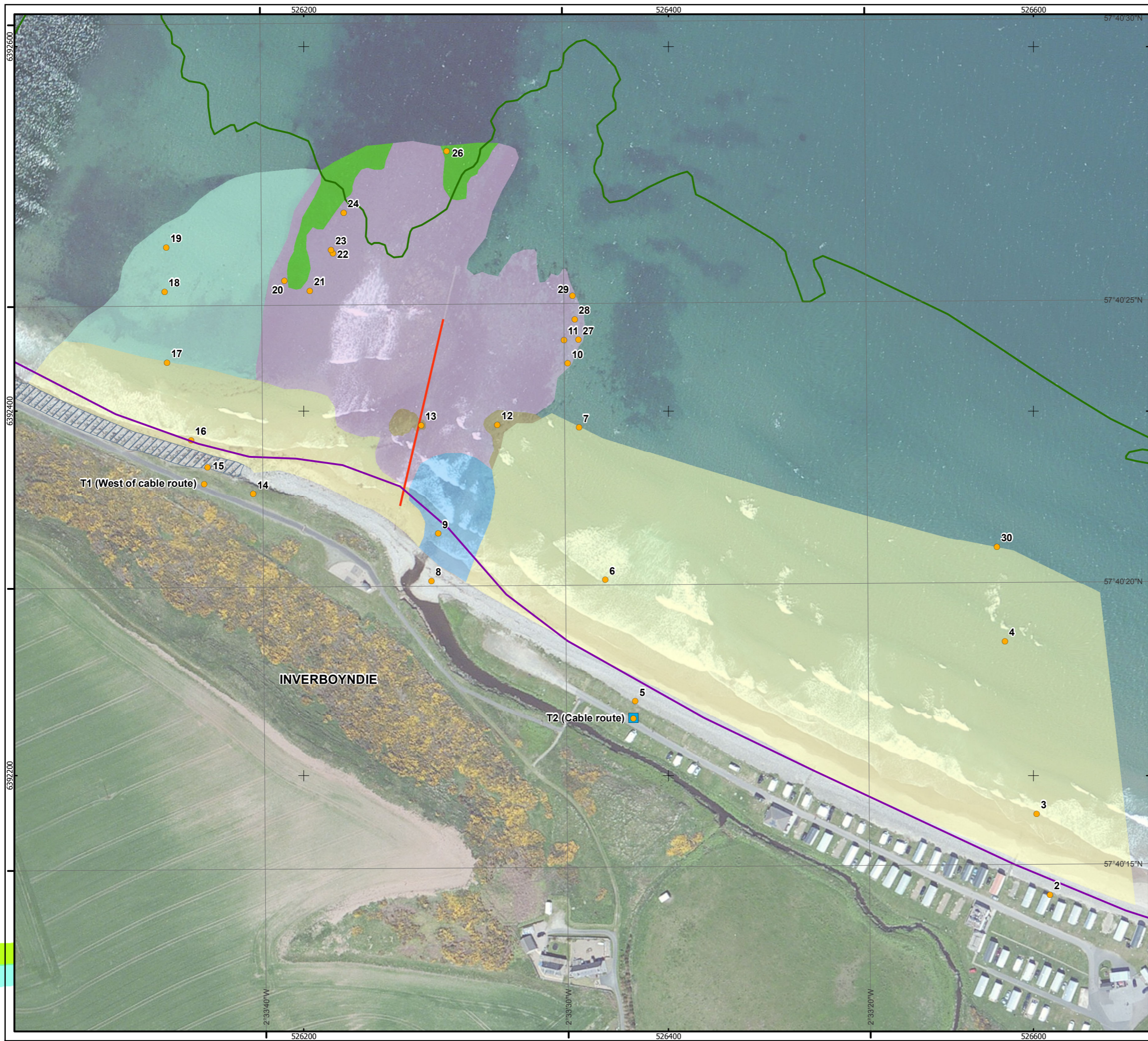
Produced: IMR
Reviewed: ES
Approved: CR

Date: 13/06/2014 Revision: A
REF: 8460001-PSO0131-EMU-MAP-003

Figure 1.0
Location Plot

Moray Offshore
Renewables Ltd

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
 Moray Offshore Renewables Ltd © 2014. This document is the property of contractors and sub-contractors and shall not be reproduced nor transmitted without prior written approval.



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
 100 Metres N

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