Appendix 4-2:
Landfall Options - Survey Report

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

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ORIEL WIND FARM PROJECT

Environmental Impact Assessment Report

Appendix 4-2: Landfall Options - Survey Report

MDR1520B
EIAR – Appendix 4-2

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1 INTRODUCTION

1.1 Background

RPS was appointed by Oriel Windfarm Limited (OWL) to carry out a Phase 1 intertidal survey at three possible offshore export cable landfall locations being considered for the Oriel Wind Farm Project (the Project). The purpose of the survey was to provide the baseline characterisation of the intertidal habitat to inform the Environmental Impact Assessment Report (EIAR) for the Project. Three potential landfall locations (Figure 2-1) were considered:

- Landfall Option A (also referred to as LF8 - Dunany (Salterstown) in the EIAR): located on the shore south of Anngassan north-west of Dunany Point;
- Landfall Option B (also referred to as Dunany (North) in the EIAR): located on the shore west of Togher south of Dunany Point; and
- Landfall Option C (also referred to as Dunany (South) in the EIAR): located on the shore west of Togher, further south of Dunany Point and Landfall Option B.

Only one of these options will be taken forward for assessment into the EIAR.

1.2 Survey Objectives

The aim of the survey was to characterise the intertidal benthic baseline environment, from low water (LWM) to high water mark (HWM), and to identify any sensitive ecological receptors at each of the potential landfall locations proposed for the Project for the purposes of informing the EIAR.

1.3 Designated Sites

The National Parks and Wildlife Service (NPWS) is responsible for designating, monitoring and reporting on designated sites in Ireland. They draw up conservation management plans for designated sites that outline conservation objectives and strategies for protecting the habitats and species for which the sites are selected. The NPWS regularly carry out monitoring of protected habitats and species to ensure an accurate and up to date record of biodiversity found in marine areas of Ireland.

The Environmental Protection Agency's (EPA) Biodiversity Action Plan 2014-2018 sets out the EPA's action plan for the implementation of its role in the protection of biodiversity. Their responsibilities in relation to intertidal environments are to undertake Water Framework Directive (WFD) monitoring programmes in estuarine and coastal waters, specifically macro-algae, macrophytes and phytoplankton (EPA, 2014).

Ireland has established Special Areas of Conservation (SACs) for 59 habitat types listed under Annex I of the EU Habitats Directive. 16 of these 59 habitat types are priority habitats, which include: active raised bog, active blanket bog, fixed dunes and coastal lagoons. Annex I habitats include six marine habitats, saltmarshes, several lake types, heaths and scree/rock habitats (NPWS, 2014a). The species in Ireland which are afforded protection under the EU Habitats Directive include salmon, otter, freshwater pearl mussel and bottlenose dolphin (NPWS, 2014a). Ireland's Prioritised Action Framework[1] under the EU Habitats Directive identifies a range of actions needed to help improve the status of Ireland's habitats and wildlife (NPWS, 2014a).

Ireland has also committed to establishing Marine Protected Areas (MPAs) to protect biodiversity. No legislation is currently used in Ireland to legally underpin protected areas established to fulfil commitments under international conventions. Therefore, since the creation of OSPAR (the Convention for the Protection of the Marine Environment of the North-East Atlantic) MPAs would not afford any legal protection to the relevant areas on their own, Ireland has established a number of its Special Areas of Conservation (SACs) as OSPAR MPAs for marine habitats (NPWS, 2021).

[1] https://www.npws.ie/sites/default/files/general/PAF-IE-2014.pdf

Landfall Options A, B and C are located 3.32 km, 4.36 km and 4.71 km from Dundalk Bay SAC [Site Code 000455], respectively, and 14.33 km, 14.9 km and 15.91 km from the Carlingford Shore SAC Site Code 002306] respectively. Both SACs have been established as MPAs in Ireland for marine habitats, which have both been submitted to the OSPAR Convention. The Dundalk Bay SAC qualifying features of interest include estuaries, mudflats and sandflats not covered by seawater at low tide, *Salicornia spp.* and other annuals colonising mud and sand, Atlantic salt meadows and Mediterranean salt meadows (NPWS, 2014b). The Carlingford Shore SAC qualifying features of interest includes Annual vegetation of drift lines and Perennial vegetation of stony banks (NPWS, 2014c).

Landfall Options A, B and C are located 24.1 km, 24.9 km, 25.9 km, respectively from the Carlingford Lough MCZ, which is designated under UK legislation and submitted to the OSPAR convention. The Carlingford Lough MCZ designated features include the habitat *Philine aperta* (White lobe shell) and *Virgularia mirabilis* (Seapen) in soft stable infralittoral mud, this habitat is only present in Carlingford Lough (DAERA, 2017).

Ireland has also established Special Protection Areas (SPAs) under the EU Birds Directive for the protection of endangered bird species. A programme to identify and designate SPA sites has been in place since 1985.

Landfall Option A is located within the Dundalk Bay SPA (Site code 4026) which is designated for a number of wetland bird species and non-breeding wintering migratory species (NPWS 2011). Landfall Options B and C are located outside this SPA. The Carlingford Lough SPA (Site code 4078) is designated for its internationally important breeding populations of Sandwich Terns, Common Terns and important numbers of overwintering Light-bellied Brent Geese (DAERA, 2015). Landfall Options A, B and C are located 20.3 km, 20.7 km, 21.7 km from the Carlingford Lough SPA, respectively.

2 METHODOLOGY

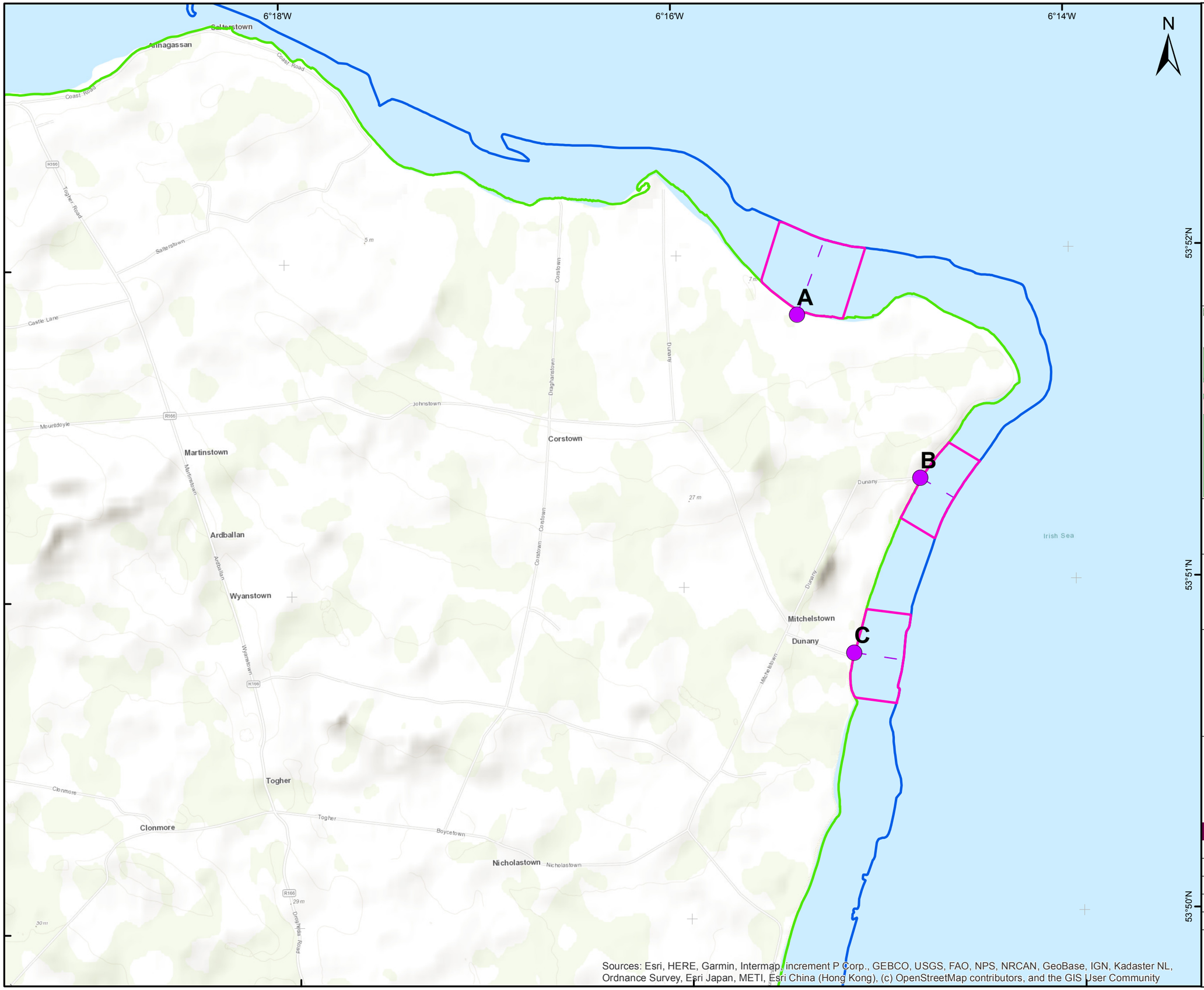
2.1 Intertidal Survey

Standard Phase 1 intertidal walkover surveys were undertaken between 15th and 18th October 2019 of Landfall Options A, B and C (Figure 2-1).

The survey was undertaken following the Department of Communications, Climate Action & Environment's (DCCAE) Guidance on Marine Baseline Ecological Assessments and Monitoring Activities (Part 1 and Part 2) (DCCAE, 2018) and with reference to standard intertidal survey methodologies as outlined in the Joint Nature Conservation Committee (JNCC) Marine Monitoring Handbook (Davies *et al.,* 2001) within Procedural Guidance No 3-1 In situ intertidal biotope recording (Wyn and Brazier, 2001 and Wyn *et al.,* 2000) and The Handbook for Marine Intertidal Phase 1 Biotope Mapping Survey (Wyn *et al.,* 2006). The survey was led by a suitably qualified ecologist experienced in habitat mapping in intertidal, coastal and terrestrial environments.

The intertidal survey comprised both a general walkover noting changes in ecological and physical characteristics and macrofauna observations. During the walkover survey, notes were made on the shore type, wave exposure, sediments/substrates present and descriptions of species/biotopes present. The spatial relationships between these features were observed and waypoints were recorded using a hand-held global positioning system (GPS) device, in conjunction with hand-written descriptions and photographs. All biotopes present were identified, and their extents mapped with the aid of aerial photography and using a hand-held GPS recorder. Any other features within the intertidal zone were also noted including rock pools, man-made structures and any habitats/species of conservation importance. Where present, these features were target noted in each of the intertidal biotope maps for the three landfall options.

Dig-over stations were placed in different biotopes, where possible, the locations of which were determined in the field. On-site sediment dig-overs were undertaken in soft sediments to help characterise the habitats. This involved lifting four spade loads (approximately 0.02 m^2) of sediment dug to a depth of 20-25 cm, which were sieved in situ through a 0.5 mm mesh, with all material returned to the same site. All macrofauna species present were identified and enumerated on site, where possible. Field notes were also taken on the physical characteristics, including sediment type and presence of anoxic layers in the sediment.

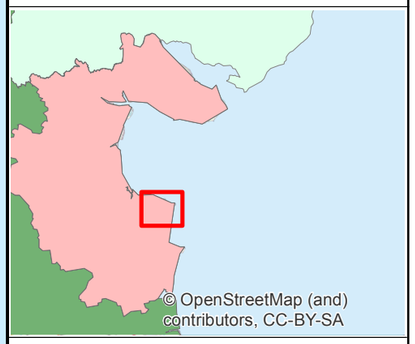


Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Legend

- Potential Landfall Location
- Intertidal Survey Area
- Survey Area Centreline
- Mean Low Water
- Mean High Water

Data Sources: Client, Ordnance Survey Ireland.



Client

Oriel Windfarm Ltd.

Project

ORIEL WINDFARM
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Title

Figure 2-1

All Potential Landfalls Intertidal Survey

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Issue Details

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2.2 Timing

The fieldwork was undertaken during the optimal survey period for intertidal biotope mapping surveys of April to October (Wyn *et al.,* 2006). Due to the occurrence of low tides close to sunrise and sunset, surveys ran for three to four and a half hours after low water in the morning and for three to four and a half hours before low water in the evening to ensure as much of the intertidal zone was sampled as possible. Low tide times and heights are presented in Table 2-1.

Table 2-1: **Tide times during the survey.**

Date	Daylight Hours	HW / LW	Time Local	Height (m)
15/10/19	07:53 -18:29	12:46	12:46	4.66
		19:00	19:00	0.93
16/10/19	07:55 - 18:27	13:18	13:18	4.67
		19:28	19:28	0.95
17/10/19	07:57 - 1825	13:55	13:55	4.66
		07:42	07:42	1.01
18/10/19	07:59 – 18:23	08:11	08:11	1.06
		14:27	14:27	4.65

2.3 Health and Safety

The survey staff adhered to the Risk Assessment and Method Statement. A site-specific risk assessment was performed on arrival at the survey location, prior to any work being carried out. Both survey staff were experienced field scientists and were aware of tidal constraints at the site. The staff wore or carried the required personal protective equipment, as necessary, including: sturdy footwear (Wellington boots or walking boots); a hi-vis jacket; sun lotion; weatherproof clothing; navigation instruments (GPS); two fully-charged mobile phones; a first aid kit; food; and plenty of drinking water. Appropriate emergency phone numbers were pre-saved in the mobile phones. A text message or phone call was placed by the lead surveyor with the onshore-based contact before and after the survey. No accidents, incidents or near-misses occurred during the intertidal surveys.

3 SURVEY RESULTS

3.1 Summary

The intertidal zone at the survey sites is sheltered from high energy wave action. All three “Landfall Options” at the landfall locations contained a mix of mobile rocky habitats and sandflats. Exposed bedrock was not recorded. Landfall Option A had the most rock comprising approximately 50% of the substratum, while Landfall Options B and C contained approximately 30% and 10% rock respectively. A steep and narrow band of shingle was present at the landward end of each beach after which a very shallow slope occurred. This shallow slope, in combination with the sheltered locations of the three beaches, have allowed extensive sandflats to accrete. The sandflats were generally fine grained and clean with a relatively low mud content and without a prominent anoxic layer.

The majority of biotopes identified across the sites surveyed reflected full salinity and low to moderate energy conditions. Zonation was clearly evident down the shore, particularly in the spatial distributions of fucoid seaweeds (JNCC, 2015).

44 separate taxa were recorded during the survey including a variety of brown, green and red seaweeds, gastropods, crustaceans, polychaete worms, ascidians, hydroids and a starfish. Dig-overs were undertaken in soft sediments, in order to ascertain any infaunal species present.

The following sections describe the intertidal survey area, including a description of the biotopes in terms of sediment and species composition. The extents of biotopes identified have been mapped together with a summary of the biotopes identified for each landfall option.

3.2 Landfall Option A

The extents of biotopes identified for Landfall Option A have been mapped in together with a summary of the biotopes identified in

Table 3-1. Photographs of biotopes and species observed within Landfall Option A are shown in Appendix A; Plate 1 to Plate 9.

3.2.1 Upper Shore

A steep and narrow band of shingle (mobile cobbles and pebbles) was present at the head of the beach. Occasionally, large patches of coarse sand were present (Plate 1). An abundance of the talitrid amphipod *Orchestia gammarellus* occurred under stones and patches of decaying seaweed, originally washed onto the strandline during high tides. The classification for this biotope is LS.LSa.St.Tal.

Below the shingle zone, a patch of LR.FLR.Eph.EntPor biotope containing an abundance of the green seaweed *Enteromorpha intestinalis* was present. Frequent components of this biotope were the barnacle *Semibalanus balanoides* and brown seaweed *Fucus spiralis*. Occasionally present were the brown seaweeds *Porphyra umbilicalis* and *Fucus vesiculosus*, the gastropod mollusc *Littorina littorea* and the barnacle *Elminius modestus.*

The biotope LR.LLR.F.Fspi.X occurred at the western end of the site running across the upper shore and into the mid-shore. *Fucus spiralis* was the dominant seaweed with *Fucus vesiculosus* frequently occurring as did *Semibalanus balanoides* and *Littorina littorea*. The common mussel *Mytilus edulis* and *Porphyra umbilicalis* were occasionally present while *Enteromorpha intestinalis* occurred in abundance towards the edges of the biotope. The remnants of an artificial stone wall and associated wooden pilings lay within this habitat (Target Note 1 (TN1);

Table 3-1) and have created several macro-habitats such as small pools in which a juvenile shore crab *Carcinus maenas*, and an anemone, *Actinia equina* were recorded. The red seaweed *Catenella caespitosa* was recorded on wooden piles and the brown seaweed *Fucus ceranoides* was also present in the vicinity in low abundance.

Two separate patches of LR.LLR.F.Fves; *Fucus vesiculosus* on moderately exposed to sheltered mid eulittoral rock, occurred with one on the western side of the upper shore (Plate 8) and one in the mid-shore. *Fucus vesiculosus* was abundant at both patches. The barnacle *Balanus crenatus* was abundant in the mid-

shore area while *Semibalanus balanoides* was dominant in the upper shore. The barnacle *Balanus balanus* was recorded from the mid-shore, while the green seaweed *Ulva lactuta* was present in both patches of the biotope.

3.2.2 Middle and Lower Shores

Two areas of LR.MLR.BF.Fser.Bo; *Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders were recorded (Plate 3 and Plate 4). The composition of the substrate was 30% sand 30% pebbles 30% boulders and 10% cobbles. These areas were highly species rich with *Fucus serratus* abundant and *Fucus vesiculosus* occasionally present. Other seaweeds recorded included *Ulva lactuta, Porphyra umbilicalis,* and *Palmaria palmata.*

Barnacles present in order of abundance were *Balanus crenatus, Balanus balanus* and *Semibalanus balanoides.* The following gastropod molluscs, *Patella vulgata, Nucella lapillus, Littorina littoralis* and *Gibbula cineraria* were variously present above and under boulders. A nudibranch mollusc likely to be *Berthella aurantiaca* was also observed.

Crustaceans living under boulders included *Porcellana platycheles*, *Carcinus maenas* and *Cancer pagurus* (Plate 5). An individual adult *Lipophrys pholis*, an intertidal fish, was also present under a large rock.

The starfish *Asterias rubens*, brittlestar *Ophiothrix fragilis*, and anemone *Actinia equina* were occasionally recorded under boulders.

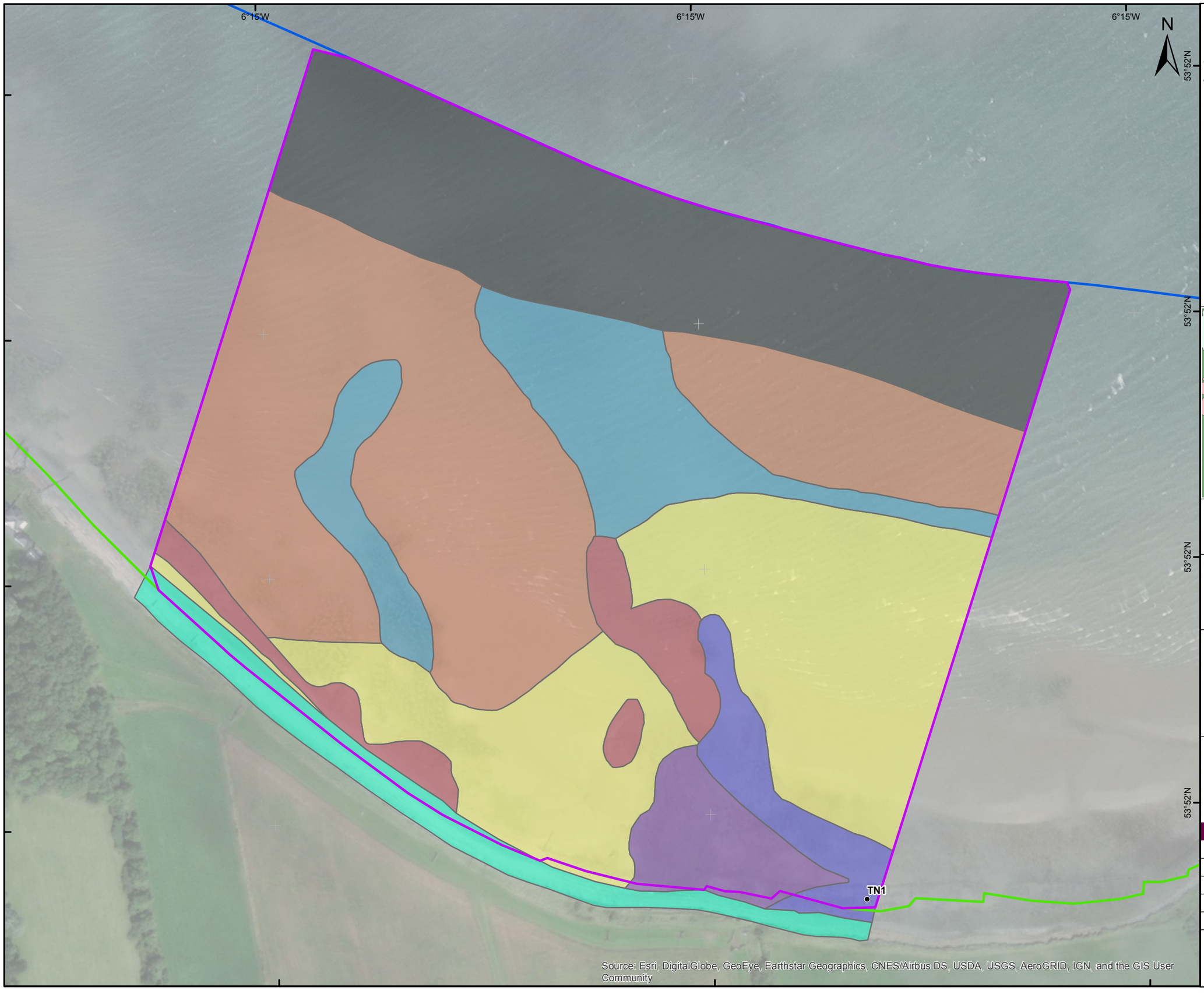
Epiphytic populations of the hydroid *Dynamena pumila* were present on fronds of *Fucus serratus* as were colonies of the ascidian *Botryllus schlosseri*. The bryozoans *Alcyonidium diaphanum* and *Electra pilosa* also colonised *Fucus serratus* with the latter bryozoan also present on rock. A tunicate likely to be *Ascidiella aspersa* was distantly observed attached under the overhang of a large boulder.

The encrusting sponge *Oscarella* sp. (Plate 7) was noted under a boulder and another featureless unidentified encrusting sponge was also photographed. The photographed sponge (Plate 6) appears to have similar characteristics, in terms of the pattern of channels and pores to *Protosuberites denhartogi* (formerly *Protosuberites epiphytum*) which has only been recorded 47 times in UK waters. Current taxonomic advice is that the species cannot be reliably identified in the field but only via microscopy, which suggests it is likely to be an under recorded species.

The polychaete worm *Pomatoceros triqueter* was frequently observed attached to stones and the sea spider *Nymphon* sp. found on *Fucus serratus*.

A form of the biotope LS.LSa.MuSa.MacAre; *Macoma balthica* and *Arenicola marina* in littoral muddy sand, occurred in upper shore and mid shore areas. The biotope on site differed slightly from the JNCC description in that *Macoma balthica* was not recorded and instead the closely related thin tellin *Macomangulus tenuis* was observed via a dig-over of the sediments. The fine sand was relatively clean (low mud content) and lacked a prominent anoxic layer, conditions which favour *Macomangulus tenuis* over *Macoma balthica*. Oligochaete worms and the polychaete worms *Hediste diversicolour, Scoloplos armiger* and *Lanice conchilega* were also observed via a dig-over of the sediments. *Arenicola marina* was more abundant in this biotope than *Lanice conchilega* in areas where the latter was present. Both of these species could be readily surveyed without digging due to the distinctive casts of *Arenicola marina* and the cases of *Lanice conchilega* which were easily visible above the surface of the sand.

Where dense populations of *Lanice conchilega* occurred and *Arenicola marina* was less abundant (if present) the biotope LS.LSa.MuSa.Lan; *Lanice conchilega* (Plate 9) in littoral sand was ascribed. This biotope occurred in clean sand mainly along the mid and lower shores with polychaetes *Euclymene lumbricoides, Nephtys hombergii, Scoloplos armiger* and *Arenicola marina* often present.



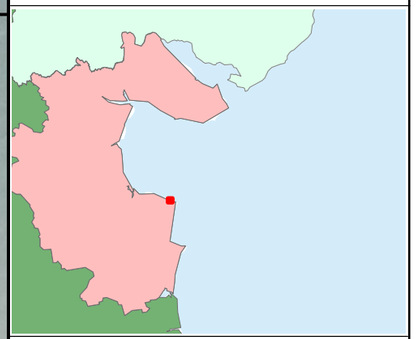
Legend

- Intertidal Survey Area
- High Water Mark
- Low Water Mark
- Remnants of an artifical stone wall and associated wooden pilings

Habitat

- LR.FLR.Eph.EntPor
- LR.LLR.F.Fspi.X
- LR.LLR.F.Fves
- LR.MLR.BF.Fser.Bo
- LS.LSa.MuSa.Lan
- LS.LSa.MuSa.MacAre
- LS.LSa.St.Tal
- Not Surveyed

Data Sources: Client, Ordnance Survey Ireland.



Client

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Project

ORIEL WINDFARM
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Title **Figure 3-1**

Landfall A Intertidal Survey Habitats

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Date: 19/01/21	Geographic Co-ordinates: ETRS89

Table 3-1: **Littoral Biotopes Present at Landfall Option A (adapted from JNCC, 2015; see Figure 3-1).**

Shore Position	Biotope/NVC Code	Biotope Name	Biotope Description
Upper shore	LS.LSa.St.Tal	Talitrids on the upper shore and strand-line	A community of sandhoppers (talitrid amphipods) may occur on any shore where driftlines of decomposing seaweed and other debris accumulate on the strandline. The biotope occurs most frequently on medium and fine sandy shores but may also occur on a wide variety of sediment shores composed of muddy sediment, shingle and mixed substrata, or on rocky shores.
	LR.LLR.F.Fspi.X	*Fucus spiralis* on full salinity upper eulittoral mixed substrata	This habitat occurs on moderately exposed to sheltered full salinity upper eulittoral mixed substrata and is characterised by the wrack *Fucus spiralis*. *Fucus vesiculosus* was also present to a lesser extent. The barnacle *Semibalanus balanoides* was common on rocks and the limpet *Patella vulgata* was frequent on the same substrate. Winkles *Littorina littorea* and *Littorina saxatilis* were found on and among the boulders and cobbles. The green seaweed *Enteromorpha intestinalis* was occasionally present in places as was the brown seaweed *Porphyra umbilicalis*.
	LR.LLR.F.Fves	*Fucus vesiculosus* on moderately exposed to sheltered mid eulittoral rock	Moderately exposed to sheltered mid eulittoral bedrock and large boulders characterised by a dense canopy of the wrack *Fucus vesiculosus* (Abundant to Superabundant). Beneath the seaweed canopy the rock surface can have a sparse covering of the barnacle *Semibalanus balanoides* and the limpet *Patella vulgata*. The mussel *Mytilus edulis* is confined to pits and crevices. A variety of winkles including *Littorina littorea* and *Littorina saxatilis* and the whelk *Nucella lapillus* are found beneath the seaweeds, whilst *Littorina obtusata/mariae* graze on the fucoid fronds. The calcareous tube-forming polychaete *Spirorbis spirorbis* may also occur epiphytically on the fronds. In areas of localised shelter, the wrack *Ascophyllum nodosum* may occur, though never at high abundance. Damp cracks and crevices often contain patches of the red seaweed *Mastocarpus stellatus* and even the wrack *Fucus serratus* may be present. The crab *Carcinus maenas* may be present in pools or among the boulders.
Mid shore	LR.FLR.Eph.EntPor	*Porphyra purpurea* and *Enteromorpha* spp. on sand-scoured mid or lower eulittoral rock	Exposed and moderately exposed mid-shore bedrock and boulders which occur adjacent to areas of sand which significantly affects the rock. As a consequence of sand-abrasion, wracks such as *Fucus vesiculosus* or *Fucus spiralis* are scarce and the community is typically dominated by ephemeral red or green seaweeds, particularly the foliose red seaweed *Porphyra purpurea* and green seaweeds such as *Enteromorpha* spp. Under the blanket of ephemeral seaweeds, the barnacles *Semibalanus balanoides* or *Elminius modestus* and the limpet *Patella vulgata* may occur in the less scoured areas, along with the occasional winkles *Littorina littorea* and *Littorina saxatilis*. Few other species are present.
	LR.MLR.BF.Fser.Bo	*Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders	Exposed to moderately exposed lower eulittoral boulders with the wrack *Fucus serratus* community of a high species richness as the presence of the boulders increases micro-habitat diversity. The upper surfaces of the boulders are colonised by a very similar fauna to the other *F. serratus* biotopes, including species such as the limpet *Patella vulgata*, the whelk *Nucella lapillus*, the anemone *Actinia equina* and the barnacle *Semibalanus balanoides.* The shaded sides of the boulders are, depending on environmental conditions, often colonised by a variety of foliose red seaweeds, including *Mastocarpus stellatus, Lomentaria articulata, Osmundea pinnatifida, Palmaria palmata* and *Chondrus crispus*. Coralline algae such as *Corallina officinalis* and coraline crusts, as well as the green seaweeds *Enteromorpha intestinalis* and *Ulva lactuca*, can be found underneath the *F. serratus* canopy or in patches on the boulders. The species composition underneath

Shore Position	Biotope/NVC Code	Biotope Name	Biotope Description
			the boulders varies considerably depending on the underlying substratum. On muddy shores the fauna living under the boulders may be limited to a few infaunal species, such as the polychaete *Cirratulus cirratus*. Where more space is available beneath the boulders there may be a rich assemblage of animals. Characteristic mobile species include the crabs *Porcellana platycheles* and *Carcinus maenas*. Also present on and beneath the boulders are the tube-forming polychaete *Pomatoceros triqueter*, spirorbid polychaetes and a few winkles such as *Littorina obtusata/mariae* and *Littorina littorea* or even the top shell *Gibbula cineraria.* Encrusting colonies of the sponge *Halichondria panicea* are also typical of the undersides of boulders, while the hydroid *Dynamena pumila* colonies can be found on the *F. serratus* fronds. The richest examples of this biotope also contain a variety of brittlestars, ascidians and small hydroids.
Lower shore	LS.LSa.MuSa.MacAre	*Limecola (Macoma) balthica* and *Arenicola marina* in littoral muddy sand	This biotope is characterised by the lugworm *Arenicola marina* and the Baltic tellin *L. balthica*. The sediment is typically muddy sand or fine sand, and often occurs as extensive intertidal flats both on open coasts and in marine inlets. An anoxic layer is usually present within 5 cm (0.5 cm within the survey area) of the sediment surface and is often visible in worm casts. The habitat on site differed slightly from the JNCC description in that *L. balthica* was not recorded and instead the closely related thin tellin *Macomangulus tenuis* was observed via dig-over of the sediments. The fine sand was relatively clean (low mud content) and generally lacked an anoxic layer; conditions which favour *M. tenuis.*
	LS.LSa.MuSa.Lan	*Lanice conchilega* in littoral sand	This biotope usually occurs on flats of medium fine sand and muddy sand, most often on the lower shore but sometimes also on waterlogged mid shores. The sand may contain a proportion of shell fragments or gravel. This biotope an also occur on the lower part of predominantly rocky or boulder shores, where patches of sand or muddy sand occur between scattered boulders, cobbles and pebbles. Conditions may be tide-swept, and the sediment may be mobile, but the biotope usually occurs in areas sheltered from strong wave action. The sediment supports dense populations of the sand mason *Lanice conchilega.* Other polychaetes present are tolerant of sand scour or mobility of the sediment surface layers and include the polychaetes *Anaitides mucosa, Eumida sanguinea, Nephtys hombergii, Scoloplos armiger, Aricidea minuta, Tharyx* spp. and *Pygospio elegans*. The mud shrimp *Corophium arenarium* and the cockle *Cerastoderma edule* may be abundant. The baltic tellin *Macoma balthica* may be present. On boulder shores, and where pebbles and cobbles are mixed in with lower shore tide-swept sand with dense *L. conchilega* between the cobbles, the infaunal component is rarely sampled. The infaunal community under these circumstances, provided that the cobbles are not packed very close together, is likely to be similar to that in areas without the coarse material.

3.3 Landfall Option B

The extents of biotopes identified for Landfall Option B have been mapped in Figure 3-2 together with a summary of the biotopes identified in Table 3-2. Photographs of biotopes and species observed within Landfall Option B are shown in Appendix A; Plate 10 to Plate 12.

A steep and narrow band of shingle (mobile cobbles and pebbles) was present at the head of the beach. Occasionally, small patches of coarse sand were present particularly where the slope declined towards the seaward edge of this feature. The talitrid amphipod *Orchestia gammarellus* was recorded albeit very sparsely under stones and patches of decaying seaweed, originally washed onto the strandline during high tides. It is likely that larger rounder stones at this site provide less suitable interstitial habitat for amphipods than the flatter, smaller stones at sites A and C. The classification for this biotope is LS.LSa.St.Tal.

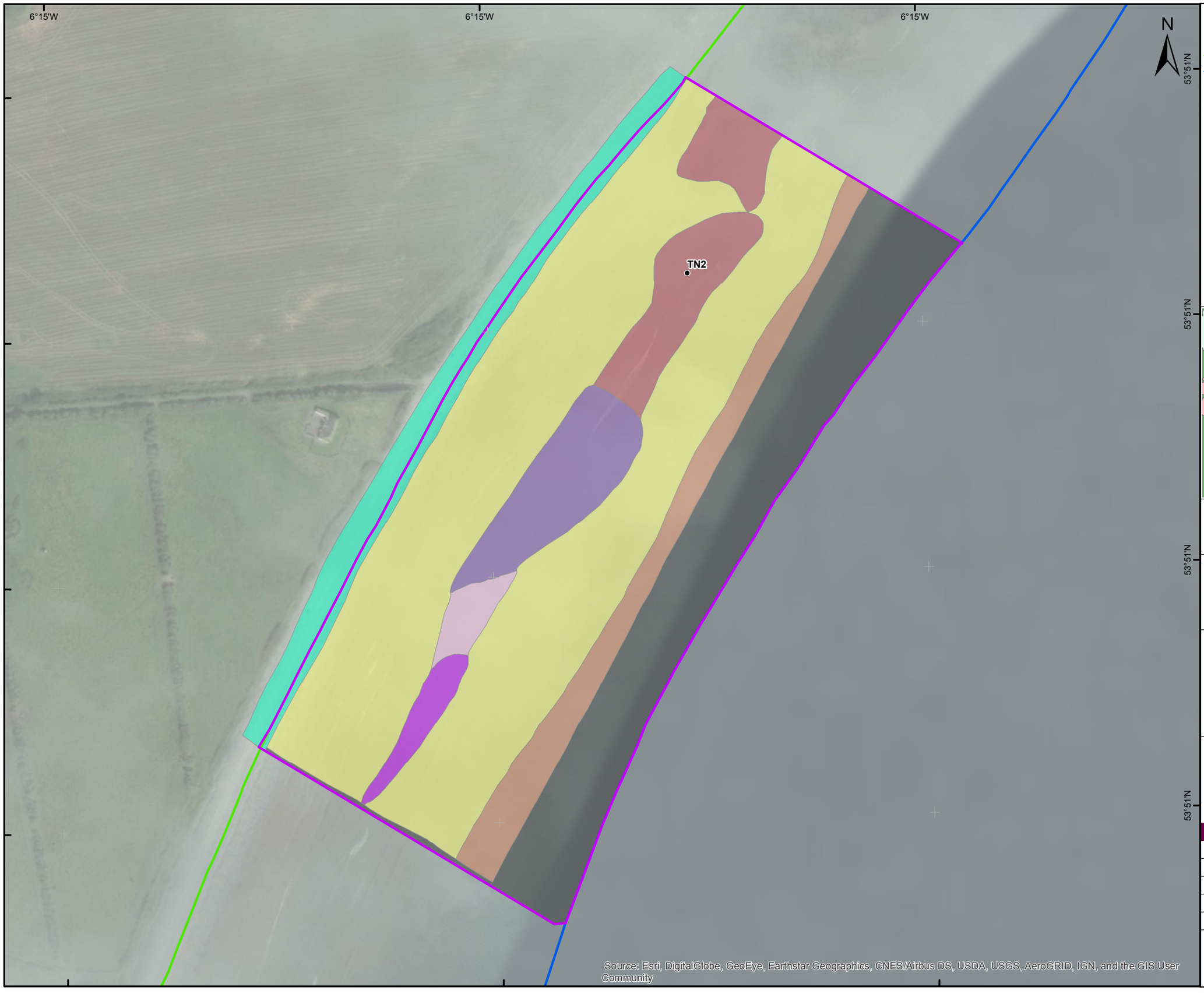
A band of LS.LSa.MuSa.MacAre; *Macoma balthica* and *Arenicola marina* in littoral muddy sand, was present immediately below the shingle zone. A second band of this biotope (Plate 12) occurred on the lower shore. Both bands of this biotope differed slightly from the JNCC description in that *Macoma balthica* was not recorded and instead the closely related thin tellin *Macomangulus tenuis* was observed via a dig-over of the sediments. The fine sand was relatively clean (low mud content) and generally lacked a prominent anoxic layer; conditions which favour *Macomangulus tenuis* over *Macoma balthica*. Oligochaete worms, a spionid worm and the polychaete worms *Hediste diversicolour*, *Scoloplos armiger* and *Lanice conchilega* were also recorded via a dig-over of the sediments. *Arenicola marina* was more abundant in this biotope *than Lanice conchilega* in areas where the latter was present.

An area of LR.LLR.F.Fves; *Fucus vesiculosus* on moderately exposed to sheltered mid eulittoral rock was present at the northern end of the site. *Fucus vesiculosus* was the most abundant seaweed with *Porphyra umbilicalis* and *Enteromorpha intestinalis* occurring frequently and occasionally, respectively. The barnacle *Semibalanus balanoides* was abundant while the molluscs *Nucella lapillus*, *Mytilus edulis* and *Patella vulgata* occurred occasionally. A patch of damaged *Fucus vesiculosus* approximately 10 m x 15 m was present (TN2). Only remnants of stipes remained; perhaps due to recent sand scouring.

A patch of the biotope LR.FLR.Eph.EntPor (Plate 11) containing an abundance of *Enteromorpha intestinalis* and *Porphyra umbilicalis* was present in the centre of the mid-shore. Frequent components of this biotope were the barnacle *Semibalanus balanoides* and the brown seaweed *Fucus spiralis*. The gastropod mollusc *Littorina littorea* was also present.

Where dense populations of *Lanice conchilega* occurred and *Arenicola marina* was less abundant (if present) the biotope LS.LSa.MuSa.Lan; *Lanice conchilega* in littoral sand was ascribed. This biotope occurred in clean sand mainly along the mid and lower shores with polychaetes *Euclymene lumbricoides*, *Nephtys hombergii*, *Scoloplos armiger* and *Arenicola marina* often present.

A mosaic of LR.LLR.F.Fves; *Fucus vesiculosus* and LR.FLR.Eph.EntPor occurred in the mid-shore. An area of barren sand scoured rock LR containing patches of LR.FLR.Eph.EntPor occurred at the southern end of the mid-shore (Plate 10).



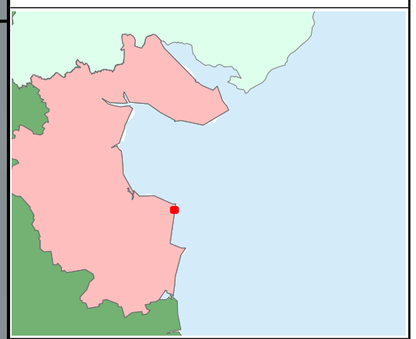
Legend

- Intertidal Survey Area
- High Water Mark
- Low Water Mark

Habitat

- LR & LR.FLR.Eph.EntPor (mosiac)
- LR.FLR.Eph.EntPor
- LR.LLR.F.Fves
- LR.LLR.F.Fves & LR.FLR.Eph.EntPor
- LS.LSa.MuSa.Lan
- LS.LSa.MuSa.MacAre
- LS.LSa.St.Tal
- Not Surveyed

Data Sources:



Client

Oriel Windfarm Ltd.

Project

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Title

Figure 3-2

Landfall B Intertidal Survey Habitats

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Issue Details

Drawn By: NG	**Project No.** MDR1520
Checked By: NS	**File Ref:** MDR1520Arc1107
Approved By: AB	
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Date: 12/2/2019	Geographic Co-ordinates: ETRS89

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Table 3-2: **Littoral Biotopes Present at Landfall Option B (adapted from JNCC, 2015; see Figure 3.2).**

Shore Position	Biotope/NVC Code	Biotope Name	Biotope Description
Upper shore	LS.LSa.St.Tal	Talitrids on the upper shore and strand-line.	A community of sandhoppers (talitrid amphipods) may occur on any shore where driftlines of decomposing seaweed and other debris accumulate on the strandline. The biotope occurs most frequently on medium and fine sandy shores but may also occur on a wide variety of sediment shores composed of muddy sediment, shingle and mixed substrata, or on rocky shores.
	LR.LLR.F.Fves	*Fucus vesiculosus* on moderately exposed to sheltered mid eulittoral rock	Moderately exposed to sheltered mid eulittoral bedrock and large boulders characterised by a dense canopy of the wrack *Fucus vesiculosus* (Abundant to Superabundant). Beneath the seaweed canopy the rock surface has a sparse covering of the barnacle *Semibalanus balanoides* and the limpet *Patella vulgata*. The mussel *Mytilus edulis* is confined to pits and crevices. A variety of winkles including *Littorina littorea* and *Littorina saxatilis* and the whelk *Nucella lapillus* are found beneath the seaweeds, whilst *Littorina obtusata/mariae* graze on the fucoid fronds. The calcareous tube-forming polychaete *Spirorbis spirorbis* may also occur epiphytically on the fronds. In areas of localised shelter, the wrack *Ascophyllum nodosum* may occur, though never at high abundance. Damp cracks and crevices often contain patches of the red seaweed *Mastocarpus stellatus* and even the wrack *Fucus serratus* may be present. The crab C*arcinus maenas* may be present in pools or among the boulders.
Mid shore	LR.FLR.Eph.EntPor	*Porphyra purpurea* and *Enteromorpha* spp. on sand-scoured mid or lower eulittoral rock	Exposed and moderately exposed mid-shore bedrock and boulders which occur adjacent to areas of sand which significantly affects the rock. As a consequence of sand-abrasion, wracks such as *Fucus vesiculosus* or *Fucus spiralis* are scarce and the community is typically dominated by ephemeral red or green seaweeds, particularly the foliose red seaweed *Porphyra purpurea* and green seaweeds such as *Enteromorpha* spp. Under the blanket of ephemeral seaweeds, the barnacles *Semibalanus balanoides* or *Elminius modestus* and the limpet *Patella vulgata* may occur in the less scoured areas, along with the occasional winkles *Littorina littorea* and *Littorina saxatilis*. Few other species are present.
Lower shore	LS.LSa.MuSa.MacAre	*Limecola (Macoma) balthica* and *Arenicola marina* in littoral muddy sand	This biotope is characterised by the lugworm *Arenicola marina* and the Baltic tellin *L. balthica*. The sediment is typically muddy sand or fine sand, often occurring as extensive intertidal flats both on open coasts and in marine inlets. An anoxic layer is usually present within 5 cm (0.5 cm within the survey area) of the sediment surface and is often visible in worm casts. The habitat on site differed slightly from the JNCC description in that *L. balthica* was not recorded and instead the closely related thin tellin *Macomangulus tenuis* was observed via a dig-over of the sediments. The fine sand was relatively clean (low mud content) and generally lacked an anoxic layer; conditions which favour *M. tenuis.*
	LS.LSa.MuSa.Lan	*Lanice conchilega* in littoral sand	This biotope usually occurs on flats of medium fine sand and muddy sand, most often on the lower shore but sometimes also on waterlogged mid shores. The sand may contain a proportion of shell fragments or gravel. This biotope an also occur on the lower part of predominantly rocky or boulder shores, where patches of sand or muddy sand occur between scattered boulders, cobbles and pebbles. Conditions may be tide-swept, and the sediment may be mobile, but the biotope usually occurs in areas sheltered from strong wave action. The sediment supports dense populations of the sand mason *Lanice conchilega.* Other polychaetes present are tolerant of sand scour or mobility of the sediment surface layers and include the polychaetes *Anaitides*

Shore Position	Biotope/NVC Code	Biotope Name	Biotope Description
			mucosa, Eumida sanguinea, Nephtys hombergii, Scoloplos armiger, Aricidea minuta, Tharyx spp. and *Pygospio elegans*. The mud shrimp *Corophium arenarium* and the cockle *Cerastoderma edule* may be abundant. The baltic tellin *Macoma balthica* may be present. On boulder shores, and where pebbles and cobbles are mixed in with lower shore tide-swept sand with dense *L. conchilega* between the cobbles, the infaunal component is rarely sampled. The infaunal community under these circumstances, provided that the cobbles are not packed very close together, is likely to be similar to that in areas without the coarse material.

3.4 Landfall Option C

The extents of biotopes identified for Landfall Option C have been mapped in Figure 3-3 together with a summary of the biotopes identified in Table 3-3. Photographs of biotopes and species observed within Landfall Option C are shown in Appendix A; Plate 13 to Plate 14.

A steep and narrow band of coarse sand and shingle was present at the head of the beach. The substrate was comprised of predominantly coarse sand with a residual amount of cobbles, pebbles and gravels. An abundance of the talitrid amphipod *Orchestia gammarellus* occurred under stones and patches of decaying seaweed, originally washed onto the strandline during high tides. The classification for this biotope is LS.LSa.St.Tal.

The biotope LR.HLR.MusB.Sem.LitX; *Semibalanus balanoides* and *Littorina* spp. on exposed to moderately exposed eulittoral boulders and cobbles was present at the southern end of the upper shore. *Semibalanus balanoides* was abundant with *Balanus balanus* also present at the seaward end of the biotope. *Littorina littorea* and *Littorina littoralis* were abundant and *Nucella lapillus* was frequently present. *Patella vulgata, Elminius modestus* and the red seaweed *Mastocarpus stellatus* occurred occasionally. *Enteromorpha intestinalis* was only present in the landward half of this biotope and *Lanice conchilega* was present in soft sediments between stones.

The LS.LSa.MuSa.MacAre; *Macoma balthica* and *Arenicola marina* in littoral muddy sand biotope on site differed slightly from the JNCC description in that *Macoma balthica* was not recorded and instead the closely related thin tellin *Macomangulus tenuis* was observed via a dig-over of the sediments. The fine sand was relatively clean (low mud content) and generally lacked a prominent anoxic layer; conditions which favour *Macomangulus tenuis* over *Macoma balthica*. Oligochaete worms and the polychaete worms *Hediste diversicolour, Scoloplos armiger* and *Lanice conchilega* were also recorded via a dig-over of the sediments. *Arenicola marina* (Plate 13) was more abundant in this biotope than *Lanice conchilega* in areas where the latter was present (Plate 14).

Two areas of barren rock LR were present, presumably due to sand scouring. The composition of the rocks was 5% boulders, 40% cobbles, 40%, pebbles and 15% gravel. Another large area of barren rock with a similar substrate composition contained large patches of LR.FLR.Eph.EntPor and is mapped in Figure 3-3 as LR and L LR.FLR.Eph.EntPor.

Where dense populations of *Lanice conchilega* occurred and *Arenicola marina* was less abundant (if present) the biotope LS.LSa.MuSa.Lan; *Lanice conchilega* in littoral sand was ascribed. This biotope occurred in clean sand mainly along the mid and lower shores with polychaetes *Euclymene lumbricoides, Nephtys hombergii, Scoloplos armiger* and *Arenicola marina* often present.

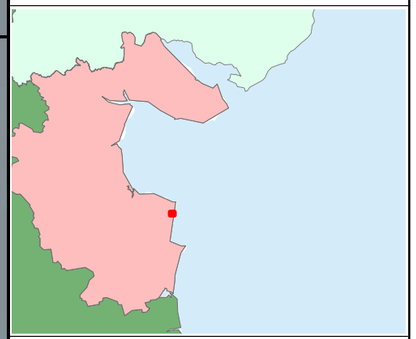
Legend

- Intertidal Survey Area
- High Water Mark
- Low Water Mark

Habitat

- LR
- LR & LR.FLR.Eph.EntPor (mosiac)
- LR.FLR.Eph.EntPor
- LR.HLR.MusB.Sem.LitX
- LR.LLR.F.Fspi.X
- LR.LLR.F.Fves
- LR.LLR.F.Fves & LR.FLR.Eph.EntPor (mosaic)
- LR.MLR.BF.Fser.Bo
- LS.LSa.MuSa.Lan
- LS.LSa.MuSa.MacAre
- LS.LSa.St.Tal
- Not Surveyed

Data Sources: Client, Ordnance Survey Ireland.



Client

Oriel Windfarm Ltd.

Project

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Title

Figure 3-3

Landfall C Intertidal Survey Habitats

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Checked By: NG	**File Ref:** MDR1520Arc1108
Approved By: ST	
Scale: 1:2,250 @ A3	**Projection:** ITM (IRENET95)
Date: 19/01/21	Geographic Co-ordinates: ETRS89

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Table 3-3: Littoral Biotopes Present at Landfall Option C (adapted from JNCC, 2015; see Figure 3.3).

Shore Position	Biotope/NVC Code	Biotope Name	Biotope Description
Upper shore	LS.LSa.St.Tal	Talitrids on the upper shore and strand-line.	A community of sandhoppers (talitrid amphipods) may occur on any shore where driftlines of decomposing seaweed and other debris accumulate on the strandline. The biotope occurs most frequently on medium and fine sandy shores but may also occur on a wide variety of sediment shores composed of muddy sediment, shingle and mixed substrata, or on rocky shores.
	LR.HLR.MusB.Sem.LitX	*Semibalanus balanoides* and *Littorina* spp. on exposed to moderately exposed eulittoral boulders and cobbles	Large patches of boulders, cobbles and pebbles in the eulittoral zone on exposed to moderately exposed shores colonised by the barnacle *Semibalanus balanoides* and, on larger rocks, the limpet *Patella vulgata*. The winkles *Littorina littorea* and *Littorina saxatilis* and the whelk *Nucella lapillus* are typically found in high numbers on and around cobbles and smaller boulders, while the anemone *Actinia equina* occurs in damp areas between and underneath larger boulders. Between the cobbles and pebbles, the mussel *Mytilus edulis* occasionally occurs, but always at low abundance, as do the crab *Carcinus maenas* and gammarid amphipods. Ephemeral green seaweeds such as *Enteromorpha intestinalis* may cover cobbles and boulders. The foliose red seaweeds *Chondrus crispus, Mastocarpus stellatus* and *Osmundea pinnatifida* as well as the wrack *Fucus vesiculosus* may also occur in low abundance on cobbles and boulders. The top shells *Gibbula cineraria* and *Gibbula umbilicalis* can, on more sheltered shores, be found among the seaweeds or underneath the boulders. The barnacle *Elminius modestus* is present on some shores.
	LR	Littoral rock (and other hard substrata)	Littoral rock includes habitats of bedrock, boulders and cobbles which occur in the intertidal zone (the area of the shore between high and low tides) and the splash zone.
Mid shore	LR.FLR.Eph.EntPor	*Porphyra purpurea* and *Enteromorpha* spp. on sand-scoured mid or lower eulittoral rock	Exposed and moderately exposed mid-shore bedrock and boulders which occur adjacent to areas of sand which significantly affects the rock. As a consequence of sand-abrasion, wracks such as *Fucus vesiculosus* or *Fucus spiralis* are scarce and the community is typically dominated by ephemeral red or green seaweeds, particularly the foliose red seaweed *Porphyra purpurea* and green seaweeds such as *Enteromorpha* spp. Under the blanket of ephemeral seaweeds, the barnacles *Semibalanus balanoides* or *Elminius modestus* and the limpet *Patella vulgata* may occur in the less scoured areas, along with the occasional winkles *Littorina littorea* and *Littorina saxatilis*. Few other species are present.
Lower shore	LS.LSa.MuSa.MacAre	*Limecola (Macoma) balthica* and *Arenicola marina* in littoral muddy sand	This biotope is characterised by the lugworm *Arenicola marina* and the Baltic tellin *L. balthica*. The sediment is typically muddy sand or fine sand, often occurring as extensive intertidal flats both on open coasts and in marine inlets. An anoxic layer is usually present within 5 cm (0.5 cm within the survey area) of the sediment surface and is often visible in worm casts. The habitat on site differed slightly from the JNCC description in that *L. balthica* was not recorded and instead the closely related thin tellin *Macomangulus tenuis* was observed via a dig-over of the sediments. The fine sand was relatively clean (low mud content) and generally lacked an anoxic layer; conditions which favour *M. tenuis.*
	LS.LSa.MuSa.Lan	*Lanice conchilega* in littoral sand	This biotope usually occurs on flats of medium fine sand and muddy sand, most often on the lower shore but sometimes also on waterlogged mid shores. The sand may contain a proportion of shell fragments or gravel. This biotope an also occur on the lower part of predominantly rocky or boulder shores, where patches of sand or muddy sand occur between scattered boulders, cobbles and pebbles. Conditions may be tide-swept,

Shore Position	Biotope/NVC Code	Biotope Name	Biotope Description
			and the sediment may be mobile, but the biotope usually occurs in areas sheltered from strong wave action. The sediment supports dense populations of the sand mason *Lanice conchilega.* Other polychaetes present are tolerant of sand scour or mobility of the sediment surface layers and include the polychaetes *Anaitides mucosa, Eumida sanguinea, Nephtys hombergii, Scoloplos armiger, Aricidea minuta, Tharyx* spp. and *Pygospio elegans*. The mud shrimp *Corophium arenarium* and the cockle *Cerastoderma edule* may be abundant. The baltic tellin *Macoma balthica* may be present. On boulder shores, and where pebbles and cobbles are mixed in with lower shore tide-swept sand with dense *L. conchilega* between the cobbles, the infaunal component is rarely sampled. The infaunal community under these circumstances, provided that the cobbles are not packed very close together, is likely to be similar to that in areas without the coarse material.

4 HABITATS OF CONSERVATION IMPORTANCE

The following habitat of conservation value has been considered in the context of the intertidal biotopes identified at the proposed Landfall Option options.

Intertidal Sand and Muddy Sand

The intertidal sand and muddy sand habitat (as defined by the LS.LSa.MuSa.MacAre biotope on Fgure 3.3 was recorded within all three Landfall Options. This habitat as *'mudflats and sandflats not covered by seawater at low tide'* is offered protection under the EU Habitats Directive, however none of the three landfall options (A, B and C) are located within the Dundalk Bay SAC. No other intertidal habitats covered by the EU Habitats Directive were noted during the survey.

The whelk *Nucella lapillus* was recorded within all three landfall options. This species is listed under the OSPAR list of threatened and/or declining species and habitats.

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Appendix A - Plates

Plate 1: **Coarse sand and shingle on the beach head at Landfall Option A.**

Plate 2: Target Note 1: Low stone wall and wooden pilings at southern corner of Landfall Option A.

Plate 3: LR.MLR.BF.Fser.Bo at Landfall Option A.

Plate 4: LR.MLR.BF.Fser.Bo at Landfall Option A.

Plate 5: *Cancer pagurus* from LR.MLR.BF.Fser.Bo at Landfall Option A.

Plate 6: Possible *Protosuberites denhartogi* from LR.MLR.BF.Fser.Bo at Landfall Option A.

Plate 7: An encrusting sponge *Oscarella* sp. In LR.LLR.F.Fves at Landfall Option A.

Plate 8: LR.LLR.F.Fves at Landfall Option A.

Plate 9: *Lanice conchilega* in clean sand at Landfall Option A.

Plate 10: **LR & LR.FLR.Eph.EntPor Barren rock patches of *Enteromorpha intestinalis* and *Porphyra umbilicalis* at Landfall Option B.**

Plate 11: LR.FLR.Eph.EntPor at Landfall Option B.

Plate 12: Soft sediments at LS.LSa.MuSa.MacAre and LS.LSa.MuSa.Lan interface Landfall Option B.

Plate 13: *Arenicola marina* cast with siphon hole LS.LSa.MuSa.MacAre at Landfall Option C.

Plate 14: LS.LSa.MuSa.MacAre foreground and LS.LSa.MuSa.Lan background at Landfall Option C.