GREENLINK
MARINE ENVIRONMENTAL STATEMENT- WALES

APPENDIX C

Greenlink Marine Habitats Regulations Assessment (HRA)

P1975_R4484_RevF1
June 2019

Greenlink Interconnector
- connecting the power markets
in Ireland and Great Britain

Greenlink
INTERCONNECTOR

Co-financed by the European Union
Connecting Europe Facility

CONTENTS

LIST OF TABLES AND FIGURES

Tables

Figures

GLOSSARY AND ACRONYMS

AA
Appropriate Assessment

An assessment carried out under Article 6(3) of the Habitats Directive of the implications of a plan or project, either individually or in combination with other plans and projects, on a European site in view of the site's conservation objectives.

ADD
Acoustic deterrent device

B Field
Magnetic field

Biodiversity
The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (UN Convention on Biological Diversity 1992).

Birds Directive
Council Directive 2009/14/EC on the conservation of wild birds.

Bryozoans
Also known as moss animals, are colonial animals that form encrustations or build bush-like structures resembling small corals.

CBRA
Cable burial risk assessment

CLB
Cable lay barge

CLV
Cable lay vessel

CHSR
Conservation of Habitats and Species Regulations 2017

CEMP
Construction Environmental Management Plan

CCW
Countryside Council for Wales

DP
Dynamic positioning

EMF
Electromagnetic field

EC
European Commission

The Commission of the European Communities.

EPS
European Protected Species
Under Article 12 of the EC Habitats Directive Member States are required to establish a system of strict protection for EPS, as listed in Annex IV across their entire range within the EU, both within and outside Natura 2000 Sites.

ES
Environmental Statement

EU
European Union

EUNIS
European Nature Information System

European Site
Collective term for Special Areas of Conservation, Special Protection Areas and Ramsar sites.

GB
Great Britain

GIL
Greenlink Interconnector Limited

GIS
Geographic Information System

Habitat
A habitat listed in Annex I of the Habitats Directive.

Habitats Directive
Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (EC Habitats Directive).

HDD
Horizontal directional drilling

HRA
Habitat Regulations Assessment

Where competent authorities assess certain plans or projects which affect Natura sites. (The acronym HRA refers to a Habitat Regulations Assessment or a Habitat Regulations Appraisal).

HVDC
High voltage direct current

Hydroids
Colonial animals typically 5-500mm or more high that branch.

iE field
Induced electric field

ICG-C
Intercessional Correspondence Group on Cumulative Effects

IROPI
Imperative reasons of overriding public interest

JNCC
Joint Nature Conservation Committee

JUB
Jack-up barge

KP
Kilometre Point

LSE
Likely significant effect

MBES
Multi-beam echo sounder

MCAA
Marine and Coastal Access Act 2009

MCZ
Marine Conservation Zone

Area designated under the Marine and Coastal Access Act 2009. They protect a range of nationally important marine wildlife, habitats, geology and geomorphology, and can be designated anywhere in English and Welsh territorial and UK offshore waters.

META
Marine Energy Testing Area

MHPA
Milford Haven Port Authority

MHWS
Mean high-water springs

MLW
Mean low water

MMO
Marine mammal observer

NPWS
National Parks & Wildlife Service (Ireland)

NRW
Natural Resources Wales

OMR
Conservation of Offshore Marine Habitats and Species Regulations 2017

OWEZ
Offshore Windfarm Egmond aan Zee

PAM
Passive Acoustic Monitoring

PCE
Potential cumulative effect

PCI
Project of Common Interest

PTS
Permanent threshold shift

QF
Qualifying Feature

RAMSAR Sites
Wetlands of international importance designated under the Ramsar Convention.

SAC
Special Area of Conservation

Are sites designated under European Communities Directive 92/43/EEC known as the 'Habitats Directive'. This requires the conservation of important, rare or threatened habitats and species (not birds, which are protected by Special Protection Areas) across Europe.

SBP
Sub-bottom profiler

Screening for Appropriate Assessment
The screening of a plan or project to establish if an appropriate assessment of the plan or project is required. Unless the screening assessment can establish that there is no likelihood of any significant effect on a European site, then an AA must be carried out.

SOPEPs
Shipboard oil pollution emergency plans

SPA
Special Protection Area

Are sites designated under the European Communities Directive 2009/14/EC, known as the 'Birds Directive', to conserve the habitats of certain migratory or rare birds.

SSS
Side Scan Sonar

SSSI
Site of Special Scientific Interest

Are nationally important areas of land and water (above mean low water) in Great Britain. SSSIs give legal protection to the best sites for wildlife and geology in England and Wales under the Wildlife and Countryside Act 1981 (as amended).

TEN-E Regulations
Trans-European Network for Energy

TJP
Transition joint pit

TTS
Temporary threshold shift

UXO
Unexploded Ordnance

1. Introduction

1.1 Project Background

Greenlink Interconnector Limited (GIL) is proposing to develop an electricity interconnector (Greenlink) linking the existing electricity grids in Great Britain (GB) and Ireland. The Greenlink project will consist of two converter stations, one close to the existing substation at Great Island in County Wexford (Ireland) and one close to the existing substation at Pembroke in Pembrokeshire (Wales). The converter stations will be connected by underground cables (onshore) and subsea cables (offshore). The Greenlink route is shown in Figure 1-1 (Drawing P1975-LOC-001).

The project is designated as a European Union Project of Common Interest (PCI), project number 1.9.1, under the provisions of European Union Regulation No. 347/2013 on guidelines for Trans-European Network for Energy (TEN-E Regulations) and has successfully applied for funding under the Connecting Europe Facility.

This Habitat Regulations Assessment (HRA) covers the Welsh Marine components of Greenlink from mean high-water springs (MHWS) at the Welsh landfall at Freshwater West, Pembrokeshire to the UK / Republic of Ireland median line. This is defined as the Proposed Development and comprises:

- Two high voltage direct current (HVDC) electricity power cables;
- A smaller fibre-optic cable for control and communication purposes;
- All associated works required to install, test, commission and complete the aforementioned cables; and
- All associated works required to operate, maintain, repair and decommission the aforementioned cables, including five repair events over the 40 year lifetime of Greenlink.

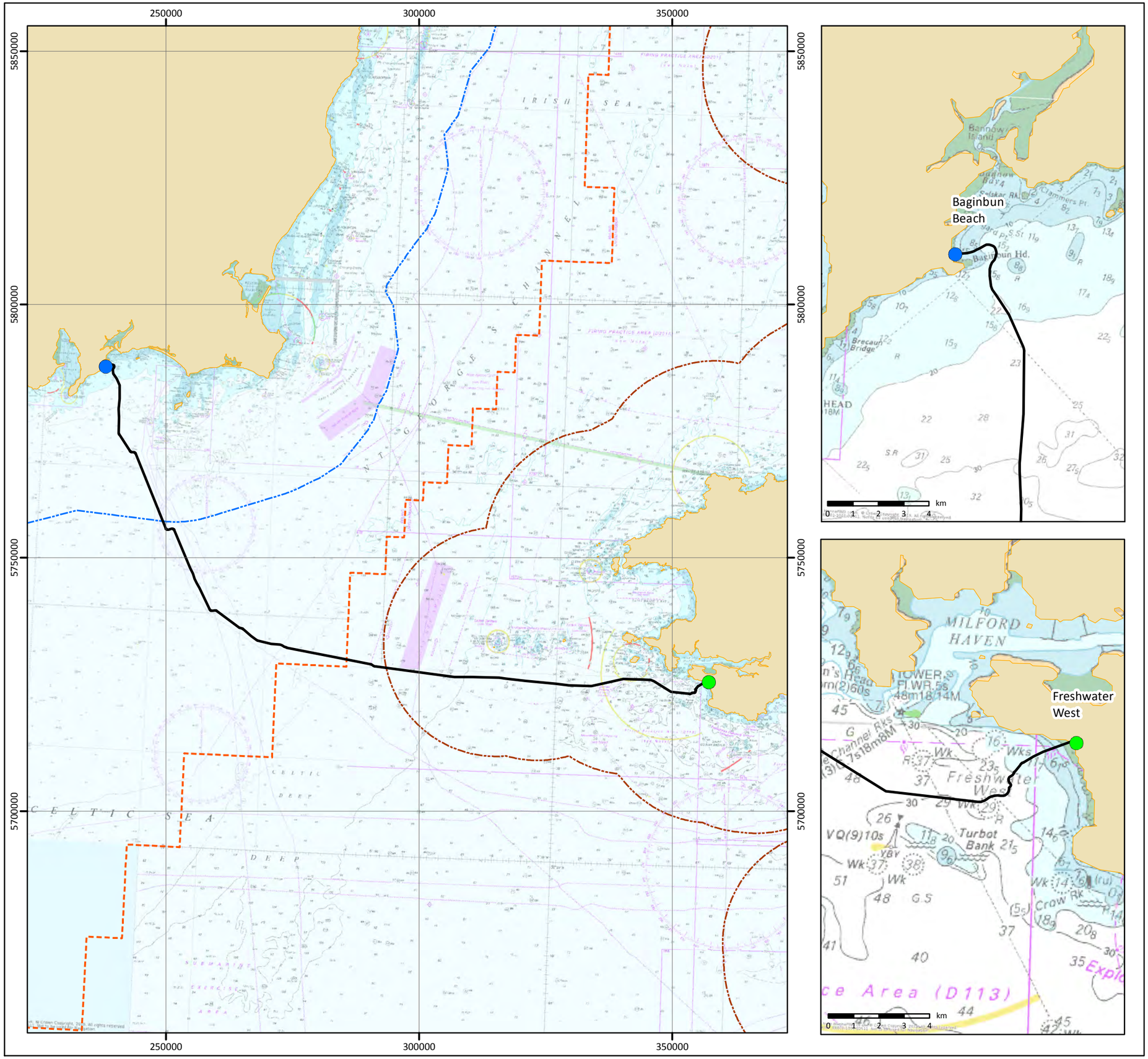
The location of the Proposed Development is illustrated in Figure 1-2 (P1975-CORR-001).

Separate HRAs / Natura Impact Statements will be prepared which cover individually the Welsh Onshore; the Irish Onshore; the Welsh Marine (the submarine route from the Ireland/UK median line to MHWS at the Welsh landfall at Freshwater West, Pembrokeshire); and the Irish Marine (the submarine route from MHWS at the Irish landfall at Baginbun Bay, County Wexford to the 12nm limit) and Irish Offshore (the submarine route from the 12nm limit to the Ireland/UK median line). Once submitted these will be available online at www.greenlink.ie. The boundaries of the individual components described are shown in Figure 1-3.

GREENLINK INTERCONNECTOR

ROUTE OVERVIEW

Drawing No: P1975-LOC-001 | **A**



Legend

Landfall

- Baginbun Beach
- Freshwater West
- Greenlink Route Centreline (Indicative)

Administrative Boundaries

- ROI 12nm Territorial Sea Limit
- UK 12nm Territorial Sea Limit
- Median Line

N
W E
S

NOTE: Not to be used for Navigation

Date	Monday, April 8, 2019 08:45:37
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; GEBCO; MarineFind; Greenlink
File Reference	J:\P1975\Mxd\01_LOC\ P1975-LOC-001.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Greenlink

Co-financed by the European Union Connecting Europe Facility

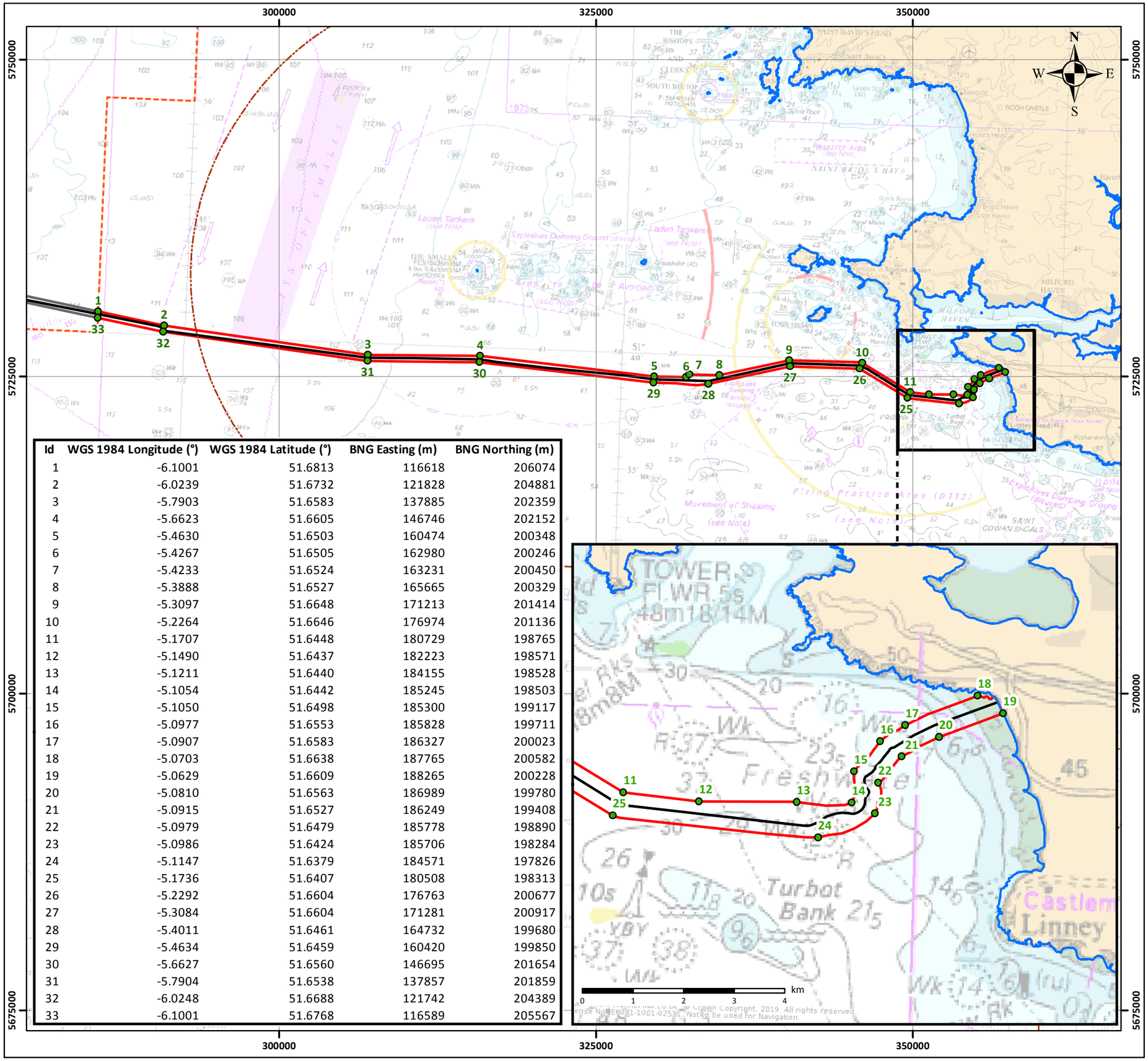
intertek

0 10 20 30 40 km

GREENLINK INTERCONNECTOR

PROPOSED DEVELOPMENT
UK Waters

Drawing No: P1975-CORR-001 | **A**



Id	WGS 1984 Longitude (°)	WGS 1984 Latitude (°)	BNG Easting (m)	BNG Northing (m)
1	-6.1001	51.6813	116618	206074
2	-6.0239	51.6732	121828	204881
3	-5.7903	51.6583	137885	202359
4	-5.6623	51.6605	146746	202152
5	-5.4630	51.6503	160474	200348
6	-5.4267	51.6505	162980	200246
7	-5.4233	51.6524	163231	200450
8	-5.3888	51.6527	165665	200329
9	-5.3097	51.6648	171213	201414
10	-5.2264	51.6646	176974	201136
11	-5.1707	51.6448	180729	198765
12	-5.1490	51.6437	182223	198571
13	-5.1211	51.6440	184155	198528
14	-5.1054	51.6442	185245	198503
15	-5.1050	51.6498	185300	199117
16	-5.0977	51.6553	185828	199711
17	-5.0907	51.6583	186327	200023
18	-5.0703	51.6638	187765	200582
19	-5.0629	51.6609	188265	200228
20	-5.0810	51.6563	186989	199780
21	-5.0915	51.6527	186249	199408
22	-5.0979	51.6479	185778	198890
23	-5.0986	51.6424	185706	198284
24	-5.1147	51.6379	184571	197826
25	-5.1736	51.6407	180508	198313
26	-5.2292	51.6604	176763	200677
27	-5.3084	51.6604	171281	200917
28	-5.4011	51.6461	164732	199680
29	-5.4634	51.6459	160420	199850
30	-5.6627	51.6560	146695	201654
31	-5.7904	51.6538	137857	201859
32	-6.0248	51.6688	121742	204389
33	-6.1001	51.6768	116589	205567

Legend

- Proposed Development Points
- Greenlink Route Centreline (Indicative)
- Proposed Development
- Irish Offshore
- UK Mean High Water
- 12nm Limit
- Median Line

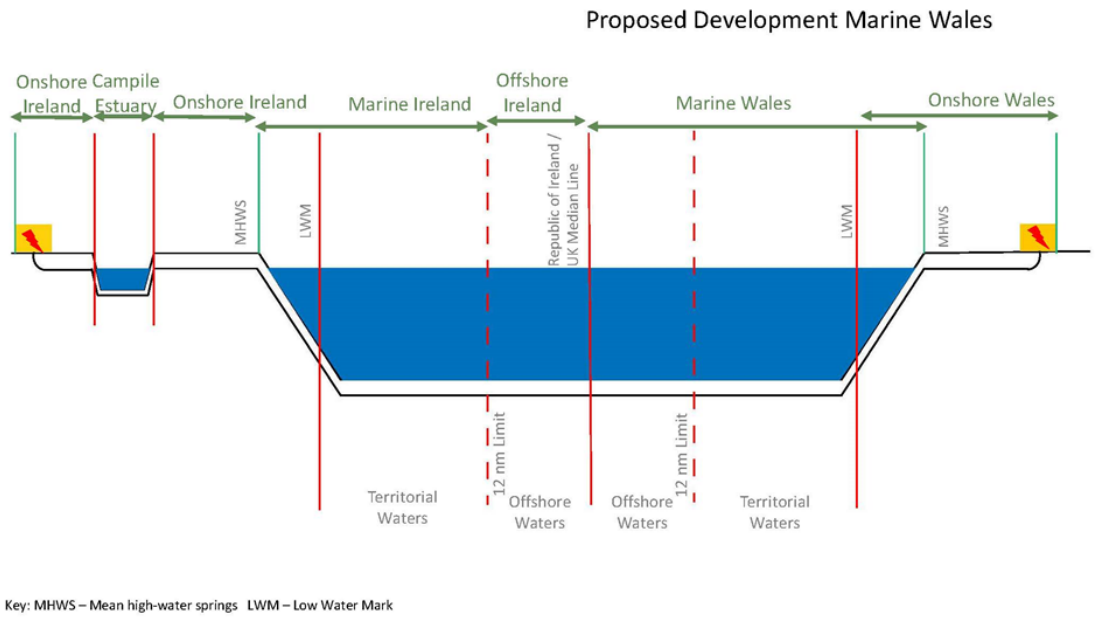
NOTE: Not to be used for Navigation

Date	Wednesday, June 5, 2019 12:44:02
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	CDA; GEBCO; UKHO; ;OSOD; MarineFind
File Reference	J:\P1975\Mxd\03_CORR\ P1975-CORR-001.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Co-financed by the European Union Connecting Europe Facility

km
0 3 6 9 12

Figure 1-3 Components of Greenlink



1.2 *Requirement for Habitat Regulations Assessment (HRA)*

The Birds Directive (2009/147/EC) and the Habitats Directive (92/42/EEC) put an obligation on European Union (EU) Member States to establish the Natura 2000 network of sites of highest biodiversity importance for rare and threatened habitats and species across the EU. The network comprises Special Areas of Conservation (SACs) designated under the Habitats Directive, and Special Protection Areas (SPAs) designated under the Birds Directive. SPAs and SACs are designated by the individual member states.

UK Government policy (ODPM Circular 06/2005) states that sites designated under the Convention on Wetlands (Ramsar, Iran 1971) known as the "Ramsar Convention"[1] are also included under the definition Natura 2000. The vast majority of Ramsar sites are also classified as SPAs.

Collectively, SPAs, SACs and Ramsar sites are referred to as European sites under UK Regulations.

A key protection mechanism under these directives is to consider the possible nature conservation implications of any plan or project on the European site network before any decision is made to allow that plan or project to proceed. Each plan considered for approval, must take into consideration the possible effects it may

[1] The Ramsar Convention is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their Wetlands of International Importance and to plan for the "wise use", or sustainable use, of all of the wetlands in their territories" (RAMSAR 2011).

have in combination with other plans and projects when going through the process known as the HRA process.

The obligation to undertake the HRA process derives from Article 6(3) and 6(4) of the Habitats Directive, and both involve a number of steps and tests that need to be applied in sequential order. Each step in the assessment process precedes and provides a basis for other steps. The results at each step must be documented so there is transparency of the decisions made.

The Proposed Development crosses the Pembrokeshire Marine / Sir Benfro Forol SAC (site code: UK0013116), the West Wales Marine / Gorllewin Cymru Forol SAC (site code: UK0030397), Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA (site code: UK9014051) and the landfall is within the Castlemartin Coast SPA (site code: UK9014061) and the Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (site code: UK0014787). As the project is not directly connected with or necessary to the management of the European sites. Therefore under the Habitats Regulations it is necessary that the Proposed Development should be subject to the HRA process.

1.3 *Aim of this Report*

The purpose of this report is to inform the HRA process in determining whether the Proposed Development, both alone and in combination with other plans or projects, is likely to have a significant effect on any European site in the context of their conservation objectives and specifically on the habitats and species for which the sites have been designated.

The HRA provides a description of the Proposed Development (Section 3); identifies the European sites that could be affected by the plans (Section 4); and identifies the potential pressures that could arise from the planned activities on the sites (Section 4). It determines it there is any connectivity between the Proposed Development and any European sites (Stage 1 Appropriate Assessment Screening, Section 4) and considers the potential for adverse effects on the conservation objectives and qualifying feature(s) within the affected European site(s) (Stage 2 Information to Inform Appropriate Assessment, Section 5). It concludes, in Section 5, with a statement for each European site where there is a likely significant effect and proposes mitigation to reduce the significance of effects. Section 6 provides a summary of the HRA process documented in this report.

This report has been prepared in accordance with current guidance, including:

- Managing Natura 2000 sites. The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC (European Commission, EC 2018a);
- Guidance on Energy Transmission Infrastructure and EU nature legislation (EC 2018b);
- The Planning Series 16 – Habitats Regulations Assessment (Welsh Government 2017)

- EU Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC (EC 2007); and
- Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC (EC 2002).

This document also presents a Marine Conservation Zone (MCZ) assessment and assessment of whether the Proposed Development has the potential to hinder the conservation objectives of Sites of Special Scientific Interest (SSSIs). The legislative requirement for these assessments is outlined in Section 2.

1.4 Consultation

Consultation has been undertaken with key statutory consultees and stakeholders and the public during key stages of project development. GIL has consulted with Natural Resources Wales (NRW) throughout project design (cable routeing) to identify the ecological constraints and sensitivities of the habitats and species in the area. A scoping opinion from NRW was received on the broader Environmental Impact Assessment which has informed the HRA process.

2. Assessment Process

2.1 Habitats Regulations Assessment

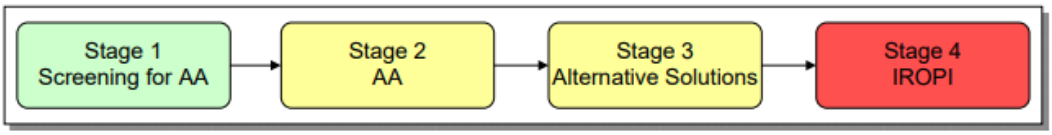
2.1.1 Legislative context

Under Article 6(3) of the EU Habitats Directive (Directive 92/43/EEC), any plan or project within or adjacent to a European site must be assessed with regard to their implications for the site conservation objectives. If the project is likely to have a significant negative effect on a European site, either alone or in combination with other plans or projects, it must undergo an Appropriate Assessment (AA) by the competent authority (those with decision making powers). Normally, the competent authorities cannot consent the plan / project without first having ascertained that it will not have an adverse effect on the integrity of the site concerned.

If an adverse negative effect is identified it may be possible to adjust the plan/project or introduce certain mitigation measures to avoid or pre-empt, remove or reduce effects to a non-significant level so that the plan/project may be approved (European Commission 2018b).

The European Commission's methodological guidance (EC 2002) outlines a four-stage approach to the AA process, where the outcome at each successive stage determines whether a further stage in the process is required. The four stages are shown in Figure 2-1 and described below. Collectively they make up what is referred to in the UK as the Habitat Regulations Assessment (HRA) process.

Figure 2-1 Stages of AA



The requirements for AA are transposed into UK statute through The Conservation of Habitats and Species Regulations 2017 (CHSR) for territorial waters (out to 12 nm); and The Conservation of Offshore Marine Habitats and Species Regulations 2017 (OMR) for UK Exclusive Economic Zone waters. Collectively they are referred to as the 'Habitat Regulations'.

Whilst the obligation to undertake the AA is derived from Articles 6(3) and 6(4) of the Habitats Directive, it is Regulation 28(2) of the OMR and 63(1) of the CHSR that sets out procedural requirements. They require that the applicant provide such information as the component authority may reasonably require for the purposes of assessment or to enable them to determine whether an AA is required.

There is no statutory method for undertaking the HRA process, but Welsh Government (2017) guidance outlines the steps to be taken by the applicant at each Stage.

2.1.2 Stage 1 - Screening for Appropriate Assessment

Screening is the process that addresses and records the reasoning and conclusions in relation to the first two tests of Regulation 28 of the OMR and Regulation 63 of the CHSR:

- Whether a plan or project is directly connected to or necessary for the management of the site, and
- Whether a plan or project, alone or in combination with other plans and projects, is likely to have significant effects on a European site in view of its conservation objectives.

Where significant effects are likely, uncertain or unknown at screening stage, then the process must proceed to Stage 2 (AA). Screening should be undertaken without the inclusion of mitigation, unless potential impacts clearly can be avoided through the modification or redesign of the plan or project, in which case the screening process is repeated on the altered plan. The greatest level of evidence and justification will be needed in circumstances when the process ends at screening stage on grounds of no effect.

2.1.3 Stage 2 - Appropriate Assessment

If Stage 1 concludes that an AA is required, then the AA must be undertaken by the Competent Authority licensing the plan or project.

To inform the AA the developer must provide data and information on the project and on the European site. An analysis of potential effects on the site must be completed and presented as 'Information to Inform Appropriate Assessment'. This is a more detailed ecological assessment of the proposed activities and looks to answer two key questions:

- What are the likely effects of the proposed activity?
- How quickly could the Qualifying Feature recover from the effect, if at all?

The duty to undertake AA, having considered the 'Information to Inform AA', and to ensure that the stringent evaluation and decision-making procedure is applied correctly, lies with the competent authority, which for the Proposed Development is the Welsh Ministers. The AA will be a focused and detailed impact assessment of the implications of the plan or project, alone and in combination with other plans and projects, on the integrity of a European site in view of its conservation objectives.

If the assessment concludes that the plan or project will adversely affect the integrity of a European site, then the process must proceed to Stage 3, or the plan or project should be abandoned.

Any mitigation measures necessary to avoid, reduce or offset negative effects should be proposed at this stage.

2.1.4 Stage 3 – Alternative solutions

This stage examines any alternative solutions or options that enable the plan or project to proceed without adverse effects on the integrity of a European site. The process must return to Stage 2 as alternatives will require AA in order to proceed. Demonstrating that all reasonable alternatives have been considered and assessed, and that the least damaging option has been selected, is necessary to progress to Stage 4.

2.1.5 Stage 4 - Imperative Reasons of Overriding Public Interest (IROPI)/Derogation

Stage 4 is the main derogation process of Article 6(4) which examines whether there are imperative reasons of overriding public interest (IROPI) for allowing a plan or project that will have adverse effects on the integrity of a European site to proceed in cases where it has been established that no less damaging alternative solution exists.

The extra protection measures for Annex I priority habitats come into effect when making the IROPI case. IROPI reasons that may be raised for sites hosting priority habitats are those relating to human health, public safety or beneficial consequences of primary importance to the environment. In the case of other IROPI, the opinion of the European Commission is necessary and should be included in the AA. Compensatory measures must be proposed and assessed. The European Commission must be informed of the compensatory measures. Compensatory measures must be practical, implementable, likely to succeed, proportionate and enforceable, and they must be approved by the Welsh Ministers.

2.2 Marine Conservation Zone Assessment

Marine Conservation Zones (MCZs) are designated under the Marine and Coastal Access Act 2009 (MCAA) to protect a range of important marine habitats, species and geological formations in English and Welsh territorial waters and offshore waters. In conjunction with other existing international and national designations these sites contribute to an ecologically coherent network of Marine Protected Areas (MPA) in the North East Atlantic.

Section 126 of the Marine and Coastal Access Act (MCAA 2009) places specific requirements on the public authority responsible for marine licensing, to determine if the licensable activity is capable of hindering the achievement of the conservation objectives stated for the MCZ.

The assessment process is similar to that required under the Habitats Regulations in that it follows a series of sequential steps as follows:

- **Screening** – Determine if the licensable activity is taking place within or near an area being put forward or already designated as an MCZ and whether the activity is capable of affecting (other than insignificantly) either (i) the protected features of an MCZ; or (ii) any ecological or geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or in part) dependant. If the answer is yes then proceed to Stage 1.
- **Stage 1 assessment** – Is the authority satisfied that there is no significant risk of the activity hindering the conservation objectives stated for the MCZ and can the authority exercise its functions to further the conservation objectives of the site. If the answer is no to either of these questions then the authority has to consider whether there are other means of proceeding with the act which would create a substantially lower risk of hindering the achievement of the objectives. If the answer is still no then proceed to Stage 2.
- **Stage 2 assessment** – This stage looks at whether the benefit to the public clearly outweighs the risk of damage to the environment and seeks to satisfy the authority that the applicant can make arrangements to undertake measures of equivalent environmental benefit to the damage which the act will have on the MCZ.

2.3 *Sites of Special Scientific Interest (SSSI) Assessment*

Sites of Special Scientific Interest (SSSI) are nationally important areas of land and water (above mean low water) in Great Britain. SSSIs give legal protection to the best sites for wildlife and geology in England and Wales under the Wildlife and Countryside Act 1981 (as amended). SSSIs are protected by law and it is an offence for any person to intentionally or recklessly damage the protected natural features of a SSSI.

To undertake works within a SSSI a developer must demonstrate that they have given due consideration to the effects of the proposed activities on the features of special interest and that the conservation objectives of the site will not be hindered by the project. There is no formal method for undertaking this assessment and therefore SSSIs have been included within this document as best practice.

3. Description of the Project

3.1 Overview

Greenlink is a proposed subsea and underground electricity interconnector between the existing electricity grids in the Republic of Ireland and Great Britain with a nominal capacity of 500 megawatts (MW). Greenlink comprises subsea and underground cables and associated converter stations to connect EirGrid's Great Island transmission substation in County Wexford (Ireland) and National Grid's Pembroke transmission substation in Pembrokeshire (Wales). The power will be able to flow in either direction, depending on supply and demand in each country.

The converter stations will be connected by two HVDC cables under the Irish Sea. A fibre optic cable will also be laid for control and communication purposes.

The subsea cable system will be joined to the corresponding land cable system in a transition joint pit (TJP) located above MHWS, and therefore does not form part of the Proposed Development (the subject of this HRA).

The proposed landfall site is Freshwater West, Pembrokeshire. The total length of the Greenlink marine cables is 159.27km of which 73.8km forms the Proposed Development.

3.2 Development of the Project

The configuration of any interconnector project is influenced by the location of the existing network infrastructure, its ability to accommodate the required connection capacity, any requirement for network reinforcements, and other factors such as environmental constraints.

A full description of the alternatives considered and route development is provided in the Greenlink Marine ES – Wales, Chapter 3. The following sections summarise the key points.

3.2.1 Connection point selection

3.2.1.1 Irish and GB Transmission Networks

The importance of Greenlink, linking the Irish and GB Transmission Networks, is recognised through its PCI status which makes it one of Europe's most important energy infrastructure projects and granting it the "highest national significance" possible. The requirement and need for Greenlink has been reinforced by Ofgem (GB) and CRU (Ireland) via the completion of a Cost Benefit Analysis which demonstrates that Greenlink offers economic benefit to consumers in both jurisdictions.

3.2.1.2 Transmission Network Substation Connection Options

The configuration of any interconnector project is influenced by the location of the existing network infrastructure, its ability to accommodate the required connection capacity, any requirement for network reinforcements, and other factors such as environmental constraints. A review of these factors was undertaken for both the Irish and GB Transmission Networks by EirGrid and National Grid Electricity System Operator, respectively.

3.2.1.3 Irish Transmission Network

A review of suitable points of connection was undertaken in Ireland. Connection locations on the east of Ireland were assessed. Following a network review the most suitable location on the east of the Irish Transmission Network was found to be the Great Island Substation in County Wexford.

3.2.1.4 GB Transmission Network

The National Grid completed a Connections and Infrastructure Options Note process to assess potential grid connection locations within the GB Transmission Network. Connection locations to the west of the GB Transmission Network were assessed.

The Connections and Infrastructure Options Note process is a defined procedure which is used for all large electricity users and generators seeking connection to the GB electricity network. This process considers both the cost benefit of different connection options and the engineering limitations of the existing network.

Eight substations were initially considered as potential connection points. National Grid Electricity System Operator then completed a Cost Benefit Analysis for the four remaining options (Alverdiscott 400kV, Swansea North 400kV, Pembroke 400kV and Pentir 400kV). Table 3-1 summarises route distances between Ireland and the four options.

Table 3-1 Summary of project distances

	Distance (km)		
Site	Onshore	Offshore	Total Distance
Alverdiscott 400kV	38	222 (direct)	260
Pembroke 400kV	36	159 (known constraints included)	195
Swansea North 400kV	59	207 (direct)	266
Pentir 400kV	49	220 (direct)	269

Note: It was acknowledged that length of direct offshore routes is likely to increase by 10 to 20% as constraints become known and therefore costs would increase accordingly.

After completing the Connections and Infrastructure Options Note and Cost Benefit Analysis, National Grid Electricity System Operator determined the most economical connection point to be Pembroke 400kV substation, requiring only a busbar extension to provide a connection point for Greenlink. National Grid Electricity

System Operator also concluded that the site facilitates the connection from other points of view (environmental, consenting etc) and as such is the preferred connection point.

3.2.2 Landfall selection

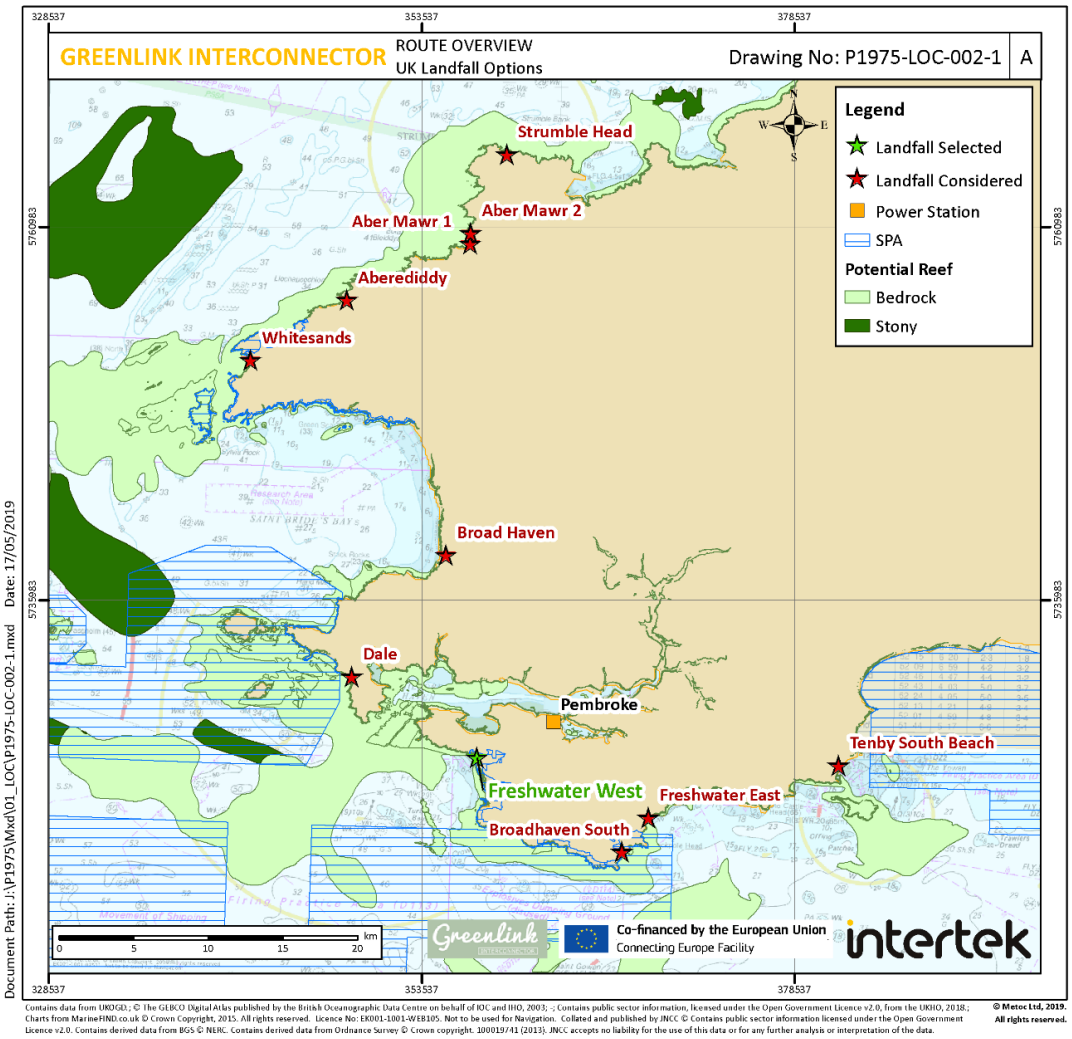
Following identification of Pembroke substation as the connection point, an options appraisal study of the Pembrokeshire coastline was undertaken to determine a suitable landfall site. Eight potential suitable landfall locations were identified and assessed using a range of environmental, technical and economic criteria. Criteria assessed included vessel access, beach composition, amenity impact, environmental constraints (e.g. presence of European sites), exposure, coastal erosion, access to beach, cable engineering and protection requirements, obstructions and existing infrastructure. All potential sites were located within the Pembrokeshire Marine / Sir Benfro Forol SAC and therefore would be subject to the same HRA process (Figure 3-1).

Of the eleven potential sites, nine were discounted as less preferential on environmental and technical grounds. For the selection process please refer to the Greenlink Marine ES – Technical Appendix N. Two 'preferred' landfall options were recommended for further investigation; Broad Haven and Freshwater West.

The Broad Haven landfall, north of Milford Haven, has minimal offshore routeing constraints but the main disadvantage was that the onshore route would require a technically challenging crossing of the Milford Haven estuary. The main benefit was that it avoided an offshore route through the Castlemartin Firing Range.

The Freshwater West landfall, provided the shortest onshore route to the converter substation and tie in point. It was recognised that the sand dunes behind the beach are environmentally sensitive but that a trenchless technique (horizontal directional drilling) could be used to avoid disturbance of the feature. Offshore the route was highly constrained due to the proximity of the Castlemartin Firing Range and Milford Haven harbour mouth. However, consultation with the Ministry of Defence and Port of Milford Haven Authority from 2013 through to 2018 determined that the co-location of a submarine cable, the military firing range and port activities was possible.

Figure 3-1 Landfall sites assessed



3.2.3 *Offshore route development*

The offshore route development has been an iterative process involving cycles of consultation, refinement and survey. The submarine cable route has been designed to avoid or reduce environmental effects while also accommodating other factors.

In Wales the main objectives driving route development were:

- To avoid where possible, or otherwise minimise the distance through which the route crosses Reef habitat within the Pembrokeshire Marine SAC;
- To avoid where possible, or otherwise minimise the distance through which the route crosses the Castlemartin Firing Range; and
- To minimise disruption to shipping associated with Milford Haven and offshore traffic separation schemes.

In late 2015 an initial route was developed from Freshwater West, which branched out offshore (around KP35) into four options crossing the Celtic Sea. These options were refined in Irish waters to conclude with a single preferred route for survey.

In spring and summer 2018 the route through Welsh waters was re-examined, ahead of the cable route survey, and in light of new data and consultation undertaken with NRW, Castlemartin Firing Range, and Milford Haven Port Authority (MHPA).

Minor route amendments were made to the preferred route (Route A) to reduce the distance the route crossed the Skomer, Skokholm and the Seas Off Pembrokeshire SPA and areas defined by the Joint Nature Conservation Committee (JNCC) as having the potential to be Reef habitat within the Pembrokeshire Marine SAC. Nearshore route adjustments were made using SEACAMs bathymetric data provided by Bangor University to follow a sediment channel through outcropping bedrock reef.

In addition, two alternatives to Route A were designed; Route B and Route E:

- Route B sought to reduce the distance the route crossed the Pembrokeshire Marine SAC and potential Reef habitat. It was later discounted through consultation with NRW.
- Route E sought to avoid completely areas identified as potential Reef habitat by routeing around it to the north. Routeing closer to Milford Haven was confirmed as possible through consultation with MHPA.

A survey strategy was agreed with NRW and a reconnaissance survey was conducted on Route A and Route E in autumn 2018. Extensive route development was carried out during the cable route survey.

Minor refinements included extending the width of the survey corridor so that specific features could be better visualised to determine if there was a way to avoid them. This included:

- Large sand waves at kilometre point (KP) 26; although these proved to be a sequence of extensive sandwaves and a route around was not viable; and
- Once the survey was outside the area covered by the SEACAMs bathymetric data it was identified that the channel system deviated outside the initial survey corridor. Additional geophysical data was acquired to follow the channel so that the outcropping rock between KP2 and KP5 could be avoided.

Major route development followed completion of the reconnaissance survey of Route A and Route E. Extensive areas of Annex I Reef habitat was identified on both routes. Advice from NRW was sought and biotope maps, seabed photographs and an interpretative report where provided. NRW recommended that additional geophysical survey be completed to the eastern end of the reconnaissance survey area between Route A and Route E.

Two north-south geophysical survey lines were run between Route E and Route A (Figure 3-2, Drawing P1975-SURV-012) to identify the northern extent of the bedrock outcrop on Route A. The additional geophysical lines showed the top of

the bedrock slightly north of the extent of the Route A survey corridor. This led to a route being designed between Route E and Route A that avoided the sensitive reef habitat on both routes.

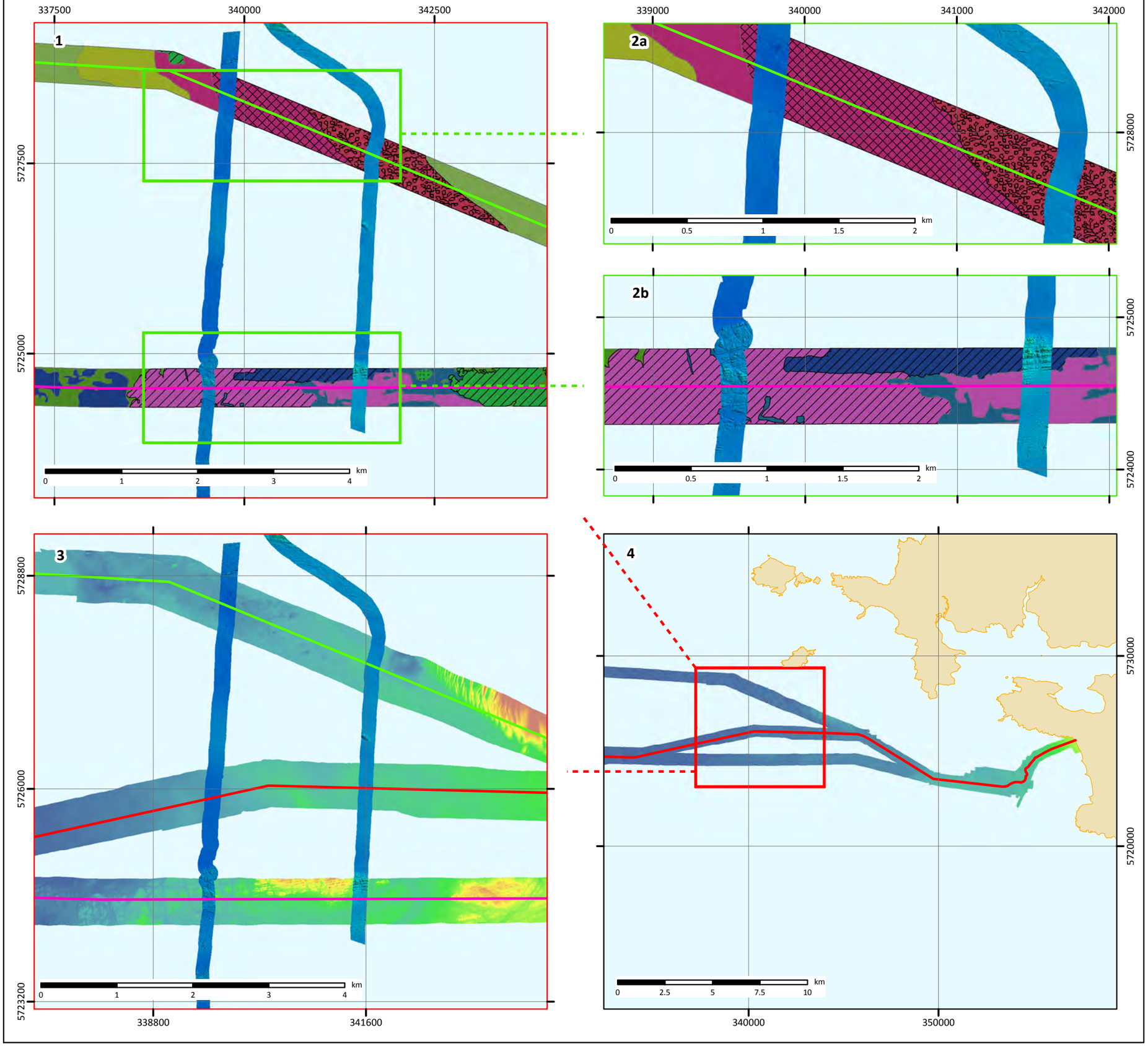
Seabed photographs, a biotope map and interpretative report were subsequently submitted to NRW for the new route section for review. NRW advice concluded that this alternative route is likely to be preferable to Route A and E; and it has been taken forward for assessment as the Proposed Development.

GREENLINK INTERCONNECTOR

SURVEY DATA

Survey Routeing to Avoid Sensitive Habitat Post NRW Consultation

Drawing No: P1975-SURV-012 | **A**



Legend

- Greenlink Route Centreline (Indicative)
- Route A Rev 1
- Route E Rev 1

N W E S

BIOTOPE CLASSIFICATION

- A5.44 - Circalittoral mixed sediments
- A4.13 - Mixed faunal turf communities on circalittoral rock
- A4.131 - Bryozoan turf and erect sponges on tide-swept circalittoral rock
- A4.22 - Sabellaria reefs on circalittoral rock
- A4.24 - Mussel beds on circalittoral rock
- A5.14 - Circalittoral coarse sediment
- A5.25 - Circalittoral fine sand
- A5.45 - Deep circalittoral mixed sediments
- A5.611 - Sabellaria spinulosa on stable circalittoral mixed sediment
- Potential AnnexI (1170) - Bedrock Reefs
- Potential Annex I (1170) - Biogenic Reef
- Potential Annex I (1170) - Low Graded Biogenic Reef
- Potential Annex I (1170) - Stony Reefs

Survey Bathymetry
Depth Below LAT (m)

High : 60.55

Low : 32.97

NOTE: Not to be used for Navigation

Date	Wednesday, April 10, 2019 09:44:20
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	OSOD; MMT; Greenlink
File Reference	J:\P1975\Mxd\02_SURV\ P1975-SURV-012.mxd
Created By	Chris Goode
Reviewed By	Chris Carroll
Approved By	Anna Farley

Co-financed by the European Union Connecting Europe Facility

intertek

3.3 Submarine cable route description

The submarine cable corridor derived from preliminary cable route engineering, consultation with stakeholders and survey is shown in Figure 1-2 (Drawing P1975-CORR-001). Kilometre points (KPs) have been assigned to the route running from KP0 at MHWS, Freshwater West, Wales to KP159.27 at MHWS, Baginbun Beach. The Proposed Development therefore runs from KP0 (landfall) to KP73.8 (UK/Ireland median line).

The Proposed Development is generally 500m wide. The final cable configuration will only need a small part of this width for installation (of the order of 10-20m). It is proposed to finalise the precise position of the submarine cables within the corridor after permits are granted but before installation has commenced. This will allow for optimisation of the final laid submarine cables to minimise engineering and environmental challenges.

It is likely that cables will be bundled together as a pair with no separation between the cables.

3.4 Project schedule

The programme for the commencement of installation has not yet been agreed but for a scheme of this size to be constructed it is expected to take approximately 36 months from start to finish. The Proposed Development is envisaged to commence on-site construction in late 2020 and be fully operational in 2023. Table 3-2 presents an indicative programme of marine works for Greenlink.

In general installation in European waters are undertaken in the summer season, broadly between April and October. This period is determined primarily by the high probability of adverse weather occurring outside of this period. The schedule will also be affected by factors such as, the availability of cable, the delivery of cable, other commitments of the installation contractor, and any Project Specific Mitigation proposed by the HRA and environmental impact assessment (EIA) process.

Table 3-2 Indicative programme for marine works

Activity	Duration (months)	2021				2022			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Landfall preparations - Ireland*	3								
Landfall preparations - Wales*	5								
Pre-lay survey	1								
Route preparation	1								
Cable lay & burial	3								
External cable protection installation	1								

* Sequencing of landfall preparation works may change

3.5 Pre-installation works

3.5.1 Survey requirements

Although detailed engineering surveys have been completed for the proposed submarine cable corridor (autumn 2018 – spring 2019), further surveys will be completed prior to the commencement of cable installation. This typically takes place 3-6 months ahead of installation.

The primary objective of these surveys is to confirm that no new obstructions have appeared on the seabed since the detailed engineering surveys, and to complete a unexploded ordnance (UXO) clearance survey. The survey will involve a range of standard geophysical survey techniques such as multi-beam echosounder (MBES), side scan sonar (SSS), sub-bottom profiler (SBP) and magnetometer.

3.5.2 Route preparation

Prior to the start of marine cable installation, it is essential to ensure the proposed centreline is clear of obstructions that may hinder the installation works. A pre-lay grapnel (a wire with a string of specially designed hooks) will be towed along the entire route to remove any debris.

For areas with large stones and/or boulders along the route, there may be a requirement to move these objects out of the way (if they cannot be avoided) so that the marine equipment can operate. To prepare a clear path for the cable to be laid and buried, a plough will be towed across the seabed, pushing the boulders to both sides. A swathe of between 5 and 10m width will be cleared of surface boulders. Areas identified as potentially requiring boulder clearance are presented in Table 3-3.

Table 3-3 Indicative route lengths potentially requiring boulder clearance

Indicative KP	Approximate length (km)	EUNIS Biotope present	Annex I habitat present
KP11.3 to KP12	0.7	A5.451 - Polychaete-rich deep Venus community in offshore mixed sediments	No
KP15 to KP22	7.0	A5.141 - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Annex I - Medium grade stony Reef
KP20.5	0.1	A5.141 - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Between two areas of Annex I - Medium grade stony Reef
KP24.9 to KP25.5	0.6	A5.142 - *Mediomastus fragilis*, *Lumbrineris spp.* and venerid bivalves in circalittoral coarse sand or gravel	No
KP34 to KP34.4	0.4	A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	No
KP53 to KP53.5	0.5	A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	No

Discrete areas of seabed will also require preparatory works known as pre-sweeping. A dredger or mass flow excavator will be used in areas of mobile sandwaves to

remove a portion of the sandwave. This is to allow the cable to be buried relative to a non-mobile reference level below the lowest level of undulations; reducing the risk of the cable becoming exposed through sandwave movement.

No pre-sweeping will be required on the Turbot Bank; a Qualifying Feature of the Pembrokeshire Marine SAC. Table 3-4 presents indicative dimensions for the areas of pre-sweeping. The first location is within the Pembrokeshire Marine SAC, but the second is not within a European site.

Table 3-4 Indicative pre-sweeping requirements

KP start	KP end	Length (m)	Maximum width (m)	Seabed footprint (m^2)	Maximum volume of sediment removed and re-deposited (m^3)
KP25.8	KP26.4	600	20	12,000	96,000*
KP64	KP69	5000	20	100,000	400,000**
* Assumes that 8m of sand (7m trough to crest + 1m for cable burial) will need to be removed across the whole profile. In reality it is likely to be less as the two sand waves are not 7m high across the entire length of the transect. **Assumes that 4m of sand (3m trough to crest + 1m for cable burial) will need to be removed across the whole profile. In reality the removed sand volumes are likely to be less as the sand waves are not the quoted height across the entire length of the transect.					

3.5.3 Route preparation at subsea cable crossing

Greenlink crosses one in-service telecommunications cable, Pan European Crossing 2, within the Proposed Development at KP59.791. Greenlink will cross the cable on a 'bridge' comprised of either aggregate (rock) or concrete mattresses. This first layer of protective material that will be positioned during route preparation. Construction of the remainder of the crossing will occur once the cables are laid, and will consist of a graded rock berm approximately 120m in length, up to 1.2m high, covering an area of 1009m^2. The crossing location lies in sandy sediments classified as EUNIS habitat A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand.

3.5.4 UXO clearance

During route design a UXO desk top study was prepared (1st Line Defence 2018), which describes the risk of encountering UXO's along the cable route. The Proposed Development crosses the Castlemartin Firing Range, and it is extremely likely that UXO's will be found here, making this a high-risk area. Due to this risk, a UXO survey was undertaken of the cable route within the Castlemartin Firing Range, with the results being used to refine the indicative centreline of the cables within the Proposed Development.

The primary objective will be to avoid encountered potential UXO by micro-routeing within the permitted corridor. If re-routeing around a particular potential UXO

appears not to be possible, and visual inspection confirms a UXO, then if it is safe to do so the UXO will be removed. As a last resort demolition measures will be undertaken in accordance with Best Practice.

UXO detonation in the Proposed Development is deemed possible, and for the purposes of this assessment it is assumed that one UXO denotation, up to 794kg in size will be required. This assumption is based on the largest explosive device to have been used historically in the region. It should be noted that this size of magnetic anomaly has not been identified in the 2019 UXO data from Castlemartin Firing Range.

3.6 Cable installation

3.6.1 Installation vessels

The cable lay operation will be performed on a 24-hour basis. It is anticipated that the following vessel types will be required for cable installation:

- Cable lay vessel (CLV) - a specialist ship designed specifically to carry and handle long lengths of heavy power cables. CLV's are equipped with dynamic positioning (DP) systems.
- Jack-up barge (JUB) - a small platform that typically has four to eight legs. It may be used in water depths of less than 10m to support the pull-in of the cables. May be supported by a tug, which would tow it into position.
- Cable lay barge (CLB) – may be used in water depths of less than 10m instead of the CLV.
- Small work boats – support the CLV, CLB and JUB e.g. during cable pull-in operations.
- Guard vessel - where deemed necessary, the CLV, CLB or other vessel operations with restricted vessel manoeuvrability will be accompanied by a guard vessel(s).
- Rock placement vessel – will be used to deposit rock in areas where rock protection is required. Where there are strong currents fall-pipe vessels have a big advantage in that the rock can be more accurately placed.

3.6.2 Cable laying

Two cable installation techniques are being considered for the Proposed Development:

- Simultaneous lay and burial – in this operation the CLV may tow the burial equipment or it is deployed by another vessel navigating close behind, creating effectively a single large spread. The cables are fed into the burial equipment directly from above and the cables are buried as the spread progresses along the route.

- Post-lay burial – in this operation the CLV lays the cables on the seabed first. A post-lay burial vessel follows to bury the cables. The post-lay burial vessel may be some physical distance, or indeed some days, behind the lay vessel, so there are two discrete operations separated physically and in time.

It may be necessary to install the cables in two sections. The end of the installed section will be temporarily left on the seabed whilst the CLV picks up the new cable. Depending on the local situation (i.e. threat levels) the end of the cable may be temporarily buried into the seabed. A ground wire will be attached to the end of the cable to enable retrieval of the end of the cable to allow cable laying to continue.

Cable joints will be made on board the CLV and will take up to a week to complete per joint location. In this time the vessel is likely to anchor to maintain position. Once the cable joint has been made on board the vessel cable laying will continue as normal.

3.6.3 Cable burial and protection

The nature of the seabed varies along the cable route ranging from fine sediments to stony reefs, consisting of pebbles and boulders and bedrock outcrops. Bedrock outcrops are predominantly found relatively close to the Pembrokeshire coastline. The choice of burial technique or protection method will depend upon the seabed conditions in each section. The preference is burial in the seabed as this provides the best protection. Where the seabed composition is not suitable for burial, external mechanical protection will be provided through rock placement or concrete mattresses.

There are three generic types of equipment for installing cables into the seabed:

- Jetting machines – use water jets to fluidise the seabed and allow the cable to sink into the seabed.
- Cable ploughs - like ploughs used in farming, a narrow blade (the plough 'share') is pulled through the seabed to create a furrow.
- Cutting - a trench is cut using a wheel or a driven chain cutter to break and move rock and hard sediments.

A typical trench is up to 1m wide. The overall footprint of the installation machinery is approximately 15m. Whilst jetting is considered to have the least effect on the environment because the footprint of the tool is smaller than other installation tools such as ploughs, the use of jetting tools does result in higher suspended sediment concentrations. However, in a review of seabed disturbance from various activities it was observed that disturbance resulting from jetting was largely restricted to fines and remained low in comparison with dredging and some fishing techniques (BERR 2008).

The recommended target burial depths along the cable length were determined in a detailed Cable Burial study (Intertek EWCS 2019b) using the Carbon Trust cable

burial risk assessment (CBRA) methodology. This concluded the target burial depth is 1.0m for all areas of loose sediment (sands / gravels) and 0.6m for areas of glacial till.

A preliminary assessment of cable installation methods is presented in Table 3-5, and indicative locations where external cable protection may be required is shown in Figure 3-4 (Drawing P1975-INST-005).

Table 3-5 Potential installation method

Cable Protection Option	Length (km)
Burial in sediment (jetting or ploughing)	57.44
External cable protection only (crossing)	0.120
Potential burial in rock or external cable protection	16.34
Total	73.9

3.6.3.2 External cable protection

Approximately 16km of the cable route within the Proposed Development may require either cutting below the base of the sand unit to achieve the required burial depth or external cable protection such as rock or concrete mattresses. External cable protection will also be required at the third-party asset crossing location.

External cable protection is used to protect subsea cables by covering them in a continuous profiled berm of concrete mattresses, graded rock or a combination of the two. The particle size of the rock used will be driven by an assessment of the local seabed geology, metocean conditions, water depth and the nature of the external threat which is being protected against. Engineering design has not yet been completed for the berms but rock sizes are likely to be in the range of 2cm to 22 cm. A filter layer is sometimes required either to provide a stable base in soft sediment for the armour layer to be installed on and/or provide protection to the cable bundle from the impact of the installation of the armour layer. If used, the filter layer would be laid first comprising of smaller particle sizes, followed by larger layer designed to prevent segregation of sediments during placement. The final layer (i.e. the armour layer) covers the other two layers and is designed to provide protection against identified external threats (e.g. anchors and fishing gear) whilst also withstanding severe metocean events.

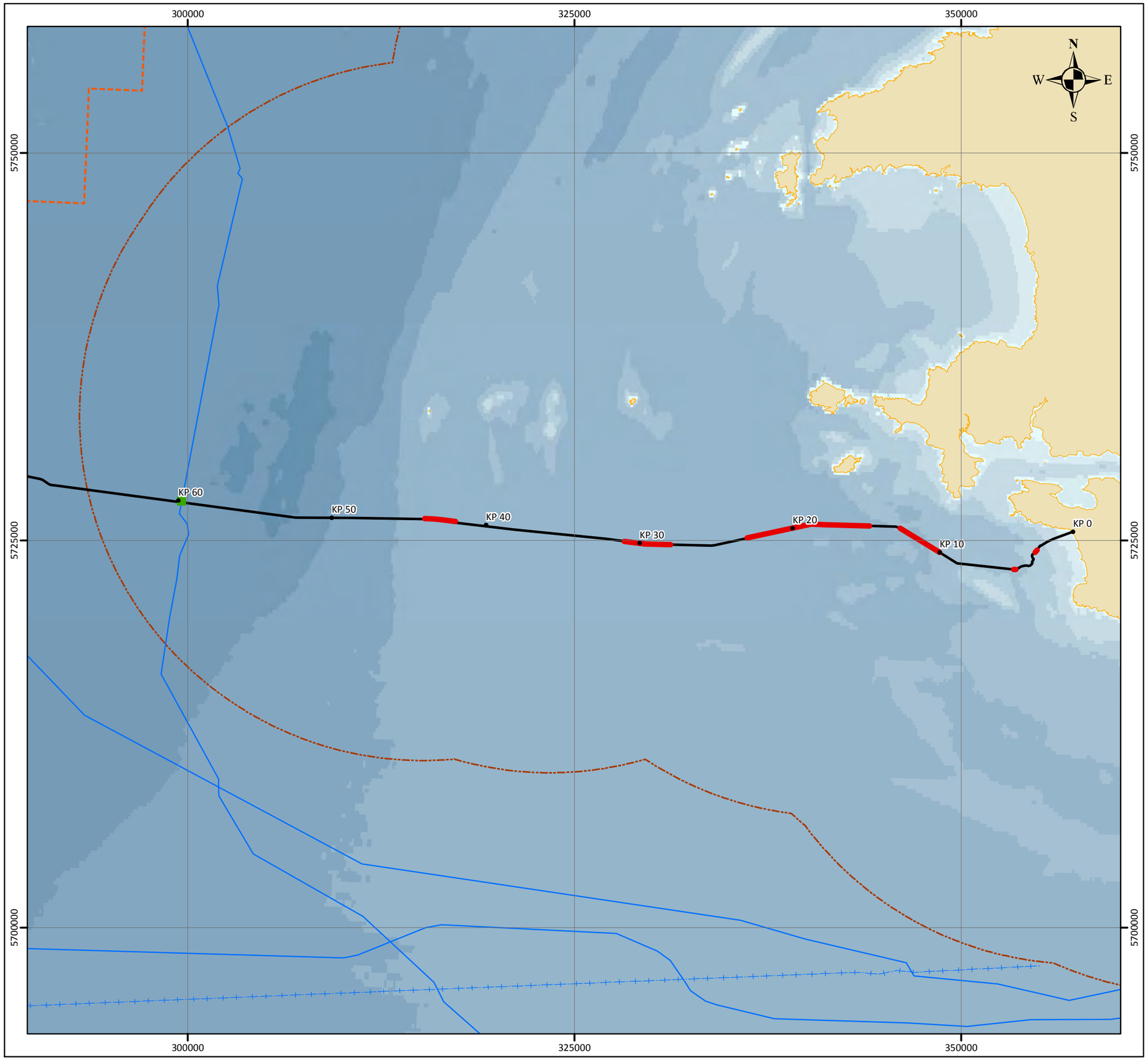
It has been assumed that the maximum height of the berm will be 1.5m, with a crest width of 1.0m. The side slopes of such a berm would be 1 vertical in 2.5 horizontal, which is the natural angle of repose of placed rock. The assessment assumes rock berms for external cable protection will have a maximum width of 10m.

The cable burial risk assessment (Intertek EWCS 2019b), informed by the geophysical and geotechnical survey data, has identified indicative locations where external cable protection may be required. Table 3-6 provides indicative locations

where rock placement could be required due to ground conditions. These locations are shown on Figure 3-3.

Table 3-6 Indicative rock protection locations (due to ground conditions)

KP start	KP end	Distance (km)	Comment	Biotope	Presence of Annex I habitat
2.38	2.41	0.03	Outcrop within sandy channel. Likely to be too tight to route around.	Outcrop is A4.138 - *Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock. Surrounding area is A5.143 - *Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand.	Bedrock Reef
2.7	2.9	0.2	0.3-0.5m cover of sand. May be able to cut down into rock below sand. Protection likely to be 2-3m wide.	A5.143 - *Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand. A5.25 - Circalittoral fine sand	
4.86	5	0.14	Small sand channel identified through bedrock reef confirmed by analysis of video transect data.	A4.138 - *Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock	Bedrock Reef
10	13	3.0	0.4-0.9m layer of sand over hard ground. May be able to cut down into rock below sand.	A5.451 - Polychaete-rich deep Venus community in offshore mixed sediments A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	
15	23	8.0	~0.4 to ~1.2m layer of Sand/Gravel /Clay/Cobble over hard ground. May be able to cut down into rock below sand.	A5.141 - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles A5.14 - Circalittoral coarse sediment	Medium grade Stony Reef
28	31	3.0	~0.3 to ~0.8m Layer of Sandy Gravel over hard ground. May be able to cut down into rock below sand.	A5.27 - Deep circalittoral sand	
42	44	2.0	Vibrocore refusal indicating thin layer of sediment over hard ground. Cone penetrometer test reached a depth of 0.8m	A5.611 - Sabellaria spinulosa on stable circalittoral mixed sediment A5.45 - Deep circalittoral mixed sediments	Potential Biogenic Reef



GREENLINK INTERCONNECTOR

INSTALLATION

Indicative Rock Protection Requirements UK Waters

Drawing No: P1975-INST-005	A

Legend

- KP
- Telecom Cable
- Telecom Cable (Disused)
- 12nm Territorial Sea Limit
- Median Line

Assumed Installation Requirement

- Known Cable Crossing
- Potential External Protection Over Hard Ground
- Assumed Successful Depth of Burial

Bathymetry

Depth below LAT (m)

- -10 - 0
- -20 - -10
- -30 - -20
- -50 - -30
- -80 - -50
- -100 - -80
- -120 - -100
- -145 - -120

NOTE: Not to be used for Navigation

Date	Monday, April 29, 2019 14:06:44
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	KISORCA; UKHO; CDA; OSOD; EMODNET; ESRI
File Reference	J:\P1975\Mxd\15_INST\ P1975-INST-005.mxd
Created By	Chris Carroll
Reviewed By	Chris Goode
Approved By	Anna Farley

Co-financed by the European Union Connecting Europe Facility

intertek

km
0 2 4 6

3.7 Cable landfall

The landfall is where the marine cables come ashore. In Wales, the landfall is located at Freshwater West, Pembrokeshire (illustrated in Figure 1-1 Drawing P1975-LOC-001).

The 'base case' is that shore-crossings will be accomplished by horizontal directional drilling (HDD) which will exit seaward of the low water mark. There will be no works on Freshwater West between MHWS and mean low water.

The landfall will be prepared in advance of the arrival of the CLV, so that the vessel is not delayed in its operations. This will involve the digging of transition joint pits (TJPs) above MWHS and the installation of cable ducts using HDD from the TJP to an exit point below mean low water.

3.7.1 HDD compound and TJPs

The HDD compound, from which drilling will take place, will be sited above MHWS as shown in Figure 3-4.

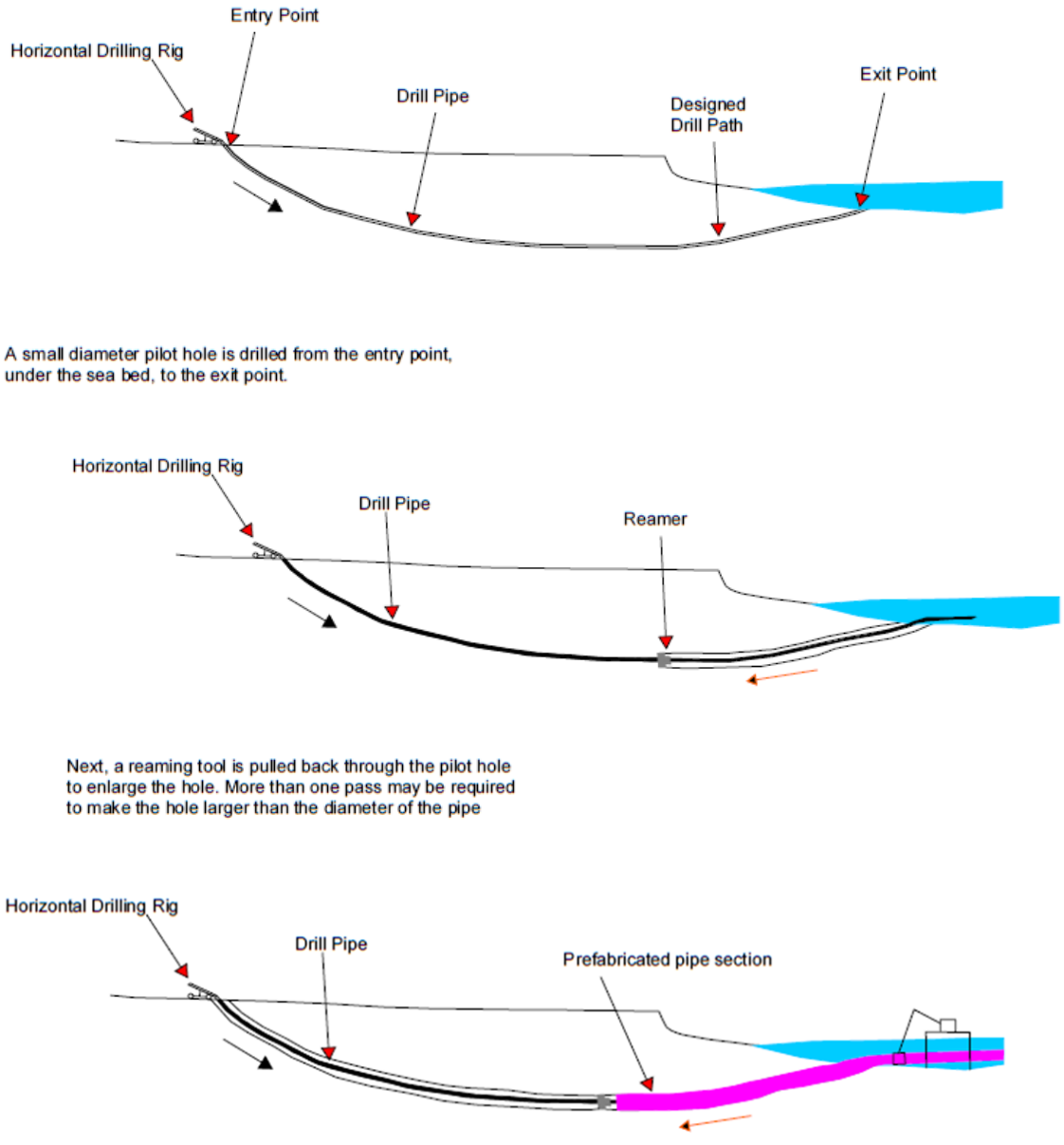
The land cables will connect with the marine cables in a TJP, buried in the ground within the area used for the HDD compound. Up to two TJPs will be dug. Each bay will be 10-15m long, 2-3m wide and 2-3m deep below ground level; covering a maximum area of 45m^2 per TJP.

Figure 3-4 Indicative location of HDD compound – Freshwater West

3.7.2 Installation of ducts - horizontal directional drilling (HDD)

HDD is a surface-launched process for boring a hole, under any sensitive features, to a point a suitable distance in the nearshore. A pipe is inserted into the drilled hole which is used as a duct into which the cables are installed. Figure 3-5 illustrates a typical shore to sea bore.

Figure 3-5 Typical HDD



The cable ducts will pass approximately 10m below the beach.

Three ducts will be drilled; two for use and one as a spare. The fibre optic cable will be installed in a duct with one of the power cables. The ducts will fan out of the TJP to achieve exit points for the marine cables in the nearshore, with a separation distance of approximately 10m. From the exit point the cables will then merge back together, usually within 100m to form the bundle.

3.7.3 HDD exit point

Preliminary design of the HDD has been undertaken, but the final design will be completed by the Installation Contractor. Based on the geological conditions at Freshwater West, the HDD is likely to exit within the orange hatched box presented in Figure 3-6 (Drawing P1975-INST-001).

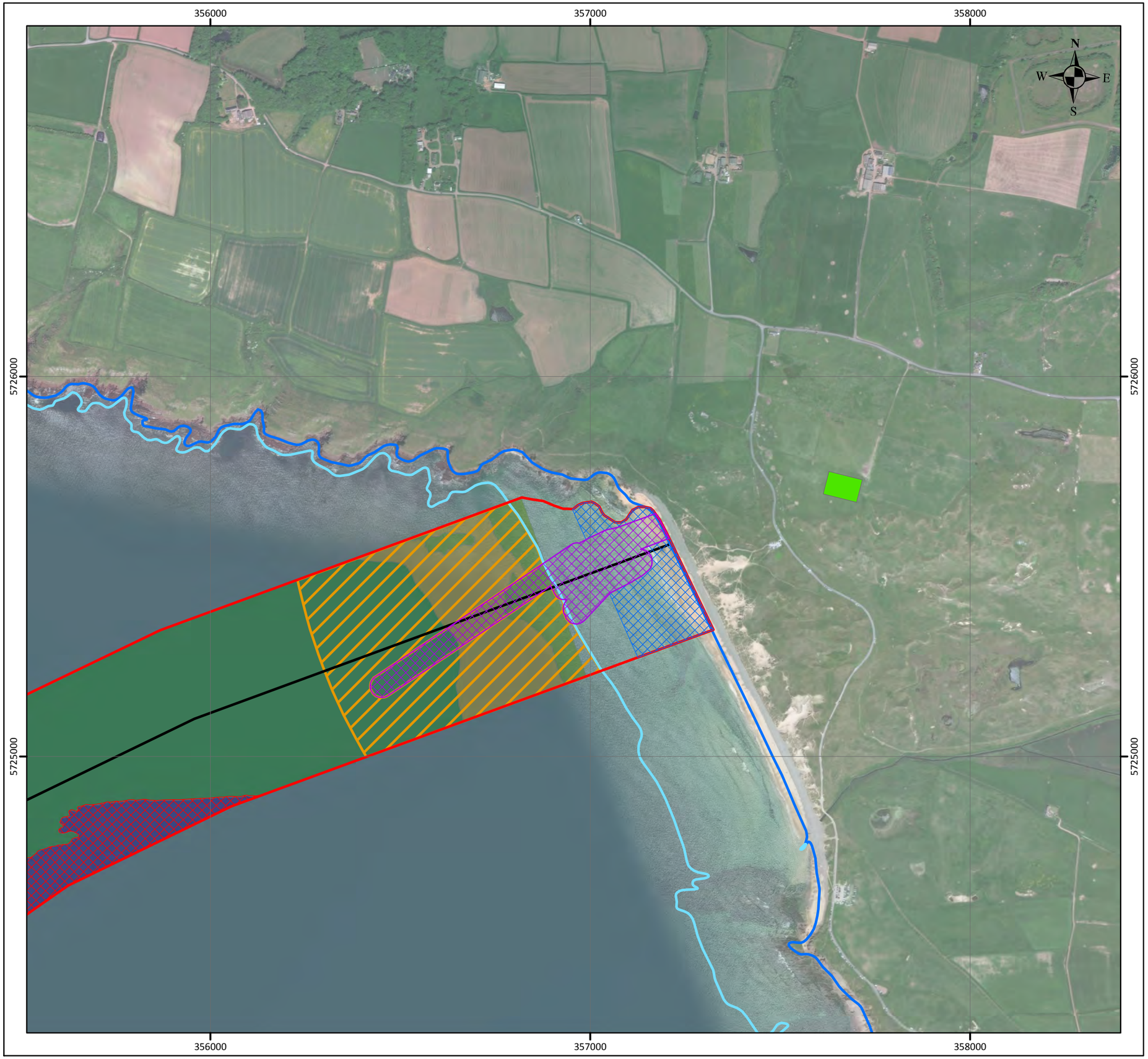
3.7.4 Marine cable installation at landfall

The installation sequence for each of the submarine cables and the fibre optic cable is likely to be similar, and will be defined by the Installation Contractor. An indicative methodology is provided below:

- The end of the duct accepting the cable will be dug out using an excavator positioned on a jack-up barge or anchored barge.
- Material excavated will be left adjacent to the HDD exit point and refilled after the cable pull-in. The submarine cable would be floated to the exit point of the duct. Small work boats and divers would support this activity.
- The submarine cable would then be connected to the messenger wire pre-installed in the duct and winched from a position close to the TJP through the duct; whereupon it can be jointed to the onshore cables.
- The cable is then installed away from the beach either using a plough or trencher (as per the offshore installation section above).

No works would be required on the beach.

As marine operations are dependent on weather conditions, offshore and nearshore installation work will be conducted on a 24-hour basis.



GREENLINK INTERCONNECTOR

INSTALLATION

Indicative HDD Exit Point - UK Landfall

Drawing No: P1975-INST-001	A

Legend

- Greenlink Route Centreline (Indicative)
- Proposed Development
- High Water Mark
- Low Water Mark
- Decommissioned MOD Cable Avoidance Zone
- HDD Compound
- Indicative HDD Exit Point
- Trenching Exclusion Zone
- Annex I Habitat Exclusion Zone

EUNIS Habitat Classification

- A4.138
- A5.13
- A5.24
- A5.261

NOTE:

No trenching to be carried out in exclusion zones.

NOTE: Not to be used for Navigation

Date	Thursday, June 6, 2019 13:48:42
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	OSOD; MMT; ESRI; Greenlink
File Reference	J:\P1975\Mxd\15_INST\ P1975-INST-001.mxd
Created By	Chris Goode
Reviewed By	Chris Carroll
Approved By	Anna Farley

Co-financed by the European Union Connecting Europe Facility

0 100 200 300 400 m

3.8 Cable operation

3.8.1 Emissions

During operation of the cables emissions to the environment will consist of magnetic (B) and induced electric (iE) fields and heat. The influence of Greenlink on the background geomagnetic field along the cable route has been calculated to be low with B and iE fields dissipating to natural background levels within 2m of the cables.

Temperature increases in the upper sediments of the seabed over buried cables are not expected to emanate further than 1m from the cable and exceed 2°C.

3.8.2 Maintenance and repair

It is likely that routine inspection surveys using standard geophysical survey equipment and/or remotely operated vehicles to monitor buried depth and integrity of rock berms will be undertaken, particularly in the initial years of operation, and should the local environmental conditions change or be suspected as having changed.

Once installed, marine cables are not expected to require routine maintenance. If a cable fault is detected, usually as a consequence of damage cause by external interaction e.g. trawlers and commercial ship anchors, the relevant section of the cable will be located and retrieved to surface for inspection and replacement. It may be necessary to de-bury the cable prior to cable recovery. A repair will typically be carried out by a single vessel. A shallow water repair, in less than 10m of water, will typically be made using an anchored barge. In deeper water a dynamically positioned cable vessel will be used. As the fault location may be uncertain up to 1km has been allowed for as a replacement length. The extra length of a repaired short cable section means it cannot be returned to its exact previous alignment on the seabed. The excess cable will be laid on the seabed in a loop off to one side of the original route. The additional joints and the extra cable length will be buried, typically using jetting machines deployed from either the repair vessel itself or a separate specialised vessel.

The Proposed Development includes 5 discrete cable repairs, each 1km in length and assumes as a worst case the external cable protection up to 10m wide will be required to protect the new section of cables if they cannot be buried into the sediment.

3.9 Decommissioning

GIL recognise the importance of considering the decommissioning process at an early stage and should decommissioning be undertaken the operation will be conducted according to the standard industry protocol at the agreed time.

At the end of the cable's life the options for decommissioning will be evaluated.

The objectives during the decommissioning process will be to minimise both the short- and long-term effects on the environment whilst making the sea safe for others to navigate. Based on current regulations and available technology, the following level of decommissioning is proposed and has been assessed:

- Cables - to be either removed or to be left safely in-situ, buried to below the natural seabed level
- Mattresses - to be left in-situ
- Rock protection - to be left in-situ

The HRA assesses the worst-case environmental effects which could either be full removal or leaving in-situ depending on the receptor.

3.10 Embedded mitigation

Greenlink has been developed through an iterative process that sought to avoid or reduce potential environmental effects. Steps taken to reduce environmental disturbance include:

- Sensitive environmental features were identified through a desk-based assessment that used publicly available datasets and survey data acquired from other developers in the region.
- Nearshore sections of the route in Wales were refined to follow identified sand channels through the bedrock reef habitat.
- Three possible routes through the Pembrokeshire Marine SAC were designed for further investigation (see Section 3.2.3). NRW was consulted on the routes and survey strategy.
- A reconnaissance survey was undertaken on two route options (Route A & Route E) through the SAC to identify areas of Reef habitat. NRW reviewed preliminary survey results.
- In consultation with NRW, a new route option was engineered between Route A and Route E that sought to avoid a greater majority of the sensitive habitats in the area. This route is the Proposed Development.
- Geophysical survey was widened to investigate previously unknown sand channels and route engineered to make use of this feature.

In addition, to the route engineering that has taken place, the project will comply with international and national statute which is designed to avoid or abate negative environmental effects.

Embedded mitigation which forms part of the design of Greenlink and is considered the 'base case' is outlined in the Greenlink Marine Environmental Statement (ES). Table 3-6 presents extracts relevant to avoiding or reducing negative environmental effects on European sites. The ID column has been retained from the ES for cross-referencing purposes.

Table 3-7 Embedded mitigation

ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM6	Ballast water discharges from Project vessels will be managed under the International Convention for the Control and Management of Ships' Ballast Water and Sediments standard.	■	■	■
EM8	The latest guidance from the GB non-native species secretariat (2015) will be followed and a Biosecurity Plan produced pre-installation.	■		
EM13	The preference is to use HDD for the cable landfalls to avoid disturbance of sensitive habitats (e.g. dune system) and disruption on beaches.	■		
EM14	Route engineering was undertaken during the marine survey to avoid sensitive habitats where possible or to reduce the distance the submarine cable corridor crosses a sensitive feature.	■		
EM15	Submarine cables will be bundled together, which reduces the seabed footprint of installation activities and the electromagnetic field generated during operation, thus minimising any potential compass deviation effects.	■	■	
EM18	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed.	■	■	■
EM19	Project vessels will not exceed 14 knots within the Proposed Development.	■	■	■
EM20	GIL will require that the appointed contractor(s) follows the 'JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys' (JNCC 2017a) (or subsequent amendments), appropriate to sub-bottom profiling and multi-beam and echo-sounder surveys respectively. In particular: • Establishing a 500m mitigation zone for marine mammal observation. • Provide non-dedicated marine mammal observers to implement the JNCC guidelines within the Pembrokeshire Marine / Sir Benfro Forol SAC and West Wales Marine / Gorllewin Cymru Forol SAC. • Undertake pre-survey search - On-board marine mammal observer will scan the waters surrounding the vessel for 30 minutes before operations start to determine whether any marine mammals are within 500m of the survey equipment. • Where possible, according to the operational parameters of the equipment concerned, its acoustic energy output shall commence from a lower energy start-up and thereafter be allowed to gradually build up to the necessary maximum output over a period of at least 15 minutes, with the duration from the start of the soft start until the start of the survey line being a maximum of 25 minutes. • If the device cannot be ramped up then it shall be switched on and off in a consistent sequential manner over a period of 20 minutes prior to commencement of the full necessary output.	■	■	■
EM21	A UXO survey will be undertaken less than 6 months prior to installation works commencing. If any significant UXO are identified the following decision making process will be followed: 1. Avoid by micro-routeing the marine cables. 2. If it cannot be avoided, consider whether it is safe to move. 3. If it cannot be moved, detonate on site.	■		

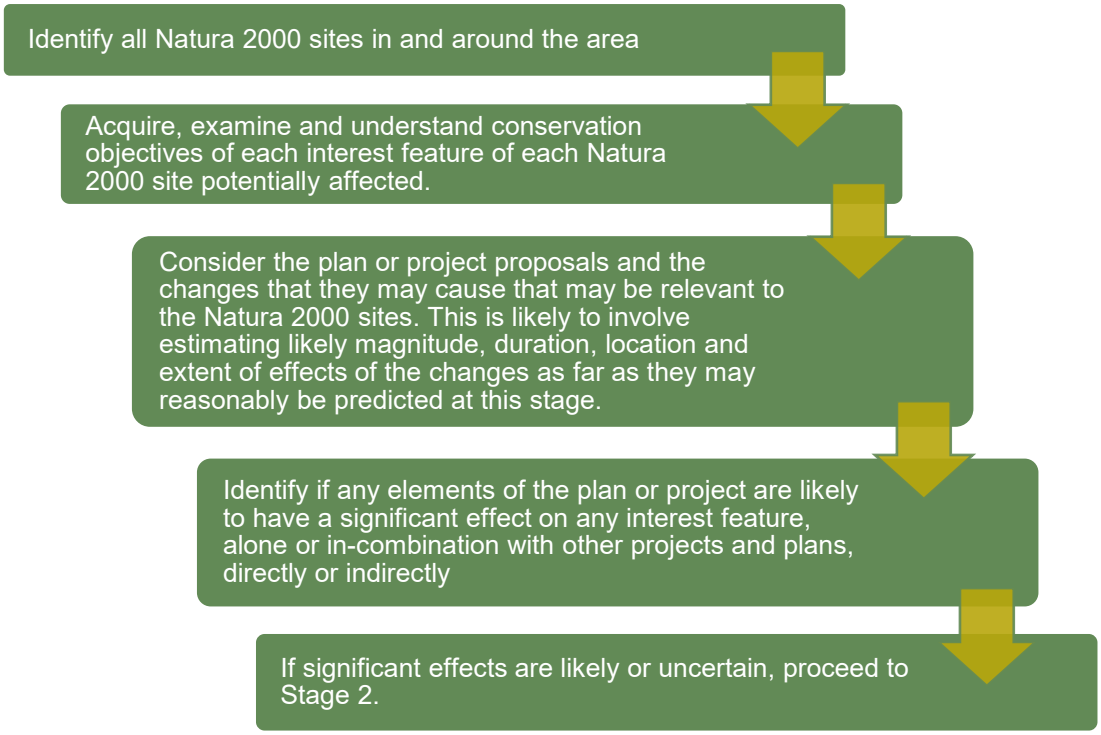
ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM23	GIL will require that the appointed UXO contractor follows the JNCC guidelines for minimising the risk of injury to marine mammals from using explosives (JNCC 2010, or as updated) including: • Establishing a default 1km mitigation zone for marine mammal observation, measured from the explosive source and with a circular coverage of 360 degrees. • Providing a trained marine mammal observer to implement the guidelines outlined in Section 2.1 to 2.4 e.g. pre-detonation search of mitigation zone. • Only commence explosive detonations during daylight hours and good visibility. • Accurately determine the amount of explosive required for the operation, so that the amount is proportionate to the activity and not excessive. • If necessary, plan the sequence of multiple explosive discharges so that, wherever possible, the smaller charges are detonated first to maximise the 'soft-start' effect.			
EM26	Post-installation inspection surveys will be conducted along the length of the cables on a regular basis.			
EM29	Rock and mattresses will only be deployed where adequate burial cannot be achieved. The footprint of the deposits will be the minimum required to ensure cable safety and rock berm stability.			
I = Installation; O = Operation (including repair & maintenance); D = Decommissioning				

4. Stage 1 – Appropriate Assessment Screening

4.1 Assessment Approach

This AA screening has been undertaken according to the process set out in Welsh Government (2017) guidance, as illustrated in Figure 4-1. It has taken into account all case law relevant to the Habitats Directive summarised in the recently issued EC Guidance (November 2018).

Figure 4-1 HRA Screening Process



4.2 Identification of relevant European sites

The potential for a European site to be significantly affected depends on whether receptors which are designating features of a European site:

a. Can come into contact with the Proposed Development; and

b. Are sensitive to the Proposed Development activities to the extent that the activity is likely to have an adverse effect on the conservation objectives for the features.

Identifying relevant European sites has therefore been achieved by applying the following steps:

2. Identify the potential pressures the Proposed Development could have on these receptors and what the zone of influence for these receptors is, i.e. the spatial extent over which effects could extend (Section 4.2.1.2)
3. Using the zones of influence as a guide define a search area within which European sites are screened for the relevant Qualifying Feature (Section 4.2.3.2); and
4. Screen SACs, SPAs, and Ramsar sites within the defined search areas to identify designating features and assess whether interest features of the site could be significantly affected by the Proposed Development (Section 4.2.3.3).

4.2.1.1 Identification of sensitive receptors

The receptors which could potentially be affected by the Proposed Development and could be the designating interest features of European sites are:

- Subtidal habitats;
- Fish;
- Birds; and
- Marine mammals (cetacean, pinniped and otter).

4.2.1.2 Defining a search area (identification of potential pressures and zone of influence)

The OSPAR Intercessional Correspondence Group on Cumulative Effects (ICG-C) pressure list and descriptions (OSPAR Commission 2011) have been used to describe the potential pressures expected from the Proposed Development. Listed in Table 4-1, these potential pressures may be direct or indirect, temporary or permanent, beneficial or harmful to the site, or a combination of these. The zone of influence – spatial extent over which effects may be extend – has also been defined.

Repair and maintenance activities during the operational phase, where required, will result in similar pressures to those described in respect to installation activities, but on a smaller and more local scale. Therefore, they have been considered alongside installation pressures.

The zone of influence has been used to establish a search area within which European sites are screened for the relevant Qualifying Feature. Since mobile species from conservation sites further field may travel into the zone of influence, the zone of influence cannot be used alone as a distance to screen in relevant conservation sites. Therefore, search areas (distances from the Proposed Development) for each receptor group have been applied taking into consideration other information such as marine mammal management units and expert judgement to use for the initial screening of sites. Justification for the spatial extent of the search area is provided in Table 4-1.

Table 4-2 identifies the pressures that have been scoped out of the HRA and the reason for the exclusion. These pressures will not be discussed further.

Table 4-1 Potential pressures, zones of influence and European site search area

Receptor	Phase	Potential Pressure	Aspect of Proposed Development	Zone of influence	Search area and justification
Habitats	Installation (including repair & maintenance) Decommissioning	Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Pre-sweeping	100m wide	Proposed Development Jetting and pre-sweeping will result in a brief, localised sediment plume. Levels of suspended sediments will be rapidly dilute within the Proposed Development and will be within the range of natural variation experienced after winter storm events in the region.
			Seabed preparation. Cable burial. Cable removal.	20m wide	
			Anchor placement	Proposed Development	
		Siltation rate changes, including smothering (depth of vertical sediment overburden)	Pre-sweeping, Cable burial. Cable removal.	100m wide	
		Hydrological changes (inshore/local)	External cable protection	Freshwater West	
		Physical change (to another seabed type)	External cable protection	10m wide	
Birds	Installation (including repair & maintenance) Decommissioning	Visual disturbance	Project vessels Welsh Onshore works e.g. at HDD compound	Radial distances 4km divers and sea ducks+ 2km all other species+	10km It is recognised that some seabirds from other SPAs will forage and loaf in zone of influence. However, disturbance will be limited in extent and duration and there is sufficient space in the surrounding environment for birds to temporarily relocate. Therefore, only sites within 10km of the Proposed Development have been screened.
Fish	Installation (including repair & maintenance) Decommissioning	Underwater noise changes*	Continuous sound from geophysical survey	2.2km radial distance	40km Although the greatest zone of influence is 6.2km, there is the potential that underwater noise changes could also impede migration to and from rivers. Therefore, the
			Continuous sound from cable installation, cable removal and vessels	50m radial distance	
			Impulsive sound - UXO detonation	6.2km radial distance	

Receptor	Phase	Potential Pressure	Aspect of Proposed Development	Zone of influence	Search area and justification
	Operation	Electromagnetic changes	Cables	2m radial distance	search area has been extended to 40km.
Cetacean and otter	Installation (including repair & maintenance) Decommissioning	Underwater noise changes*	Continuous sound from geophysical survey	2.6km radial distance	Management Unit** In recognition of the highly mobile nature of cetaceans the relevant species management unit will define the search area.
			Continuous sound from cable installation, cable removal and vessels	130m radial distance	
			Impulsive sound - UXO detonation	54km radial distance	
	Operation	Electromagnetic changes	Cables	2m radial distance	
Pinniped	Installation (including repair & maintenance) Decommissioning	Underwater noise changes*	Continuous sound from geophysical survey	130m radial distance	100km grey seal It is estimated that grey seal forage up to 100km from their haul out sites (DECC 2016) 50km harbour seal Harbour seal are not known to make trips greater than 50km from haul out sites (DECC 2016)
			Continuous sound from cable installation, cable removal and vessels	2.6km radial distance	
			Impulsive sound - UXO detonation	54km radial distance	

* Zones of Influence for underwater noise changes have been taken from the Greenlink Marine ES – Wales Technical Appendix D – Underwater Sound Modelling (Intertek EWCS 2019a) and are based on the largest UXO device historically used in the area; a sea-mine of 794kg.

** Most cetaceans are wide-ranging, and individuals encountered within Welsh waters form part of a much larger biological population whose range extends into adjacent jurisdictions. As a result, management units (MUs) have been outlined for seven of the common regularly occurring species following advice from the Sea Mammals Research Unit (DECC 2016) and the International Council for the Exploration of the Sea (ICES). These provide an indication of the spatial scales at which impacts of anthropogenic activities should be taken into consideration.

+ Based on the extent and potential consequences of seabird displacement from offshore wind farm developments published by the UK Joint Statutory Nature Conservation Bodies (JNCC 2017b).

Co-financed by the European Union
Connecting Europe Facility

Table 4-2 Pressures scoped out and the reason for exclusion

Pressure Scoped Out of EIA	Receptor	Reason for Scoping Effect out of the ES
Hydrocarbon and PAH contamination	All receptors	Unplanned events (accidental oil or chemical spills) have been scoped out of the ES for the following reasons: • The likelihood of a large oil spill occurring from a Project vessel is extremely low and the risk is no greater than that for any other vessel in the Proposed Development's area. • All Project vessels will have control measures and shipboard oil pollution emergency plans (SOPEP) in place and will adhere to MARPOL Annex I requirements. • A Construction Environmental Management Plan (CEMP) and an Emergency Spill Response Plan will be developed and implemented for the installation phase. Execution of these plans will ensure that the risks associated with an unplanned event will be effectively managed in line with relevant international and national statute.
Temperature changes - local	Habitats Fish	When cables are in operation, localised heating of the environment may occur surrounding the cables (i.e. sediments including interstitial water, where cables are buried, rock berms/concrete mattresses when cable protection employed). Seawater temperatures within the Celtic Sea vary seasonally and therefore are likely to accommodate minor localised variations in temperature associated with thermal losses. Impacts on seabed temperature will not have a significant effect. The indirect effects on fish and shellfish have therefore also been scoped out of the HRA.
Penetration and/or disturbance including abrasion	Intertidal habitats Intertidal birds	The preferred method of installation at the landfall is HDD. The HDD will exit below the low water mark and therefore intertidal habitats will not be affected and there will be no indirect effects on birds (e.g. temporary loss of food resource).
Visual disturbance	Fish	The effect could occur during cable installation, as a result of the presence of the installation vessels and equipment (and associated noise) within the vicinity of operations. This could result in the displacement of fish within the water column. The disturbance from installation operations will be short term, localised and not considered likely to be significant given existing background levels of noise and shipping in the St Georges Channel and around Milford Haven. Therefore, this effect has been scoped out of the HRA.
Siltation rate changes including smothering (depth of vertical sediment overburden)	Fish	There are three pathways for species to be smothered as a result of project activities: by displaced sediments during trenching; by the re-deposition of suspended sediment; and by cable protection material being placed on the seabed. The effect from displaced sediment will be very localised, only effecting species in the immediate vicinity of cable trenches. Suspended sediment settlement levels are expected to be minimal with any material deposited likely to be quickly re-suspended and distributed by natural hydrodynamic processes. Therefore, this aspect of the effect on fish and shellfish has been scoped out of the HRA. The suspension of sediments within the water column from cable installation may cause small, localised and temporary turbidity before being re-deposited on the seabed. A temporary reduction in the feeding capability of species relying on sight to locate their prey may occur. Most species are likely to be tolerant to any changes in turbidity levels (likely to be equivalent

Pressure Scoped Out of EIA	Receptor	Reason for Scoping Effect out of the ES
		to those experienced during storm events) and the significance of the effect is likely to be negligible. Therefore, this aspect of the effect on fish and shellfish has also been scoped out of the HRA. The effects of depositing cable protection material will be assessed.
Death or injury by collision	Marine mammals	Although shipping collision is a recognised cause of basking shark and marine mammal mortality worldwide, the key factor influencing the injury or mortality caused by collisions is ship size and speed. Ships travelling at 14 knots or faster are most likely to cause lethal or serious injuries. Although the presence of the cable lay vessels and support vessels will marginally increase the level of vessel activity within the area for the duration of the marine works, none of the Proposed Development's vessels will be travelling at speeds exceeding 14 knots. Cable lay vessels move along the cable route at the rate of cable installation, approximately 100-300m per hour depending on sediment conditions, resulting in a low likelihood of collision. Given that vessels will be operating at less than 14 knots, the effect is scoped out of the HRA as it is not likely to be significant.
Light	Birds	NRW Scoping Opinion SC1816 noted "Consideration should be given to the impacts of lighting at any stage of the project on Manx shearwater, a feature of the Skomer, Skokholm and the Seas off Pembrokeshire SPA." The necessity of scoping in the pressure was queried on the grounds that: • The Proposed Development lies 3.13km south of Skokholm. Where the Proposed Development is close to the islands it is within an area of moderate to high shipping density. This is the main route for the Pembroke to Rosslare ferry amongst other vessels transiting to and from Milford Haven. • The Proposed Development is to the south of the known rafting areas of manx shearwater. • Both manx shearwater and puffin score low for susceptibility to disturbance on the Joint SNCB Interim Displacement Advice Notice (2017). • The cable lay vessel will be progressing very slow along the route; effectively stationary in terms of bird displacement. it is a 24-hour continuous operation and would progress through the SPA. • The introduction of the cable lay vessel will be within the day-to-day variation of ship numbers in the area. Birds in the region are habituated to the shipping levels and the cable lay vessel will not significantly increase this. NRW agreed that the pressure could be scoped out on the grounds that "The Conservation Objectives for the SPA call for "The breeding population of Manx shearwater should be stable or increasing with no measured decrease in numbers (based on a population count of 150,968), based on annual study plots. The current population for Manx shearwater is estimated at just under 300,000 individuals. This is the lowest conservative estimate (there are differences in counting methods). Therefore the population is doing well and we [NRW] don't consider that the presence of one ship, carrying out the activities proposed …, has the potential to have a significant effect on population numbers." (Pauls, L. 04/04/2019 [email])

4.2.1.3 Screening of European sites

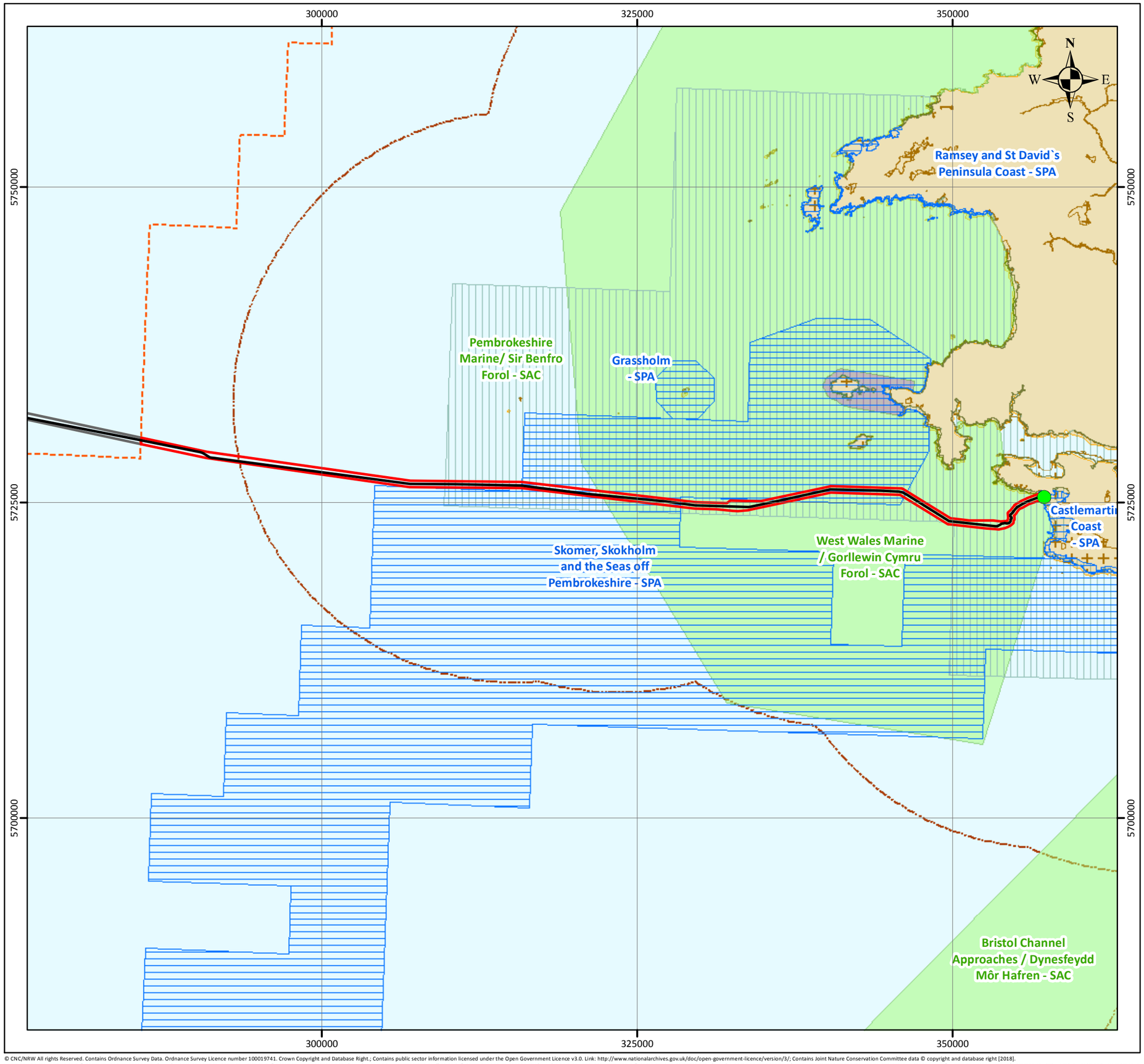
A geographic information system (GIS) was used to map the boundaries of European sites in relation to the Proposed Development. All conservation sites with marine components which are within the defined search area distance for identified receptors have been listed along with their qualifying features. Figure 4-2 (Drawing (P1975-PROT-001) shows the sites crossed by the Proposed Development.

A total of 12 European sites were screened in this assessment and are shown in Table 4-3. In addition, 12 SSSIs and 1 MCZ were also screened and are shown in Table 4-4.

For each site it was determined whether there is the potential for an interaction between the Proposed Development and the Qualifying Features i.e. whether there is a pressure-receptor pathway. This is determined by comparing information such as the extent of the zone of influence with information regarding the conservation feature e.g. species foraging distances, spatial extent of habitats etc. The interactions were defined as follows:

- Possible: A pathway between the Proposed Development and the Qualifying Feature can be identified that is likely to result in an effect; or
- Unlikely: Either a pathway between the Proposed Development and the Qualifying Features cannot be identified or a pathway exists but there is no physical overlap of the pressure and the Qualifying Feature.

For all Qualifying Features where it is determined that there is a possible interaction, the likely significance of the effect is assessed in light of the conservation objectives for the site in Section 4.4.



GREENLINK INTERCONNECTOR

PROTECTED SITES
UK Waters

Drawing No: P1975-PROT-001	A

Legend

- Freshwater West
- Proposed Development
- Irish Offshore
- UK 12nm Territorial Sea Limit
- Median Line

Environmental Designations

- SAC
- SAC - Harbour Porpoise
- SPA
- MCZ
- SSSI

NOTE: Not to be used for Navigation

Date	Monday, April 8, 2019 12:00:50
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	NRW; JNCC; DCCAE; UKHO; CDA; GEBCO; Greenlink
File Reference	J:\P1975\Mxd\08_PROT\ P1975-PROT-001.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Greenlink

Co-financed by the European Union Connecting Europe Facility

intertek

km
0 2.5 5 7.5 10

Table 4-3 Initial screening for relevant European sites

Site Name & Code	Distance	Qualifying feature	Potential Pressure	Likelihood of interaction
Pembrokeshire Marine / Sir Benfro Forol SAC UK0013116	Within	Estuaries Coastal lagoons Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) Submerged or partially submerged sea caves Large shallow inlets and bays Shore dock *Rumex rupestris*	No pressure-receptor pathway	**Screened out** as the Qualifying Features are not within the Proposed Development
		Reefs	Penetration and/or disturbance including abrasion	**Possible** - Cable installation techniques are intrusive and therefore have the potential to disturb the Qualifying features of the site that the Proposed Development crosses.
			Physical change (to another seabed type)	**Possible** - external cable protection will be required within this Qualifying Feature.
			Siltation rate changes	**Unlikely** - Seabed preparation, cable burial and cable removal will cause a brief, localised increase in suspended sediment in the water column with subsequent re-deposition of sediment on surrounding habitats. Calculations presented in Greenlink Marine ES - Chapter 6, indicate that deposition of sand and gravel will be restricted to the footprint of the cable trench equipment (<20m). Although silt will be deposited over a larger area (up to 4.5km from the trench) the layer of deposition will be less than 1mm thick and therefore not measurable above natural levels of turbidity and sediment deposition.
			Hydrological changes	**Unlikely** - Use of external cable protection will cause localised change in seabed topography but due to water depths and distances offshore there will be no effect on coastal processes.
		Sandbanks which are slightly covered by seawater all the time	Penetration and/or disturbance including abrasion	**Possible** - Cable installation techniques are intrusive and therefore have the potential to disturb the Qualifying features of the site that the Proposed Development crosses.

Site Name & Code	Distance	Qualifying feature	Potential Pressure	Likelihood of interaction
			Physical change (to another seabed type)	**Screened out** as external cable protection will not be used within this Qualifying Feature.
			Siltation rate changes	**Unlikely** – Seabed preparation, cable burial and cable removal will cause a brief, localised increase in suspended sediment in the water column with subsequent re-deposition of sediment on surrounding habitats. Calculations presented in Greenlink Marine ES – Chapter 6, indicate that deposition of sand and gravel will be restricted to the footprint of the cable trench equipment (<20m). Although silt will be deposited over a larger area (up to 4.5km from the trench) the layer of deposition will be less than 1mm thick and therefore not measurable above natural levels of turbidity and sediment deposition.
Pembrokeshire Marine / Sir Benfro Forol SAC UK0013116	Within	Sandbanks which are slightly covered by seawater all the time	Hydrological changes	**Screened out** – external cable protection will not be used within this Qualifying Feature and therefore there is no pathway for hydrological changes
		Mudflats and sandflats not covered by seawater at low tide	Physical change (to another seabed type)	**Screened out** as external cable protection will not be used within this Qualifying Feature.
			Siltation rate changes	**Screened out** as there will be no intrusive works within the intertidal area.
			Hydrological changes	**Possible** - Installation of external cable protection has the potential to affect coastal processes effecting the beach at Freshwater West.
		• Grey seal Halichoerus grypus • Otter Lutra lutra	Underwater noise changes	**Possible** – Greenlink Marine ES Wales - Technical Appendix D concluded that underwater noise could cause temporary injury or disturbance.
			Disturbance (visual)	**Possible** - Disturbance will be limited to that initiated by the movement of the project vessels.
		• Allis shad Alosa alosa • Twaite shad Alosa fallax	Underwater noise changes	**Possible** - Greenlink Marine ES Wales - Technical Appendix D concluded that underwater could disturb cause temporary injury or disturbance.
			Electromagnetic changes	**Unlikely** – effects of EMF will be not be measurable above natural background levels within 2m of the cables. The slight elevation in field strength will not inhibit migration to or from rivers.

Site Name & Code	Distance	Qualifying feature	Potential Pressure	Likelihood of interaction
		• Sea lamprey Petromyzon marinus • River lamprey Lampetra fluviatilis	Underwater noise changes	**Unlikely** – Sea lamprey are not hearing specialist fish species and it is unlikely that they will be effected by underwater noise changes.
			Electromagnetic changes	**Unlikely** – effects of EMF will be not be measurable above natural background levels within 2m of the cables. The slight elevation in field strength will not inhibit migration to or from rivers.
Skomer, Skokholm and the seas off Pembrokeshire /Sgomer, Sgogwm a moroedd Penfro SPA UK9014051	Within	Breeding birds: • Red-billed chough Pyrrhocorax pyrrhocorax • European storm petrel *Hydrobates pelagicus* • Migratory species (breeding): • Lesser black-backed gull *Larus fuscus* • Manx shearwater Puffinus puffinus • Atlantic Puffin Fratercula arctica • Seabird assemblages - Regularly supports at least 20,000 seabirds in any season.	Disturbance	**Possible** – It is possible that breeding and migratory birds from this site could be disturbed by cable installation activities.
		• Short-eared owl *Asio flammeus*	No pressure-receptor pathway	**Screened out**
West Wales Marine / Gorllewin Cymru Forol SAC UK0030397	Within	• Harbour porpoise (*Phocoena phocoena*)	Underwater noise changes	**Possible** - Greenlink Marine ES Wales - Technical Appendix D concluded that underwater noise could cause temporary injury or disturbance.
Castlemartin Coast SPA	Within	Breeding bird and over winter:	Disturbance	**Possible** - Disturbance is predicted to be limited to that initiated by the movement of the project vessels. Although chough are terrestrial birds and do not use the

Site Name & Code	Distance	Qualifying feature	Potential Pressure	Likelihood of interaction
UK9014061		• Red-billed Chough		marine environment for foraging, they nest in the sea cliffs along this stretch of coast and may forage close to the landfall area.
Limestone Coast of South West Wales Arfordir Calchfaen de Orllewin Cymru SAC UK0014787	Within	• Dune grassland • Caves (terrestrial and sea) • Dry heaths • Early gentian Gentianella anglica • Petalwort Petalophyllum ralfsii • Greater horseshoe bat • Dry grasslands and scrublands on chalk or limestone • Vegetated sea cliffs	No pressure-receptor pathway identified	**Screened out** as Proposed Development will not interact with these features.
Grassholm SPA UK9014041	8.55	• Regularly occurring migratory species (breeding): • Gannet Morus bassanus	Disturbance	**Possible -** Disturbance is predicted to be limited to that initiated by the movement of the project vessels. It is possible that the qualifying species of this site could forage within the vicinity of the Proposed Development.
Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC UK0030396	20	• Harbour porpoise	Underwater noise changes	**Possible** - Site is within the Celtic and Irish Seas (CIS) Management Unit. Greenlink Marine ES Wales - Technical Appendix D concluded that underwater noise could cause temporary injury or disturbance.
			Electromagnetic changes	**Unlikely** - effects of EMF will be not be measurable above natural background levels within 2m of the cables. The slight elevation in field strength will not inhibit migration.
North Anglesey Marine / Gogledd Môn Forol SAC UK0030398	170	• Harbour porpoise	Underwater noise changes	**Possible** - Site is within the Celtic and Irish Seas (CIS) Management Unit. Greenlink Marine ES Wales - Technical Appendix D concluded that underwater noise could cause temporary injury or disturbance.
			Electromagnetic changes	**Unlikely** - effects of EMF will be not be measurable above natural background levels within 2m of the cables. The slight elevation in field strength will not inhibit migration.

Site Name & Code	Distance	Qualifying feature	Potential Pressure	Likelihood of interaction
North Channel SAC UK0030399	279	• Harbour porpoise	Underwater noise changes	**Possible** – Site is within the Celtic and Irish Seas (CIS) Management Unit. Greenlink Marine ES Wales - Technical Appendix D concluded that underwater noise could cause temporary injury or disturbance.
			Electromagnetic changes	**Unlikely** - effects of EMF will be not be measurable above natural background levels within 2m of the cables. The slight elevation in field strength will not inhibit migration.
Carmarthen Bay and Estuaries / Bae Caerfyrddin ac Aberoedd SAC UK0020020	29	• Sea lamprey • River lamprey	Underwater noise changes	**Unlikely** – Sea lamprey are not hearing specialist fish species and it is unlikely that they will be effected by underwater noise changes.
			Electromagnetic changes	**Unlikely** – effects of EMF will be not be measurable above natural background levels within 2m of the cables. The slight elevation in field strength will not inhibit migration to or from rivers.
		• Twaite shad • Allis shad	Underwater noise changes	**Possible** - Greenlink Marine ES Wales - Technical Appendix D concluded that underwater could disturb cause temporary injury or disturbance.
			Electromagnetic changes	**Unlikely** – effects of EMF will be not be measurable above natural background levels within 2m of the cables. The slight elevation in field strength will not inhibit migration to or from rivers.
		• Sandbanks which are slightly covered by seawater all the time • Estuaries • Mudflats and sandflats not covered by seawater at low tide • Large shallow inlets and bays • Salicornia and other annuals colonizing mud and sand • Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	No pressure-receptor pathway identified	**Screened out** as Proposed Development will not interact with these features.

Site Name & Code	Distance	Qualifying feature	Potential Pressure	Likelihood of interaction
		• Otter		
Bae Ceredigion / Cardigan Bay SAC UK0012712	72	• Bottlenose dolphin *Tursiops truncatus*	Underwater noise changes	**Possible** - Site is within the Offshore Channel and SW England (OCSW) Management Unit. Greenlink Marine ES Wales - Technical Appendix D concluded that underwater noise could cause temporary injury or disturbance.
			Electromagnetic changes	**Unlikely -** effects of EMF will be not be measurable above natural background levels within 2m of the cables. The slight elevation in field strength will not inhibit migration.
		• Sea lamprey • River lamprey • Grey seal	Underwater noise changes	**Screened out** as site is outside of the search area for fish species and at the limit of grey seal foraging range.
		• Sandbanks which are slightly covered by sea water all the time • Reefs • Submerged or partially submerged sea caves	No pressure-receptor pathway identified	**Screened out** as site is outside of the search area for habitats.
Pen Llyn a'r Sarnau / Lleyn Peninsula and the Sarnau SAC UK0013117	124	• Bottlenose dolphin	Underwater noise changes	**Possible** - Site is within the Offshore Channel and SW England (OCSW) Management Unit. Greenlink Marine ES Wales - Technical Appendix D concluded that underwater noise could cause temporary injury or disturbance.
			Electromagnetic changes	**Unlikely -** effects of EMF will be not be measurable above natural background levels within 2m of the cables. The slight elevation in field strength will not inhibit migration.
		• Grey seal • Otter • Sandbanks which are slightly covered by sea water all the time • Estuaries • Coastal lagoons	No pressure-receptor pathway identified	**Screened out** as site is outside of the respective search areas and species unlikely to travel to Proposed Development.

Site Name & Code	Distance	Qualifying feature	Potential Pressure	Likelihood of interaction
		• Large shallow inlets and bays • Reefs • Mudflats and sandflats not covered by seawater at low tide • Salicornia and other annuals colonizing mud and sand • Atlantic salt meadows (Glauco-Puccinellietalia maritimae) • Submerged or partially submerged sea caves		

Table 4-4 Initial screening for relevant SSSI and MCZ sites

Site Name & Code	Distance	Qualifying feature	Potential Pressure	Likelihood of interaction
Broomhill Burrows SSSI 1136	Within	• Red-billed Chough Pyrrhocorax pyrrhocorax • Lapwing Vanellus vanellus	Disturbance	**Possible -** Disturbance is predicted to be limited to that initiated by the movement of the project vessels. Although chough are terrestrial birds and do not use the marine environment for foraging, they nest in the sea cliffs along this stretch of coast and may forage close to the landfall area. Lapwings breed in the dune slacks at the back of Freshwater Bay.
Arfordir Penrhyn Angle / Angle Peninsula Coast SSSI 0923	0.06	• Red-billed Chough	Disturbance	**Possible** – Disturbance is predicted to be limited to that initiated by the movement of the project vessels. Although chough are terrestrial birds and do not use the marine environment for foraging, they nest in the sea cliffs along this stretch of coast, may forage close to the landfall area and NRW has requested the chough of this site are considered.
		Intertidal species • Reef habitat • Submerged or partially submerged sea caves • Peregrine falcon *Falco peregrinus* • Greater horseshoe bat Rhinolophus ferrumequinum • Lesser horseshoe bat *R. hipposideros*	No pressure-receptor pathway identified	**Screened out** as Proposed Development will not interact with these features.
Castlemartin Range SSSI 0140	0.54	• Red-billed Chough	Visual disturbance	**Screened out -** Site is within Castlemartin Coast SPA which lists red-billed chough as a Qualifying Feature. The assessment for these features has therefore been undertaken within the screening for the SAC.
		• Breeding seabirds (guillemot, razorbill, kittiwake, fulmar, lesser-black-backed gull, herring gull, shag)	Disturbance	**Possible -** It is possible that breeding birds from this site could be disturbed by cable installation activities.

Site Name & Code	Distance	Qualifying feature	Potential Pressure	Likelihood of interaction
		• Grey seal • Otter	Disturbance Underwater noise changes	**Screened out** - Site is within Pembrokeshire Marine / Sir Benfro Forol SAC which lists grey seal and otter as a Qualifying Feature. The assessment for these features has therefore been undertaken within the screening for the SAC.
		• Rare and scarce plants and invertebrates • Coastal geology • Greater horseshoe bat • Lesser horseshoe bat	No pressure-receptor pathway identified	**Screened out** as Proposed Development will not interact with these features.
Castlemartin Corse SSSI 0242	0.71	• Cliff and foreshore rock outcrops • Sand dune system • Grassland • Insects, lichen and reptiles. • Lapwing	No pressure-receptor pathway identified	**Screened out** as Proposed Development will not interact with these features.
Milford Haven Waterway SSSI 0282	1.44	• Geology • Ancient woodland • Rare and scarce maritime plants • Greater horseshoe bat • Lesser horseshoe bat	No pressure-receptor pathway identified	**Screened out** as Proposed Development will not interact with these features.
	1.44	• Otter	Underwater noise changes / Disturbance	**Screened out** - Site is within Pembrokeshire Marine / Sir Benfro Forol SAC which lists otter as a Qualifying Feature. The assessment for this features has therefore been undertaken within the screening for the SAC.
		Over-wintering wildfowl and waders including: • Eurasian teal *Anas crecca* • Eurasian widgeon *Anas penelope*	Disturbance	**Unlikely** – these birds will be found feeding in the intertidal area. Therefore, given the distance of this SSSI (as the cross flies across land) to the Proposed Development, it is considered unlikely that these birds will be disturbed.

Site Name & Code	Distance	Qualifying feature	Potential Pressure	Likelihood of interaction
		• Eurasian curlew *Numenius arquata* • Little grebe Tachybaptus ruficollis • Dunlin Calidris alpine • Common shelduck *Tadorna tadorna*		
Dale and South Marloes Coast SSSI 0585	3.22	• Rocky and sandy shore communities • Nationally scarce green and red algal communities • Maritime grassland, maritime heath, maritime cliff crevice and ledge vegetation, coastal scrub • Shore dock • Golden hair lichen Teloschistes flavicans • Scaly cricket Pseudomogoplistes vicentae	No pressure-receptor pathway identified	**Screened out** as Proposed Development will not interact with these features.
		• Red-billed chough	Disturbance	**Unlikely** - Appendix B indicates that disturbance is predicted to be limited within a few hundred metres of foraging birds. During the most sensitive season (breeding) birds stay within 100-300m of nests. Therefore given the distance of the site it is unlikely that birds will be disturbed.
		• Grey seal	Underwater noise changes / Disturbance	**Screened out -** Site is within Pembrokeshire Marine / Sir Benfro Forol SAC which lists otter as a Qualifying Feature. The assessment for this features has therefore been undertaken within the screening for the SAC.
Skokholm SSSI 0297	3.15	• Manx shearwater • Atlantic puffin • Atlantic storm petrel	Disturbance	**Screened out -** Site is within Skomer, Skokholm and the seas off Pembrokeshire /Sgomer, Sgogwm a moroedd Penfro SPA which lists the bird species as a Qualifying Feature. The assessment for this features has therefore been undertaken within the screening for the SPA.

Site Name & Code	Distance	Qualifying feature	Potential Pressure	Likelihood of interaction
		• Razorbill • Guillemot • Lesser-black backed gull • Fulmar • Herring gull • Greater black-backed gull		
		• Grey seal	Underwater noise changes / Disturbance	**Screened out -** Site is within Pembrokeshire Marine / Sir Benfro Forol SAC which lists grey seal as a Qualifying Feature. The assessment for this features has therefore been undertaken within the screening for the SAC.
Grassholm / Ynys Gwales SSSI 0594	8.55	• Gannet Morus bassanus	Disturbance	**Screened out -** Site is within Grassholm SPA which lists gannet as a Qualifying Feature. The assessment for this features has therefore been undertaken within the screening for the SPA.
		• Grey seal	Underwater noise changes / Disturbance	**Screened out -** Site is within Pembrokeshire Marine / Sir Benfro Forol SAC which lists grey seal as a Qualifying Feature. The assessment for this features has therefore been undertaken within the screening for the SAC.
		• Intertidal communities	No pressure-receptor pathway identified	**Screened out** as Proposed Development will not interact with these features.
Skomer Island and Middleholm SSSI 0953	6.83	Breeding birds: • Manx shearwater, • Atlantic puffin • Atlantic storm petrel • Razorbill • Guillemot • Lesser black-backed gull • Kittiwake • Red-billed chough	Disturbance	**Screened out -** Site is within Skomer, Skokholm and the seas off Pembrokeshire /Sgomer, Sgogwm a moroedd Penfro SPA which lists the bird species as a Qualifying Feature. The assessment for this features has therefore been undertaken within the screening for the SPA.

Site Name & Code	Distance	Qualifying feature	Potential Pressure	Likelihood of interaction
		• Grey seal	Underwater noise changes / Disturbance	**Screened out -** Site is within Pembrokeshire Marine / Sir Benfro Forol SAC which lists grey seal as a Qualifying Feature. The assessment for this features has therefore been undertaken within the screening for the SAC.
		• Short-eared owl • Reef communities • Sea caves • Skomer vole Clethrionomys glareolus skomerensis • Rare and scare plants and lichens • Maritime grassland and cliff crevice communities	No pressure-receptor pathway identified	**Screened out** as Proposed Development will not interact with these features.
Marloes Mere SSSI 0464	6.82	• Scare plant and insect communities and wintering wildfowl	No pressure-receptor pathway identified	**Screened out** as Proposed Development will not interact with these features.
De Porth Sain Ffraid / St Bride's Bay South SSSI 0342	7.66	• Rocky and sandy shore communities • Ancient sessile oak woodland • Geology	No pressure-receptor pathway identified	**Screened out** as Proposed Development will not interact with these features.
		• Grey seal	Underwater noise changes / Disturbance	**Screened out -** Site is within Pembrokeshire Marine / Sir Benfro Forol SAC which lists grey seal as a Qualifying Feature. The assessment for this features has therefore been undertaken within the screening for the SAC.
Stackpole SSSI 0024	9.08	• Rocky and sandy shores • Limestone sea cliffs • Wooded valleys • Rare plant and invertebrate species	No pressure-receptor pathway identified	**Screened out** as Proposed Development will not interact with these features.

Site Name & Code	Distance	Qualifying feature	Potential Pressure	Likelihood of interaction
		• Red-billed chough • Breeding seabirds (kittiwake, razorbill, guillemot, Atlantic puffin, fulmar)	Disturbance	**Unlikely** - Site is outside of zone of influence for disturbance for breeding birds. Although individuals may be use the Proposed Development for feeding and loafing there is sufficient available habitat in the wider region for birds which are briefly displaced by the presence of vessels.
		• Otter	Disturbance	**Screened out -** Site is within Pembrokeshire Marine / Sir Benfro Forol SAC which lists otter as a Qualifying Feature. The assessment for this features has therefore been undertaken within the screening for the SAC.
Skomer MCZ	7.55	• Grey seal •	Underwater noise changes / Disturbance	**Screened out -** Site is within Pembrokeshire Marine / Sir Benfro Forol SAC which lists grey seal as a Qualifying Feature. The assessment for this features has therefore been undertaken within the screening for the SAC.
		• Pink seafan • Sponge communities • Eelgrass • Algal communities	No pressure-receptor pathway identified	**Screened out** as Proposed Development will not interact with these features.

4.3 Assessment of Likely Significant Effects (LSE)

A likely effect is defined as one that cannot be ruled out on the basis of objective information. The test is a 'likelihood' of effects rather than a 'certainty' of effects. Where the Proposed Development is likely to undermine the site's conservation objectives, it must be considered likely to have a significant effect on the site. The assessment of that risk must be made in light, amongst other things, of the characteristics and specific environmental conditions of the site concerned. If Table 4-3 or Table 4-4 identified that an interaction between the Proposed Development and the Qualifying Feature(s) is possible, the potential for a likely significant effect (LSE) on the conservation objectives has been considered in the sections below.

To support the assessment, two Appendices have been provided. Appendix A presents the findings of an underwater noise assessment conducted on the Proposed Development's activities; and Appendix B provides information to support the assessment of red-billed chough.

4.3.1 Pembrokeshire Marine / Sir Benfro Forol SAC

The Proposed Development crosses this site from KP0 to approximately KP50. The SAC covers an area of 1380.69km^2.

4.3.1.1 Conservation objectives

Habitats

To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status.

- Range - The overall distribution and extent of the habitat features within the site, and each of their main component parts is stable or increasing.
- Structure and function - The physical biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded. Important elements include; geology; sedimentology; geomorphology; hydrography and meteorology; water and sediment chemistry; and biological interactions.
- Species - The presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded. Important elements include: species richness; population structure and dynamics; physiological health; reproductive capacity; recruitment; mobility; and range.

Species

To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status.

- Populations - The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements include: population size; structure, production; condition of the species within the site.

  As part of this objective it should be noted that for otter and grey seal contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression.

  For grey seal and otter, populations should not be reduced as a consequence of human activity.

- Range - The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.

  As part of this objective it should be noted that for otter and grey seal:

  - Their range within the SAC and adjacent inter-connected areas is not constrained or hindered.
  - There are appropriate and sufficient food resources within the SAC and beyond.
  - The sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing

- Supporting habitats and species - The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include; distribution; extent; structure; function and quality of habitat; and prey availability and quality.

4.3.1.2 Assessment against conservation objectives – Reefs

Screening identified a possible pressure-receptor pathway for the pressures 'penetration and/or disturbance including abrasion' and 'physical change (to another seabed type)'.

The seabed within the direct zone of influence of the installation will be temporarily disturbed. The actual cable installation is a one-off event, but the seabed along the cable centreline could be disturbed on two to three discrete occasions within approximately a three month period. The first occasion will be for any seabed preparation works e.g. boulder clearance, pre-sweeping; the second occasion will be the pre-lay grapnel run; and the third occasion will be the cable lay and burial or deposit of external cable protection. These activities will be within the same zone of influence. When assessing the significance of the effect the assessment has considered the culmination of these activities.

Cable installation is an intrusive activity involving burying the cable in the seabed. Although the footprint of the disturbance is relatively small (20m wide) the

Proposed Development crosses reef sub-types: Bedrock Reef; Stony Reef; and Biogenic Reef.

Stony Reef and Bedrock Reef can be of high environmental value, as they may contain more delicate species such as rugose squat lobsters, ascidians and sponges that take longer to re-colonise hard substrata and grow to adult size. Recoverability of such habitats is expected to take longer, and therefore the overall magnitude of effect from cable installation could be higher in Reef habitat.

Although much of the Bedrock Reef within the Proposed Development can be avoided through careful routeing, there are small sections (totally 170m in length) where the outcropping rock will be crossed and external cable protection may be required.

In addition, medium grade Stony Reef has been identified between KP15 and KP23. It may be possible to bury the cables in this area, but some boulder clearance may be required. Where this is needed large cobbles and boulders would be pushed to either side of the centreline. However, it has also been identified that burial in sediment may not be feasible in this 8km section and external cable protection would be required.

Although the potential effects are highly localised, abrasion is likely to have short-term effects on the species inhabiting the Reef habitat. This Reef is high in diversity and predominantly dominated by ascidians and hydrozoans. Other taxa identified include poriferans and bryozoans. There is also the potential that the use of external cable protection will reduce the range (extent) of the habitat within the site.

The assessment concludes that there is the potential for a likely significant effect.

Screening Conclusion: Potential for LSE. Appropriate Assessment is required.

4.3.1.3 Assessment against conservation objectives - Sandbanks which are slightly covered by sea water all the time

The Qualifying Feature is reported to cover 414.12km^2 of the SAC; of which the Turbot Bank covers approximately 19.10km^2.

The Proposed Development crosses the Turbot Bank for approximately 5km between KP5 and KP10. The cable route survey identified that two habitat classifications are present within the Proposed Development on this Qualifying Feature; A5.25 Circalittoral fine sand; and A5.44 Circalittoral mixed sediment. The habitats contain various species of infauna, such as the molluscs *Goodallia triangularis, Asbjornsenia pygmaea, A. prismatica, T. ovata, Kurtiella bidentata* and the polychaete *Nephtys cirrosa, O. borealis, Lumbrineris cingulate, Glycinde nordmanni* and different amphipods which may be affected by seabed disturbance.

Burial in sediment will be achievable in this area without the need for pre-sweeping or external cable protection.

The Turbot Bank is exposed to wave action, suggesting that epifauna and infauna present will be characteristic of moderately strong tidal currents, and given the dominance of sand and coarse sediments, can be viewed as adaptable to physical disturbance. Many infaunal species may live at depths where they will be protected from surface disturbance and in areas where direct loss occurs, it is likely that adjacent areas will act to replenish communities rapidly as most infaunal species are mobile and the zone of influence is narrow. Bivalves are likely to take longer than polychaetes to re-colonise areas but even considering this it is unlikely to exceed months (MarLIN 2019).

The zone of influence of the installation (15m) represents a very small area (0.075km^2) when compared to the extent of the habitat in the site. The Proposed Development will temporarily effect 0.39% of the Turbot Bank and 0.09% of the wider Qualifying Feature. However, it will not change the physical characteristics of the seabed, meaning that once installation activities have ceased the seabed will still be suitable for recolonization from the surrounding area. As the range, structure, function and species of the habitat will not be effected other than temporarily there will be no likely significant effects on the conservation objectives.

Screening conclusion: No potential for LSE. AA is not required

4.3.1.4 Assessment against conservation objectives – Mudflats and sandflats not covered by seawater at low tide

The presence of external cable protection in the offshore region may cause very localised changes in water flows. This in turn could cause localised scour. Scour will only occur in areas of sediment where bottom current either already exceed the critical bedload parting velocity, or where external cable protection results in an increase in current velocity to above the critical bedload parting velocity. Given that current speeds within the Proposed Development are relatively low, particularly near the seabed due to frictional effect, high scour is unlikely to be a significant issue.

The description of this pressure also includes sediment transport considerations e.g. whether the installation of the rock berms could affect transport of sediment to and from the beach at Freshwater West.

Depth of closure is an important concept used in coastal engineering. The depth of closure is a theoretical depth along a beach profile where sediment transport is very small or non-existent (USACE 2019), or basically the furthest distance offshore at which there is no significant sediment transport between the nearshore and offshore. Depth of closure has been conservatively estimated, using a mean significance wave height of 1.63m, as 14.5m below lowest astronomical tide for Freshwater West. Beyond this depth, there will be theoretically little effect on beach processes.

All the indicative locations for external cable protection proposed are in water depths greater than 14.5m. Therefore, it is concluded that there will be no effects on sediment transport pathways at Freshwater West.

Screening conclusion: No potential for LSE. AA is not required

4.3.1.5 Assessment against conservation objectives – Grey seal

The site overlaps between mean low water (MLW) and MHWS with the following SSSIs and MCZ which list grey seal as a Qualifying Feature. The below assessment therefore also applies to these sites.

- Castlemartin Range SSSI
- Dale and South Marloes Coast SSSI
- Grassholm / Ynys Gwales SSSI
- Skomer Island and Middleholm SSSI
- De Porth Sain Ffraid / St Bride's Bay SSSI
- Skomer MCZ

Table 4-1 identified that there is a possible pressure-receptor pathway between grey seal and activities which generate underwater noise. An underwater noise assessment provided in Appendix A, concluded that:

- Continuous noise generated by vessels and cable installation will not injure grey seal, and will only generate noise levels sufficient to cause disturbance within 130m of the vessels.
- Geophysical survey will generate noise levels sufficient to temporarily injure grey seal within 40m, and disturb animals within 2.6km, of the sound source.
- In the event that UXO detonation is required, grey seal within 17km could be injured, and animals within 54km would experience noise levels sufficient to cause disturbance (based on worst-case detonation of 794kg explosive).

Grey seal densities in the water within the Proposed Development are estimated to be approximately 0.4 individuals per km^2 [1] (Jones et al. 2013).

Animals within the SAC are part of the South and West England and Wales Management Unit. They are not thought to form a discrete population within the SAC but are part of the wider SW Wales population. This population extends to SW England and SE Ireland. The SW Wales population is approximately 5000 individuals. They range throughout the open coast areas of the site and predominantly confined to a few favoured locations (e.g. Stack Rock). The closest

[1] Estimated upper 95% confidence interval of total estimated usage of grey seal around the UK. Average number of seals is up to 10 per 5x5km grid in the region of the Proposed Development.

haul-out is Linney Head[2], approximately 3.5km south of the Proposed Development.

Continuous noise

Grey seal in water are vulnerable to sound generated by the geophysical survey. For geophysical survey it is best practice to follow the JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys' (JNCC 2017a). Adherence to the guidelines constitutes best practice and will, in most cases, reduces the risk of deliberate injury to marine mammals to negligible levels. Adherence to the guidelines has been incorporated into the Proposed Development as embedded mitigation EM20.

The underwater noise changes associated with a geophysical survey and therefore the associated potential for disturbance is generally acknowledged as small when compared to activity such as use of air guns during 2D and 3D seismic and wind farm piling (BEIS 2018). It is possible that a geophysical survey will be undertaken ahead of installation, with further inspection surveys completed every 3-5 years post-installation. Animals will have sufficient time to avoid the installation and survey vessels, and it is unlikely that they will swim over operating equipment.

The proposed activities will be restricted in duration and will progress slowly along the cable centreline through the Proposed Development, with the zone of influence constantly moving. Assuming an average survey speed of 3.6km/hour the 50km route length within the SAC would be surveyed in approximately 14 hours. During the 14 hour period approximately 260km^2 of the SAC will experience a brief increase in underwater noise; equivalent to 18.8% of the site.

Animals may actively avoid the activity, but will return to the area once the vessels have passed through. The Proposed Development will not reduce the population, hinder the range (other than briefly) or effect the supporting habitats and species that grey seal rely on.

Screening conclusion: No potential for LSE. AA is not required.

Impulsive noise

It is unknown how many, if any, UXO detonations will be required within the Proposed Development. The Proposed Development passes through the Castlemartin Firing Range, so it is highly likely that UXO will be encountered.

Should UXO be found which require clearance by detonation it is assumed that there would be a relatively large release of impulsive sound energy, creating high amplitude shock waves (von Benda-Beckmann et al. 2015). The precise injury effect range cannot be stated in advance of information on the nature and quantity of explosive material potentially involved, which will not be known until a UXO is identified. However, by making certain assumptions, Appendix A concluded that

[2] http://pembrokeshiremarinesac.org.uk/english/special/seal_c.htm

grey seal are vulnerable to permanent injury within 17km and to temporary injury within 54km of the UXO detonation. Disturbance resulting from a single 794kg UXO detonation would cover an area of up to 9,160km^2; the whole of the SAC would experience the brief elevated noise levels.

As animals could be injured there is the potential for a LSE on the population structure.

Screening Conclusion for UXO detonation: Potential for LSE / AA is required.

4.3.1.6 Assessment against conservation objectives – Otter

The site overlaps between MLW and MHWS with Stackpole SSSI and Milford Haven Waterway SSSI which list otter as a Qualifying Feature.

Otter are known to use a narrow zone close to shore (<100m) for foraging. The known locations of otter at Freshwater West are to the south of the Proposed Development. Significant numbers are not expected to use the waters of the Proposed Development. Any disturbance of otter will be localised, temporary and minor in nature.

Screening conclusion: No potential for LSE / AA is not required

4.3.1.7 Assessment against conservation objectives – Allis shad and Twaite shad

Table 4-1 identified there is a possible pressure-receptor pathway between shad and activities which generate underwater noise. An underwater noise assessment provided in Appendix A, concluded that:

- As hearing specialist fish, twaite shad and allis shad (members of the clupeid family) individuals are sensitive to underwater noise changes.
- There is no direct evidence of permanent injury to fish species from shipping and other continuous noise (such as cable installation).
- Geophysical survey could cause noise levels sufficient to cause temporary injury within 2.2km of the noise source.
- Detonation of a UXO, could generate noise levels sufficient to cause fish mortality within 6.5km of the detonation site (based on worst-case detonation of 794kg explosive).

<u>Continuous noise</u>

For geophysical works the potential zone of influence is transient as it moves slowly in a constant direction along the principal survey line orientation. It is expected that fish will avoid the area once operations have started and are extremely unlikely to move towards the sound source.

The works will not lead to any long term displacements as they are transient and temporary. Individuals would be expected to be able to return once the operation had passed through. However, it should be noted that the ability of small fish to take avoiding action may be limited, and temporary displacement may not therefore occur.

Temporary displacement of mobile species in the marine environment is not expected to result in significant adverse effects for the individuals concerned unless it interferes with a critical lifecycle activity such as spawning. The Proposed Development is not a spawning ground for Allis or Twaite Shad. However, juvenile shad are known to forage in the nearshore environment, so some interaction may be possible.

Any disturbance effects from noise associated with operations will be localised, temporary and transient. There will be no effect on the distribution of the species. In addition, the Proposed Development will not effect the population structure, range (spawning extent or habitat extent) or structure of supporting habitats and prey species. Considering the extent of inshore habitat available the likely effect on shad has been assessed as not significant.

Screening conclusion: No potential for LSE / AA is not required

Impulsive noise

It is unknown how many, if any, UXO detonations will be required within the Proposed Development. The Proposed Development passes through the Castlemartin Firing Range, so it is highly likely that UXO will be encountered.

In line with embedded mitigation EM21 a decision making process will be followed for any potential UXO whereby the target is first avoided, then removed and if neither previous option is feasible, detonation is undertaken.

Should UXO be found which require clearance by detonation it is assumed that there would be a relatively large release of impulsive sound energy, creating high amplitude shock waves (von Benda-Beckmann et al. 2015).

Salmon and twaite shad are likely to be sensitive to such disturbance. However, the explosion will be brief, with the shock waves attenuating rapidly in the water column, thus resulting in a restricted lethal zone (Continental Shelf Associates, Inc 2004). Although there is the potential that individuals will be killed the activity, if required, is unlikely to affect the viability of the population. It will not affect the range or supporting habitats and species.

Screening conclusion: No potential for LSE / AA is not required

4.3.3 Skomer, Skokholm and the seas off Pembrokeshire / Sgomer, Sgogwm a moroedd Benfro SPA

The Proposed Development crosses this site between KP13 and KP23 and between KP31 to KP43.5. It then runs adjacent to the site boundary until KP55. The SAC covers an area of 1,668km^2. Component SSSIs include Skokholm SSSI and Skomer Island and Middleholm SSSI.

4.3.3.1 Conservation objectives

The protected features covered by the conservation objectives are the qualifying marine species of the SPA: breeding populations of storm petrel, lesser black-backed gull, Manx shearwater, and Atlantic puffin as well as the breeding seabird assemblage. For each of these features there are four conservation objectives:

- The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term.
- The distribution of the population should be being maintained, or where appropriate increasing.
- There should be sufficient habitat, of sufficient quality, to support the population in the long term.
- Factors affecting the population or its habitat should be under appropriate control".

4.3.3.2 Assessment against conservation objectives

The islands of Skomer and Skokholm support the largest concentrations of breeding seabirds in England and Wales; the breeding seabird assemblage totals over 394,000 birds. The islands support the largest breeding colony of Manx shearwater in the world (316,000 pairs) and one of the largest colonies of lesser-black-backed gull in Britain (over 10,000 occupied nests).

The SPA boundary includes waters vital for essential ecological requirements (preening, bathing, displaying, loafing/ resting at sea) for Manx shearwater and Atlantic puffin (as individually qualifying features) as well as common guillemot and razorbill (as component species of the seabird assemblage).

To set the boundaries for the SPA, JNCC undertook analysis of seabird densities to identify concentrations or 'hotspots' of birds offshore. Density maps presented in NRW (2015) show important foraging areas for Manx shearwater and Atlantic puffin. During design (routeing) of the Proposed Development, the position of the SPA boundary was taken into consideration and the length of cable route within the site boundary was minimized where possible. Figure 4-3 (Drawing P1975-BIRD-001) below shows starting from Freshwater West the Proposed Development initially follows the bottom boundary of the northern section of the SPA which is identified as important for Atlantic puffin. The Proposed Development then takes the shortest

route through the larger area identified as important for Manx shearwater before the route continues just above the northern boundary of the SPA.

Table 4-1 identified that there is the potential pressure-receptor pathway for the pressure disturbance. Disturbance is predicted to be limited to that initiated by the movement of the project vessels. Birds may take evasive action, but a single disturbance event does not have any immediate effect on the survival or productivity of an individual bird. Repeated disturbance, or disturbance over an extended period, can however affect survival and productivity.

The Proposed Development passes >2km south of the islands of Skokholm and Skomer (i.e. outside of the zone of influence for disturbance). It is therefore unlikely that nesting birds will be disturbed by the presence of the project vessels should any activities temporally overlap with the breeding season. Therefore the discussion below focuses on the effects of displacement.

Atlantic Puffin

Puffin arrive at breeding colonies in March and April and leave again by the beginning of August. Sensitivity to displacement differs considerably between seabird species. The Joint SNBC Interim Displacement Advice Notice (JNCC 2017b) provides a scoring system to help assist in the assessment of species, susceptibility to disturbance by windfarm structures, ship and helicopter traffic. This metric gives an indication of which species are expected to be most susceptible to displacement effects. As a general guide any species scoring 3 or more should be considered further. Atlantic puffin has a score of 2 for disturbance susceptibility which suggests it is unlikely to be sufficiently disturbed by the presence of the vessel to be displaced for a significant period.

In addition, shipping activity along the Proposed Development is expected to be moderate due to the presence of shipping routes to Milford Haven, and the presence of a traffic separation zone to the north of the Proposed Development through which ships transit in and out of the Irish Sea. Against this level of activity, the introduction of the project vessel(s) is unlikely to have any significant effect. Any disturbance caused by the project will be temporary in nature and limited in extent. Given the Proposed Development is at the southern limit of the area important for puffin, any disturbance is likely to be not significant. The project vessels will move continuously through the Proposed Development and therefore their presence in any one location will be brief allowing any disturbed birds to return within a short period of time.

Manx shearwater

Manx shearwater score 1 for disturbance susceptibility and therefore would not normally require further assessment. However as Manx shearwater is a qualifying feature of the 4km marine extension around Skomer and Skokholm they are considered further here.

During the breeding season (April to August) prior to dusk, adult Manx shearwaters assemble in flocks or 'rafts' on the surface of the sea 1-10 km from the colony. When darkness falls, these 'rafting' birds, of up to 10,000 individuals in some locations, fly to their burrows to feed their chicks (McSorley et al. 2008). Radio-telemetry tracking of breeding Manx shearwater was undertaken at Skomer island from May to August in 2003 (McSorley et al. 2008). The results of the tracking indicated that overall the birds formed rafts most often to the north of the island and no rafts were formed before 19:00. Birds moved significantly closer to the colony as the evening progressed.

Figure 4-3 (Drawing P1975-BIRD-001) shows the locations of rafting Manx shearwater from the 2003 tracking data in relation to the proposed cable corridor. The closest rafting Manx shearwater were located at least 5.96km to the north of the Proposed Development. Should rafting Manx shearwater be present within the vicinity of the Proposed Development during cable installation, any disturbance will take place within the context of existing sources of disturbance, such as commercial shipping, commercial fishing and recreational vessels in the area. Figure 4-3 shows that there are high densities of shipping present along the Proposed Development, south of Skokholm island within the SPA. It is therefore likely that the Manx shearwater will be habituated to vessel noise, lights and physical presence and the addition of the project vessel(s) is unlikely to be noticeable against natural variation in shipping levels.

The magnitude of the effect will depend on the degree of disturbance. The most disruptive activities are those that are sudden, noisy or fast. As such, helicopters and speedboats usually cause the greatest disturbance (Natural England and Suffolk Coast and Heaths 2012). Vessels travelling at faster speeds cause a greater level of disturbance in terms of the proportion of birds flushing and at further distances (Bellefleur et al. 2009; Ronconi and St Clair 2002). The project vessels will be slow moving, only between 100 – 300 m / hour, which is slower than walking speed (generally assumed to be 5 km / hour). At such slow speeds, the vessels are effectively stationary in terms of bird displacement. Studies have shown that slow moving vessels cause little disturbance to birds and birds may habituate to frequent and relatively benign events and noises (Hill et al. 1997). It is therefore concluded that any disturbance will be temporary and localised and will not result in any likely significant effects on Manx shearwater.

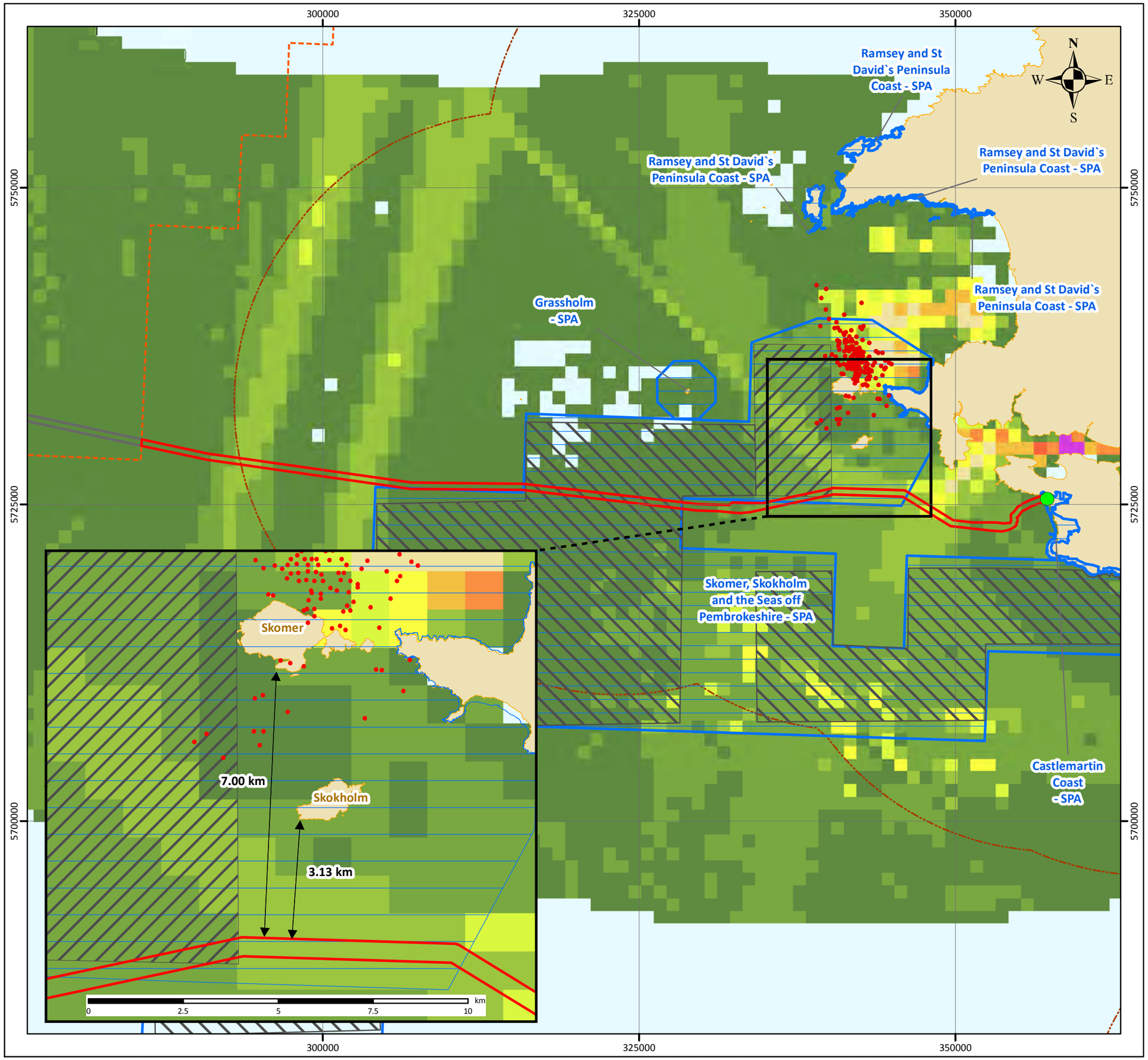
Screening conclusion: No potential for LSE / AA is not required

GREENLINK INTERCONNECTOR

BIRD ACTIVITY

Locations of Rafting Manx Shearwater (after McSorley et al 2008) in Relation to the Proposed Development and Existing Shipping Activity

Drawing No: P1975-BIRD-001	A



Legend

- Manx Shearwater Rafting Location
- Freshwater West
- Proposed Development
- Irish Offshore
- UK 12nm Territorial Sea Limit
- Median Line

Protected Site

- SPA
- Important Area - Atlantic Puffic
- Important Area - Manx Shearwater

NOTE: Not to be used for Navigation

Date	Wednesday, May 8, 2019 08:12:04
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	UKHO; CDA; OSOD; JNCC; Ocenaeering; Greenlink; Intertek
File Reference	J:\P1975\Mxd\13_BIRD\ P1975-BIRD-001.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Co-financed by the European Union Connecting Europe Facility

0 2.5 5 7.5 10 km

4.3.4 West Wales Marine / Gorllewin Cymru Forol SAC

The Proposed Development crosses this site from KP0 to KP37. The SAC covers an area of 7,376km^2.

4.3.4.1 Conservation objectives

To avoid deterioration of the habitats of harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring the integrity of the site is maintained and the site makes an appropriate contribution to maintaining Favourable Conservation Status (FCS) for the UK harbour porpoise.

- To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term:
- The species is a viable component of the site.
- There is no significant disturbance of the species.
- The supporting habitats and processes relevant to harbour porpoises and their prey are maintained.

4.3.4.2 Assessment against conservation objectives

Marine cable installation, operation and decommissioning will generate underwater sound from a number of sources:

- Continuous sound sources e.g. vessel movements, cable laying, rock placement, geophysical survey; and
- Impulsive sound sources e.g. UXO detonation (if required).

The Conservation Objectives and Advice on Operations published by the JNCC (2019) for the SAC suggests…

"noise disturbance within an SAC from a plan/project individually or in combination is significant if it excludes harbour porpoises from more than

1. 20% of the relevant area of the site in any given day, and

2. An average of 10% of the relevant area of the site over a season."

An underwater noise assessment presented in Appendix A, considers the potential for injury and disturbance from the Proposed Development. It concludes:

Injury from continuous sound – cable installation

Sound resulting from cable installation activities (DP vessel, trenching, rock placement etc.) does not exceed the thresholds for permanent (permanent threshold shift, PTS) or temporary (temporary threshold shift, TTS) injury. Harbour porpoise are therefore not at risk of injury from the cable installation (rock placement and vessel noise).

Injury from continuous sound – geophysical survey

Harbour porpoise (high-frequency cetacean) are vulnerable to sound generated by the multi-beam echosounder, sidescan sonar and sub-bottom profilers with the largest zone of influence being from the multibeam echosounder. Permanent injury could occur within 110m and temporary injury within 180m of the multi-beam echosounder.

For geophysical survey it is best practice to follow the JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys' (JNCC 2017a). Adherence to the guidelines constitutes best practice and will, in most cases, reduce the risk of deliberate injury to marine mammals to negligible levels. Adherence to the guidelines has been incorporated into the Proposed Development as embedded mitigation EM20.

Disturbance from continuous sound – cable installation

Harbour porpoise are vulnerable to disturbance from cable installation activities, but the zone of influence is small; 130m radial distance from activities. The cable installation activities will move slowly along the cable route and although animals may briefly avoid the activity they will return to an area once the activity has passed through. The current moderate level of shipping and ambient sound around Milford Haven and within the Celtic Sea will not increase significantly from the presence of the project vessels during the cable installation.

Disturbance from continuous sound – geophysical survey

Disturbance could occur up to 2.6km radial distance (21.24km^2) from the survey vessel. Evidence of the effects of geophysical surveys on cetaceans is limited but BEIS (2018) summarises the results of a study carried out in the Moray Firth. It observed responses to a 10-day 2D seismic survey which exposed a 200km^2 area to noise throughout that period. A relative decrease in density of harbour porpoise within 10km of the survey vessel was reported, but effects were brief with animals returning to the area within 19 hours of cessation of activities.

The underwater sound changes associated with the cable installation and the geophysical survey, and therefore the associated potential for disturbance is generally acknowledged to be lower when compared to an activity such as use of air guns during 2D and 3D seismic and wind farm piling. Animals will have sufficient time to avoid the installation and survey vessels, and it is unlikely that they will swim over operating equipment.

The proposed activities will be restricted in duration and will progress slowly through the Proposed Development, with the zone of influence constantly moving. Assuming an average survey speed of 3.6km/hour the 37km route length within the SAC would be surveyed in approximately 10.5 hours. During the 10.5 hour period approximately 193km^2 of the site would experience a brief increase in underwater noise; equivalent to 2.6% of the site. Animals may actively avoid the activity, but will return to the area once the vessels have passed through. The Proposed Development will therefore not act as a barrier to movement, or cause significant short or long-term disturbance.

Screening Conclusion for continuous sound: No potential for LSE / AA is not required

Injury and disturbance from impulsive sound

It is unknown how many, if any, UXO detonations will be required within the Proposed Development. The Proposed Development passes through the Castlemartin Firing Range, so it is highly likely that UXO will be encountered. The Greenlink UXO desk-based assessment (1st Line Defence 2018) also identified a high-risk area in the St Georges Channel; a former WWII sea mine ground.

A UXO survey has been completed for the section of the Proposed Development within the Castlemartin Firing Range which has identified a few magnetic anomalies but there is sufficient space within the application area for the cable to be micro-sited around any potential UXO (in accordance with the decision-making process outlined in EM21 i.e. first avoid, then remove, and if neither previous option is feasible, detonate). An additional UXO survey will be completed ahead of the installation campaign to ensure that any new UXO or UXO that has moved is identified.

Should UXO be found which require clearance by detonation it is assumed that there would be a relatively large release of impulsive sound energy, creating high amplitude shock waves (von Benda-Beckmann et al. 2015). The precise injury effect range cannot be stated in advance of information on the nature and quantity of explosive material potentially involved, which will not be known until a UXO is identified. However, by making certain assumptions, Appendix A concluded that harbour porpoise are vulnerable to permanent injury within 23km and to temporary injury within 27km of the UXO detonation. Disturbance resulting from a single 794kg UXO detonation would cover an area of up to 9,160km^2.

The zone of influence for temporary injury (27km radial distance) would cover 2290km^2. This is equivalent to noise disturbance over 31% of the SAC area for a day. It is therefore considered significant disturbance.

Screening Conclusion for UXO detonation: Potential for LSE / AA is required.

4.3.5 Castlemartin Coast SPA

The intertidal area of the Proposed Development form KP0 to approximately KP0.33 is within the site. The SPA covers an area of 11.22km^2 as a linear strip along the coastline. Component SSSIs include Broomhill Burrows and Castlemartin Cliffs and Dunes, Stackpole and Stackpole Quay.

4.3.5.1 Conservation objectives

The conservation vision for Red-billed chough is:

- A breeding chough population will occur along the limestone coast, between Freshwater West and Barafundle Bay.
- This population will be maintained at a minimum of 12 breeding pairs (representing 3.5% of the GB population, at the 1993 SPA designation level)
- Choughs will continue to, feed, roost and breed successfully, unhindered by human recreational activities (e.g. climbing).
- The majority of pairs will rear young each year, with an annual average productivity of at least two young per occupied territory.
- Choughs will continue to have access to large amounts of optimal feeding habitat (open areas with very short grassland and heath vegetation <1cm to <3cm in height) within all cliff-top management units and within dune grassland management units at Broomhill Burrows, Brownslade and Linney Burrows and on Stackpole Warren.
- Yellow ant-hills, an important summer food resource, will occur in coastal turf, throughout the SPA, at densities up to approximately 550 ant-hills per ha.
- A non-breeding chough population (variable in number between 10 and 50 birds) made up largely of juvenile and sub-adult birds will occur at any season.

4.3.5.2 Assessment against conservation objectives

Around 4% of the UK population of chough occur within the SPA. There is regular interchange of the chough from this site and those from the adjacent Angle Peninsula Coast SSSI. In addition a number of other SSSIs within close proximity to the Proposed Development also list chough as a Qualifying Feature.

Appendix B provides background information on the species and the surveys which have been undertaken by GIL to inform assessment of effects. This information has been used to draw the following conclusions:

- The only area that is likely to be utilised by chough is within the Wales Onshore component of Greenlink; the HDD compound above Freshwater West.
- Chough were not recorded during a breeding bird survey of the compound.
- The wintering bird survey results indicated that a maximum of four red-billed chough were observed in the compound area at any given time (assumed to be two pairs) which represents 8% of the wintering Castlemartin Coast SPA population (cited as 24 pairs).
- The preliminary Onshore HRA (Arup 2018) concluded that there would be no likely significant effects on red-billed chough taking into account the distance from individual territories, the limited area affected by the works in relation to the available feeding habitat, combined with the temporary nature of the cable installation works, the subsequent reinstatement of the construction area and maintenance of the existing land management regime post-installation.

- The two closest chough territories to the Proposed Development landfall site (Parsons Quarry Bay on the Angle Peninsula and Furzenips on Freshwater West) are both approximately 1.5km from the Proposed Development.
- During the most sensitive time (breeding season) chough are likely to spend most of their time foraging between 100m to 300m from the nest, over 1km from the Proposed Development.
- Most disturbance occurs when people come within 35m of foraging chough.

In conclusion, the Proposed Development will not disturb foraging chough given the distance to the closest chough territories.

Screening conclusion: No potential for LSE / AA is not required

4.3.6 Grassholm SPA

4.3.6.1 Conservation objectives

The Qualifying Feature is Gannet. The vision for the feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The population will not fall below 30,000 pairs in three consecutive years.
- It will not drop by more than 25% of the previous year's figures in any one year.
- There will be no decline in this population significantly greater than any decline in the North Atlantic population as a whole (CCW 2008).

4.3.6.2 Assessment against conservation objectives

Disturbance is predicted to be limited to that initiated by the movement of the project vessels. Birds may take evasive action, but a single disturbance event does not have any immediate effect on the survival or productivity of an individual bird. Repeated disturbance, or disturbance over an extended period of time, can affect survival and productivity. Activities such as geophysical survey or cable installation will be discrete events, with the project vessel passing slowly through the Proposed Development following the cable centreline. Individual activities will typically be separated in time by a period of weeks, or months.

Gannet forage over large distances; Thaxter et al. (2012) estimate a maximum range of 590km during the breeding season. However, the Joint SNCB Interim Displacement Advice Note (2017) note that although their disturbance susceptibility score is 2, suggesting displacement is not of concern, there is empirical studies suggesting that they are sensitive to displacement. However, the Proposed Development will take place against moderate shipping activity in the region due to the presence of shipping routes to Milford Haven, and the presence of a traffic separation zone to the north of the Proposed Development through which ships transit in and out of the Irish Sea. Against this level of activity, the introduction of the project vessel(s) is unlikely to have any significant effect. Any disturbance

caused by the Proposed Development will be temporary in nature and limited in extent.

In addition, the Proposed Development passes >8.5km south of the island of Grassholm (i.e. outside of the zone of influence for disturbance).

Screening Conclusion: No potential for LSE/ AA is not required

4.3.7 Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC, North Anglesey Marine/ Gogledd Môn Forol SAC and North Channel SAC

4.3.7.1 Conservation objectives

The conservation objectives for the three sites are the same:

To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to maintaining Favourable Conservation Status for the UK harbour porpoise.

To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term:

1. The species is a viable component of the site.
2. There is no significant disturbance of the species.
3. The supporting habitats and processes relevant to harbour porpoises and their prey are maintained.

4.3.7.2 Assessment against conservation objectives

It is possible that harbour porpoise from these sites may be observed in the area given that the Proposed Development is located in the same management unit as these sites (Celtic and Irish Sea MU).

The zone of influence of disturbance from cable installation and the geophysical survey is small (2.6km). These sites are located between 20km and 279km from the Proposed Development. Therefore, noise generated from cable installation and geophysical survey will not result in significant disturbance to harbour porpoise from these sites. In addition, noise generated from cable installation and survey operations will not affect harbour porpoise habitat or prey items and harbour porpoise will still be a viable component of these sites.

If UXO detonation was required within the Proposed Development there is the potential that the zone of influence for disturbance (52km radial distance, based on 794kg detonation) would overlap with the closest of the sites (Bristol Channel Approaches / Dynesfeydd Môr Hafren SAC). However, the disturbance will be a brief one-off event (less than a day), potentially only overlapping with a small portion of

the site. Therefore, harbour porpoise will still remain a viable component of the site following detonation. In addition, the detonation would not significantly effect harbour porpoise habitat or prey items.

Screening Conclusion: No potential for LSE/ AA is not required

4.3.8 Cardigan Bay / Bae Ceredigion SAC and Pen Llyn a'r Sarnau / Lleyn Peninsula and the Sarnau SAC

4.3.8.1 Conservation objectives

The conservation objectives for the sites are to achieve and maintain in the long-term favourable conservation status for the species features. With respect to bottlenose dolphin this means:

- The population is maintaining itself on a long-term basis as a viable component of its natural habitat;
- The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing.

4.3.8.2 Assessment against conservation objectives

The initial screening (Table 4-3) concluded that there was a possible pressure-receptor pathway between the Proposed Development and the bottlenose dolphin Qualifying Feature of these two sites.

Bottlenose dolphin don't form a discrete site-based population within the two SACs but are part of the wider Channel and SW England management unit. Dolphins associated with the Cardigan Bay SAC move into and through the Pen Llyn a'r Sarnau SAC. Bottlenose dolphin have been observed within the Proposed Development (at densities of 0.06 animals per km^2), and as the species is highly mobile it is possible that animals from the two sites might be present during the planned activities.

The noise assessment presented in Appendix A concluded that the zone of influence of disturbance from cable installation and the geophysical survey is small (2.6km). These sites are located 72km and 124km from the Proposed Development. Therefore, noise generated from cable installation and geophysical survey will not result in significant disturbance to bottlenose dolphin from these sites. In addition, as there is no spatial overlap between the Proposed Development and the sites, noise generated from cable installation and survey operations will not affect

harbour porpoise habitat or prey items and harbour porpoise will still be a viable component of these sites.

If UXO detonation is required within the Proposed Development there is the potential that animals from the sites could be present within the zone of influence for disturbance (52km radial distance, based on 794kg detonation). The disturbance will be a brief one-off event (less than a day) and will not overlap with the site boundaries. The numbers of animals likely to be effected will be very small. Therefore, harbour porpoise will still remain a viable component of the site following detonation. In addition, the detonation would not significantly effect harbour porpoise habitat or prey items.

Screening Conclusion: No potential for LSE/ AA is not required

4.3.9 Carmarthen Bay and Estuaries / Bae Caerfyrddin ac Aberoedd SAC

4.3.9.1 Conservation objectives

Species - Twaite shad and Allis shad

To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status.

- Populations - The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements include: population size; structure, production; condition of the species within the site.
- Range - The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.

As part of this objective it should be noted that:

- Their range within the SAC and adjacent inter-connected areas is not constrained or hindered.
- There are appropriate and sufficient food resources within the SAC and beyond.
- The sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing
- Supporting habitats and species - The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include; distribution; extent; structure; function and quality of habitat; and prey availability and quality.

4.3.9.2 Assessment against conservation objectives

Twaite shad and Allis shad are members of the herring family, Clupeidae. Adults spend most of their time at sea in coastal waters but return to rivers in late spring (April – June) to spawn. Clupeids are high sensitivity hearing species are therefore will react to changes in underwater noise levels.

Marine cable installation, operation and decommissioning will generate underwater sound from a number of sources:

- Continuous sound sources e.g. vessel movements, cable laying, rock placement, geophysical survey; and
- Impulsive sound sources e.g. UXO detonation (if required).

An underwater noise assessment is presented in Appendix A. It considers the potential for injury and disturbance from the Proposed Development. It draws upon underwater noise modelling presented in the Greenlink Marine ES – Technical Appendix D which combined literature review with underwater sound modelling.

Continuous sound

Appendix A concluded that clupeids are expected to show strong avoidance behaviour (i.e. reaction by virtually all individuals) within 8m of the cable installation activities, whilst significant avoidance (85% of individuals will react to noise) is expected within 66m. The zone of influence for geophysical survey has been estimated as 2.2km.

The presence of several vessels and continued noise with 24-hour operations means it is likely that the most hearing specialist fish will demonstrate temporary avoidance behaviour from early on in and remain outside the zone influence of operations for the duration of the installation activities or geophysical survey. The works will not lead to any long-term displacements as they are transient and temporary. Individuals would be expected to be able to return once the operation had passed through.

The site is not within the zone of influence for the pressure and therefore there will be no direct effects on the conservation objectives e.g. activities will not reduce the range, populations or supporting habitats within the site.

The site has been screened as clupeids are mobile species and therefore individuals from the site could travel into the zone of influence. However, given the distance to the site (29km), and the large areas of available habitat, it is unlikely that significant numbers of individuals will be present. It is extremely unlikely that fish will experience a significant effect other than brief displacement from the immediate area surrounding the continuous noise source. Disturbance will therefore not affect the population.

Screening conclusion for continuous sound: No potential for LSE/ AA is not required

Impulsive sound – UXO detonation

If UXO detonation is required within the Proposed Development there is the potential that fish from the site could be present within the zone of influence for permanent injury (6.2km radial distance, based on 794kg detonation). The pressure change will be a brief one-off event (less than a day) and will not overlap with the site boundaries. The numbers of animals likely to be effected will be very small. Therefore, Twaite shad and Allis shad will still remain a viable component of the site following detonation. In addition, the detonation would not significantly effect habitat or prey items.

Screening conclusion for impulsive sound: No potential for LSE/ AA is not required

4.3.10 Broomhill Burrows SSSI

The site covers 2.01km^2 and includes the intertidal area at Freshwater West down to the low water mark. The Proposed Development lies within the site from KP0 to KP0.33.

4.3.10.1 Conservation objectives

To maintain, conserve or restore biodiversity, natural heritage, habitats, species or landscapes with legal protection status.

4.3.10.2 Assessment against conservation objectives

Table 4-2 concluded that there was possible pressure-receptor pathway between the Proposed Development and two bird species listed as Qualifying Features of the site; red-billed chough, and lapwing.

The site is a component feature of the Castlemartin SPA. The assessment against the conservation objectives for the Castlemartin SPA in relation to chough concluded that there is no potential for LSE.

Lapwing breed in the dune system above MHWS; outside of the Proposed Development. As there will be no works between MHWS and the low water mark it is unlikely that vessels in the nearshore area will disturb nesting birds.

Screening conclusion: Conservation objectives will not be hindered

4.3.11 Angle Peninsula Coast SSSI

The SSSI covers an area of 1.34km^2 and is approximately 60m NW of the Proposed Development at the Freshwater West landfall.

4.3.11.1 Conservation objectives

To maintain, conserve or restore biodiversity, natural heritage, habitats, species or landscapes with legal protection status.

4.3.11.2 Assessment against conservation objectives

Table 4-4 concluded that there was possible pressure-receptor pathway between the Proposed Development and the Qualifying Feature red-billed chough.

The SSSI supports a small breeding population (usually one to two pairs a year), and roosting areas for a significant proportion of the South Pembrokeshire non-breeding population of chough. There is a communal roost in the Whitedole/South Studdock area within the SSSI which is regularly occupied by up to 15 chough and there are a number of available nest sites along the cliffs, one or two of which are occupied each year. There is regular interchange of the chough from this site and those from the neighbouring Castlemartin Coast SPA.

Appendix B provides background information on the species and the surveys which have been undertaken by Greenlink Interconnector Limited to inform assessment of effects. This information has been used to draw the following conclusions:

- The only area that is likely to be utilised by chough is within the Wales Onshore component of Greenlink; the HDD compound above Freshwater West.
- Chough were not recorded during a breeding bird survey of the compound.
- The wintering bird survey results indicated that a maximum of four red-billed chough were observed in the compound area at any given time (assumed to be two pairs) which represents 8% of the wintering Castlemartin Coast SPA population (cited as 24 pairs).
- The preliminary Onshore HRA (Arup 2018) concluded that there would be no likely significant effects on red-billed chough taking into account the distance from individual territories, the limited area affected by the works in relation to the available feeding habitat, combined with the temporary nature of the cable installation works, the subsequent reinstatement of the construction area and maintenance of the existing land management regime post-installation.
- The two closest chough territories to the Proposed Development landfall site (Parsons Quarry Bay on the Angle Peninsula and Furzenips on Freshwater West) are both approximately 1.5km from the Proposed Development.
- During the most sensitive time (breeding season) chough are likely to spend most of their time foraging between 100m to 300m from the nest, over 1km from the Proposed Development.
- Most disturbance occurs when people come within 35m of foraging chough.

In conclusion, the Proposed Development will not disturb foraging chough given the distance to the closest chough territories.

Screening conclusion: Conservation objectives will not be hindered

4.3.12 Castlemartin Range SSSI

This site is a component part of the Castlemartin Coast SPA. It covers an area of 20.89km^2 and lies 0.54km from the Proposed Development.

At this site, an open cliff top with grazed pasture supports 15-20 pairs of chough at one of its main breeding locations in west Wales.

4.3.12.1 Conservation objectives

To maintain, conserve or restore biodiversity, natural heritage, habitats, species or landscapes with legal protection status.

4.3.12.2 Assessment against conservation objectives

Table 4-4 concluded that there was possible pressure-receptor pathway between the Proposed Development and two Qualifying Features red-billed chough and breeding seabirds.

The site is a component feature of the Castlemartin SPA. The assessment against the conservation objectives for the Castlemartin SPA in relation to chough concluded that there is no potential for significant effects.

With respect to the Qualifying Feature breeding seabirds, the coastal cliffs within the site support the largest concentration of breeding seabirds on the Pembrokeshire mainland, with about 12,000 – 16,000 individual guillemots (*Uria aalge*), and 800 – 1,100 razorbills (*Alca torda*), mainly nesting at Stack Rocks. Other smaller colonies are scattered along the cliffs opposite the Stacks, and elsewhere on the Range, at locations such as Mewsford Point. A small (currently declining) number of kittiwakes (*Rissa tridactyla*) also breed, along with a few puffins (*Fratercula arctica*). Other breeding seabirds include fulmar (*Fulmarus glacialis*), lesser black-backed gull (*Larus fuscus*), herring gull (*L. argentatus*) and shag (*Phalacrocorax aristotelis*).

Although the Proposed Development lies 0.54km from the SSSI, the coastal cliffs are approximately 2.9km at the closest point (Brimstone Rock) from the Proposed Development. Stack Rocks, where the greatest concentration of seabirds are, is further south around the coast, approximate 8km distant (in a straight line across land) from the Proposed Development. Mewsford Point is 9.5km from the Proposed Development.

It is possible that birds will use the Proposed Development e.g. for foraging, loafing, bathing, flying across. However, given the distances to the sea cliffs, nesting birds within the site will not be disturbed. Any disturbance caused by project vessels will be temporary in nature and limited in extent. Birds will be able to return to the area shortly after the vessels have passed through. The area is subject to moderate levels of shipping, fishing and recreational activity and against this baseline the addition of a few vessels is unlikely to be noticeable within the normal day-to-day and seasonal changes in activity levels.

Screening conclusion: Conservation objectives will not be hindered

4.4 Possible in-combination effects

The Habitats Directive requires that plans or projects are assessed alone and in-combination with other plans or projects to determine whether a likely significant effect to European sites could occur. Only plans or projects that would increase the likelihood of significant effects should be considered.

The nature of a linear interconnector cable project mean that the majority of potential pressures result in short term and localised effects. Most effects, as a result of the Proposed Development, will be restricted to a zone within 10km either side of the Proposed Development. An initial area of search of 10km has therefore been applied either side of the Proposed Development to identify plans and projects for inclusion within this assessment.

Known types of projects and plans considered include:

- Renewable energy projects i.e. offshore wind farms;
- Sites for marine aggregate dredging and disposal;
- Cables and pipelines;
- Oil and gas exploration and development;
- Carbon Capture and Storage; and
- Military Practice Areas.

Projects and plans have been identified through desktop review of published information[2] and through consultation with stakeholders e.g. NRW, The Crown Estate, Marine Energy Wales, Bombora Wave Power and Ministry of Defence.

Commercial fisheries, shipping interests and recreational use has been scoped out of the list of projects as they are considered to represent baseline conditions, and are not considered as projects and plans.

Table 4-5 identifies known developments situated within 10km of the Proposed Development.

[2] Data sources included: UKDEAL; National Infrastructure Planning website; Natural Resources Wales website; Marine Energy Wales website; The Crown Estate Website, Oil and Gas Authority activity maps.

Table 4-5 Projects and Plans within 10km of the Proposed Development

Project Category	Name / Type of Project		Status	Operator/Owner/ Other Details	Distance*
Disposal sites	Milford Haven (LU170)		Closed	Milford Haven Port Authority (MHPA)	0.25km
	Milford Haven Three (LU169)		Open	MHPA	8km
	St Ann's Head (LU180)		Closed	MHPA	2km
	Neyland (LU190)		Open	MHPA	10km
	Munitions dump sites (two delineated)		Disused	MOD	1.2km 4km
Cables	Pan European Crossing 2 (Telecom)		Active	Century Link (Level 3)	0km
	Submarine cables in the estuary (Milford Haven)		Unknown	Unknown	5km
Dredging	Maintenance dredging		Active	MHPA	3km
Military Practice area	Castlemartin Firing Range		Active	MOD	0km
Marine energy	Marine energy test area (META)	Site 8	Proposed	Marine Energy Wales	0km
		Site 7			6km
		Site 1-5			8km
	Bombora Wave Power Seacam device (linked to META 8)		Prospective	Bombora Wave Power	0km
	Wave Dragon Test Site		Prospective	Wave Dragon Wales Ltd	3.5km
Scientific Surveys	Marker buoy deployment		Installed	Bombora Wave Power	0km
	Bangor University Scientific Research Surveys		Licence	Bangor University	0.5km
	Deposit of scientific experiment and marker buoys		Licence	University College of Swansea	0.5km
	MacroBioCrude project		Uncertain (Licence until 2018)	Swansea University	8-10km
	Marine Benthic Invertebrate / Sediment Grab Sampling		Proposed	Natural Resources Wales	2.2km
Oil and Gas	Seismic survey		Prospective	ENI UK	2km
	Wellhead 50/10-1		Disused	Mobil	9.5km
Construction	Milford Haven Port Development		Prospective	Milford Haven Port Authority	7km
	Neyland Yacht Haven Marina (Piling works)		Active	Neyland Yacht Haven Ltd	10km
	Salvaging of anchors and chains		Licence	Mr J Middleton	4 km
	Jetty Maintenance		Licence	Puma Energy (UK) Ltd	5 km
	Deposit of a temporary trackway and jetty		Licence	REM Engineering Limited	4.5km

* Closest distance to Proposed Development

For there to be a potential cumulative effect (PCE) the Proposed Development and another project or plan there must be a common pressure-receptor pathway which overlaps spatially and temporally. A screening exercise has been undertaken, presented below, to determine if any of the projects or plans identified have:

a. A common-pressure receptor pathway with the Proposed Development (Section 4.4.1.2);

c. Activities, the effects of which overlap spatially with the Proposed Development (Section 4.4.1.3); and

d. Activities, the effects of which overlap temporally with the Proposed Development (Section 4.4.1.4).

4.4.1.2 Common pressure-receptor pathway assessment

The projects fall into eight categories. An activity / pressure/ receptor matrix for these eight categories has been developed (Table 4-6) to define the common pressures associated with the project types, and which receptors can be effected. Where pressures where identical the categories have been grouped together for presentation purposes. If there is no common pressure-receptor pathway the project pressure is screened out.

Table 4-6 Activity / pressure / receptor matrix for identified projects

Category	Phase	Pressure	Receptors			
			Habitats	Fish	Birds	Marine Mammals
Disposal sites Dredging	Operation	Siltation rate changes	■			
		Disturbance			■	
		Underwater noise changes		■		■
		Physical change (to another seabed type)	■			
Cables Marine Energy Scientific surveys	Installation and Repair	Penetration and/or disturbance including abrasion	■			
		Siltation rate changes	■			
		Hydrological changes (inshore/ local)	■			
		Physical change (to another seabed type)	■			
		Disturbance			■	
		Underwater noise changes		■		■
Military Practice Area Oil and gas	Operation	Disturbance			■	
		Underwater noise changes		■		■
Construction	Installation	Penetration and/or disturbance including abrasion	■			
		Siltation rate changes	■			
		Physical change (to another seabed type)	■			
		Disturbance			■	
		Underwater noise changes		■		■

4.4.1.3 Spatial overlap assessment

Of the projects listed in Table 4-6, Milford Haven (LU170), St Ann's Head (LU180), the two munitions dump sites, and well head 50/10-1 have been screened out from further consideration. All sites are closed or decommissioned and no further activities that could affect the environment will be associated with them.

For there to be a potential cumulative effect (PCE) the effects from the Proposed Development and other plans and projects must overlap spatially. If there is no spatial overlap between the pressures, the pressure from the plan or project can be screened out at this stage. Table 4-7 presents an assessment of the projects to determine if spatial overlaps exist with the Proposed Development.

Table 4-7 Spatial overlap assessment

Key	Screened out – No common pressure-receptor pathway	Screened out – Common pressure receptor pathway but outside Proposed Development zone of influence	Screened in – Common pressure receptor pathway and within Proposed Development zone of influence

Project		Distance*	Greenlink pressures and zone of influence (km)					
			Penetration and/or disturbance including abrasion	Siltation rate changes	Hydrological changes (inshore/ local)	Physical change (to seabed another type)	Disturbance	Underwater noise changes
			0.02	0.10	0.00	0.01	4.00	2.60
Milford Haven Three (LU169)		8						
Neyland (LU190)		10						
Pan European Crossing 2 (Telecom)		0						
Submarine cables in the estuary (Milford Haven)		5						
MHPA Maintenance dredging		3						
Castlemartin Firing Range		0						
Marine energy test area (META)	Site 8	0km						
	Site 7	6km						
	Site 1 - 5	8km						
Bombora Wave Power Seacam device (linked to META 8)		0						
Wave Dragon Test Site		3.5						
Marker buoy deployment		0						
Bangor University Scientific Research Surveys		0.5						
Deposit of scientific experiment and marker buoys		0.5						
MacroBioCrude project		8-10						
Marine Benthic Invertebrate / Sediment Grab Sampling		2.2						
Seismic survey		2						
Milford Haven Port Development		7						
Neyland Yacht Haven Marina (Piling works)		10						
Salvaging of anchors and chains		4						
Jetty Maintenance		5						
Deposit of a temporary trackway and jetty		4.5						

4.4.1.4 Temporal overlap assessment

Although Table 4-7 has determined that there is a spatial overlap between twelve projects and the Proposed Development, the effects must overlap temporally as well as spatially for there to be a PCE. If there is no temporal overlap between projects the project is screened out.

Table 4-8 Temporal overlap assessment

Name / Type of Project	Status	Conclusion
Pan European Crossing 2 (Telecom)	Installed	Cable is installed so any repairs will be on an adhoc basis. No confirmed schedule - Screened out
MHPA Maintenance Dredging	Active	License active until 2022 - Potential for temporal overlap
Castlemartin Firing Range	Active	Range is active with ongoing exercises - Potential for temporal overlap
Bombora Wave Power Seacam device (META8)	Proposed	Consultation with Bombora Wave Power indicates deployment of advice is expected in 2020 for a duration of 6-12 months - Potential for temporal overlap
Wave Dragon	Proposed	No confirmed schedule for the project - Screened out
Marker buoy deployment	Installed	License active until 2019 - No temporal overlap - Screened out
Bangor University Scientific Research Surveys	Licensed	License is valid until 2021 but there is no confirmed schedule - Screened out
Deposit of scientific experiment and marker buoys	Licensed	License expires in 2019 - No temporal overlap - Screened out
Marine Benthic Invertebrate / Sediment Grab Sampling	Renewal license	License expires in 2021 - Potential for temporal overlap
Seismic survey	Proposed	No confirmed schedule for the project - Screened out
Salvaging of anchors and chains	Licensed	License expires in 2021 - No temporal overlap - Screened out

4.4.1.5 Potential for cumulative effects

Five projects have been screened in to be assessed for PCE. The potential for the projects to increase the likelihood of the Proposed Development having a LSE on a European site is discussed below.

MHPA Maintenance Dredging

The common pressure receptor-pathway between this project and the Proposed Development is disturbance to birds. The project and the Proposed Development are set against a background of moderate shipping activity associated with the shipping routes to, from and within Milford Haven. The two projects will only contribute an additional one or two vessels to this background level at any one time, which is within the seasonal and daily fluctuations experienced in the area. Therefore there is no potential for a PCE.

Castlemartin Firing

The common pressure-receptor pathway between this activity and the Proposed Development is disturbance to birds and underwater noise changes effecting fish and marine mammals. The Castlemartin Firing Range is an active military exercise area. However, grey seal and seabirds still use the coastline of the range for breeding. This suggests that they are habituated to the noise levels and activities associated with the range. Screening of the Proposed Development identified that there is the potential for LSE on grey seal and harbour porpoise from the detonation of UXO (if required). The detonation will be a brief one-off event. As there will not be continued disturbance it will not accumulate with the activities associated with the Castlemartin Firing Range. There is no potential for PCE.

Bombora Wave Power Seacam Device (META Site 8)

Six common pressure-receptor pathways were identified between the Bombora Wave Power project and the Proposed Development.

The Bombora Wave device will be a temporary gravity based structure (i.e. it will not require intrusive anchoring or piles to keep it in place), installed at the 10m water depth contour. It will have a footprint of approximately 75m x 16m (1200m^2). The location of the device will be in sandy sediments which are not a Qualifying Feature of the Pembrokeshire Marine SAC.

Bombora Wave Power are currently considering the possibility of connecting the device to land via a data cable. There are several options for the cable protection and route. It is expected the cable would be surface laid and protected with clam shells. It is possible that rock protection may be used but this could not be confirmed during the HRA process.

Based on the information available and in the absence of information regarding a possible cable route or external cable protection Table 4-9 presents the assessment of the likelihood of PCE.

Table 4-9 Assessment of PCE between Bombora Wave Power and Proposed Development

Pressure	Justification	Conclusion
Penetration and/or disturbance including abrasion	The footprint of the structure and the Proposed Development installation will both temporarily disturb habitat defined as EUNIS habitat 'A5.261 *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment'. MarLIN (2019) class this habitat as having low sensitivity to the pressure. The habitat is therefore expected to recover quickly following disturbance. Given the small footprints of both the proposed development and the Bombora Wave Power device in this area and the fact that the habitat is not a Qualifying Feature of the Pembrokeshire SAC the assessment concludes no PCE.	No PCE
Siltation rate changes	The Proposed Development will only have a brief effect on suspended sediment concentrations. Similarly, the Bombora Wave Power device is likely to have a brief effect on suspended sediment concentrations during installation. However, both effects will be within the natural background range experienced in the region (e.g. after storm events).	No PCE

Pressure	Justification	Conclusion
Hydrological changes (inshore/ local)	The Proposed Development will not have an effect on the hydrology at Freshwater West and therefore there is no potential for a PCE with the Bombora Wave Power device	No PCE
Physical change (to another seabed type)	The Proposed Development will cause localised physical changes to seabed conditions where external cable protection is required. It has been identified that there will be LSE on the Pembrokeshire Marine SAC Qualifying Feature Reef. The Bombora Wave Power device gravity structure will also change the seabed type; from sand to an artificial structure. However, this will be a short-term change and when the gravity base foundations are removed, the habitat will return to pre-installation conditions. The structure is not within a Qualifying Feature of the Pembrokeshire Marine SAC. Given the small size of the change and the fact that the Bombora Wave power device will not affect the conservation objectives for the Qualifying Feature Reef it is concluded there will be no PCE. It is unknown whether there will be external cable protection and therefore this aspect cannot be assessed.	No PCE
Disturbance	The Stage 1 Screening assessment concluded that there was no LSE on the Bird Qualifying Features of any of the European sites that the Proposed Development crosses or is close to. There is limited information available on the Bombora Wave Power project, but it is assumed that installation will require the temporary presence of one of more vessels, similar to cable installation. The device will be installed ahead of the Proposed Development installation and therefore it is unlikely that there will be temporal overlap of activities. If there is, then there is the potential that birds will be disturbed by two sets of nearshore activities. However, the significance of this will be negligible with no long-term effects on populations.	No PCE
Underwater noise changes	Bombora Wave Power confirmed that they will not be applying for consent to detonate UXO.	Not assessed

Marine Benthic Invertebrate / Sediment Grab Sampling

The common pressure-receptor pathway between this project and the Proposed Development is disturbance to birds and underwater noise changes. Stage 1 Screening concluded that the Proposed Development will not have a LSE on birds or marine mammals from the presence of the project vessels or the generation of continuous noise. There is limited information available on the survey but it is assumed that it would involve the presence of one or more vessels generating underwater noise levels similar to a standard vessel. Therefore there will be no PCE.

4.4.1.6 Conclusion

The assessment has screened projects within 10km of the Proposed Development. It has concluded that there will be no PCEs between the Proposed Development and any other known project, plan or activity.

4.5 Screening Statement and Conclusions

To determine whether the Proposed Development is likely to have a significant effect on any European sites, either individually or in-combination with other plans or projects, AA screening was carried out.

The screening assessed twelve European sites that were either within the direct zone of influence of the Proposed Development or contain mobile Annex II species which could potentially travel into the Proposed Development. In addition, twelve SSSIs and one MCZ was also screened.

A review of the Proposed Development identified seven pressures that could be exerted on Qualifying Features during installation, maintenance, repair, operation and decommissioning. These were:

- Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion
- Siltation rate changes, including smothering (depth of vertical sediment overburden)
- Hydrological changes (inshore/local)
- Physical change (to another seabed type)
- Disturbance
- Underwater noise changes
- Electromagnetic changes

Sites were assessed to determine if there was a potential pressure-receptor pathway between the Proposed Development and the Qualifying Feature(s).

Initial screening concluded, that it is considered possible that there exists a pressure-receptor pathway between the Proposed Development and the Qualifying Features of eleven of the twelve European sites reviewed, and three of the twelve SSSIs assessed (Table 4-6). Further analysis of the LSEs taking into consideration the sites conservation objectives identified two sites, where it cannot be ruled out that the Proposed Development will not have a LSE. Table 4-10 summarises the conclusions of the assessment of LSE.

Twenty-six other projects or plans within 10km of the proposed Development were also assessed to determine it there was a potential for cumulative effects on the European Sites. No PCEs were identified.

Screening has concluded that Appropriate Assessment is required for:

- Pembrokeshire Marine / Sir Benfro Forol SAC (site code: UK0013116)
- West Wales Marine / Gorllwein Cymru Forol SAC (site code: UK0030397)

Table 4-10 Summary – Potential for likely significant effects

Site Name & Code	Applicable Qualifying Feature	Potential Pressure on Site	Conclusion
Pembrokeshire Marine / Sir Benfro Forol SAC UK0013116	Reef	Penetration and/or disturbance including abrasion Physical change (to another seabed type)	Potential LSE. AA is required
	Sandbanks which are slightly covered by seawater all the time	Penetration and/or disturbance including abrasion	No potential for LSE / AA is not required
	Mudflats and sandflats not covered by seawater at low tide	Hydrological changes	No potential for LSE / AA is not required
	Grey seal	Underwater noise changes - UXO detonation	Potential for LSE. AA is required
		Disturbance (visual)	No potential for LSE / AA is not required
	Otter	Underwater noise changes Disturbance	No potential for LSE / AA is not required
	Allis shad	Underwater noise changes	No potential for LSE / AA is not required
	Twaite shad	Underwater noise changes	No potential for LSE / AA is not required
Skomer, Skokholm and the seas off Pembrokeshire /Sgomer, Sgogwm a moroedd Penfro SPA UK9014051	Breeding birds	Disturbance	No potential for LSE / AA is not required
West Wales Marine / Gorllewin Cymru Forol SAC UK0030397	Harbour porpoise	Underwater noise changes - UXO detonation	Potential for LSE. AA is required
Castlemartin Coast SPA	Red-billed chough	Disturbance	No potential for LSE / AA is not required
Grassholm SPA UK9014041	Gannet	Disturbance	No potential for LSE / AA is not required
Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC UK0030396	Harbour porpoise	Underwater noise changes	No potential for LSE / AA is not required
North Anglesey Marine / Gogledd Môn Forol SAC UK0030398	Harbour porpoise	Underwater noise changes	No potential for LSE / AA is not required
North Channel SAC UK0030399	Harbour porpoise	Underwater noise changes	No potential for LSE / AA is not required
Carmarthen Bay and Estuaries / Bae	Allis shad	Underwater noise changes	No potential for LSE / AA is not required

Site Name & Code	Applicable Qualifying Feature	Potential Pressure on Site	Conclusion
Caerfyrddin ac Aberoedd SAC UK0020020	Twaite shad	Underwater noise changes	No potential for LSE / AA is not required
Bae Ceredigion / Cardigan Bay SAC UK0012712	Bottlenose dolphin	Underwater noise changes	No potential for LSE / AA is not required
Pen Llyn a'r Sarnau / Lleyn Peninsula and the Sarnau SAC UK0013117	Bottlenose dolphin	Underwater noise changes	No potential for LSE / AA is not required
Broomhill Burrows SSSI 1136	Red-billed chough	Disturbance	Conservation objectives will not be hindered
Arfordir Penrhyn Angle / Angle Peninsula Coast SSSI 0923	Red-billed chough	Disturbance	Conservation objectives will not be hindered
Castlemartin Range SSSI 0140	Breeding seabirds	Disturbance	Conservation objectives will not be hindered

5. Stage 2 – Information to Inform Appropriate Assessment

5.1 Introduction

The Stage 1 Screening documented in Section 4 concluded that there is the potential for likely significant adverse effects on the following two sites and that an AA is required:

- Pembrokeshire Marine / Sir Benfro Forol SAC (site code: UK0013116)
- West Wales Marine / Gorllwein Cymru Forol SAC (site code: UK0030397)

The AA is a focused and detailed impact assessment of the implications of the plan or project alone and in combination with other plans and projects, on the integrity of a European site in view of its conservation objectives. It is undertaken by the competent authority, which for Marine Licence applications is the Welsh Government, supported by NRW. To inform the AA, the proponent of the plan (i.e. Greenlink Interconnector Limited) must provide 'Information to Inform AA' which provides data and information on the project and an analysis of potential effects on the European site.

Welsh Government (2017) guidance on Stage 2 simply states the developer should *"Provide information to the competent authority as reasonably required for the purposes of assessing the implications for N2K* [European] *sites in light of relevant conservation objectives. Draft a report to inform the competent authority's Appropriate Assessment."*

In the absence of more specific guidance, the Irish National Parks & Wildlife Service (NPWS) 2012 guidance has been followed. This has been used for the Irish Marine component of Greenlink, and therefore provides a common standard across the project.

The NPWS guidance (2012) on the content of the Stage 2 Information to Inform AA (referred to as Natura Impact Assessment in Ireland) states:

"The more detailed ecological assessment of proposed activities requires that two key questions be addressed: 'What are the likely impacts of the proposed activity?' and 'How quickly could the qualifying interest recover from the impact, if at all?'".

The guidance identifies questions which should be considered when providing information to support the AA for habitats and species Qualifying Features.

This Stage 2 - Information to Inform AA draws on information provided in the HRA as outlined in Table 5-1. It considers the two sites for which the potential for a LSE has been identified and provides further assessment of the significant effects on the Qualifying Feature(s) of these sites. Where appropriate it proposes mitigation measures which could be taken by GIL to reduce the significance of effects.

Table 5-1 Cross-reference to other supporting information

Relevant information	Section
Description of the Project	Section 3
Conservation objectives of the European site	Section 4.3
Assessment of aspects of the Proposed Development which could negatively affect the conservation objectives of the European site	Section 4.3

5.2 Pembrokeshire Marine / Sir Benfro Forol SAC

5.2.1 Qualifying Feature - Reef

5.2.1.1 Screening conclusion

The AA screening identified that there is the potential for a LSE on the Qualifying Feature Reef from the following pressures:

- penetration and/or disturbance including abrasion; and
- physical change (to another seabed type).

The conservation objectives for the Qualifying Feature are:

To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status.

- Range - The overall distribution and extent of the habitat features within the site, and each of their main component parts is stable or increasing.
- Structure and function - The physical biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded. Important elements include; geology; sedimentology; geomorphology; hydrography and meteorology; water and sediment chemistry; and biological interactions.
- Species - The presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded. Important elements include: species richness; population structure and dynamics; physiological health; reproductive capacity; recruitment; mobility; and range.

The AA screening concluded that in relation to the conservation objectives the two pressures have the potential to effect the range, structure and function, and have localised effects on species abundance.

5.2.1.2 Assessment of effects

Background Information

A detailed assessment of effects on Reef habitat has been provided in the Greenlink Marine ES – Wales; Chapter 7 Benthic and Intertidal Ecology. The assessment provided here summarises the pertinent information and relates it to the conservation objectives to determine if there will be a significant adverse effect on the SAC. For ease of reference, the Greenlink Marine ES – Wales Chapter 7 has been provided as Appendix C.

All three sub-types of Reef habitat were identified by the cable route survey within the Proposed Development; Bedrock Reef, Stony Reef and Biogenic Reef. The location of the habitat in relation to the indicative centreline and Proposed Development boundaries is displayed in Appendix C, Figures 7-10 to 7-13 (Drawings P1975-HAB-005, P1975-HAB-004 Sheet 2, P1975-HAB-006, and P1975HAB- 004 Sheet 5).

Cable installation is a one-off event, but the seabed along the cable centreline could be disturbed on two to three discrete occasions within approximately a three month period. The first occasion will be for any seabed preparation works e.g. boulder clearance; the second occasion will be the pre-lay grapnel run; and the third occasion will be the cable lay and burial or protection. These activities will be within the same zone of influence. When assessing the significance of the effect the assessment has considered the cumulation of these activities.

The potential for LSEs on each of the conservation objectives is discussed in turn below.

Range (Distribution and Extent)

The extent of Reef habitat within the SAC is reported as 409.97km^2 (40997.43 hectares) (JNCC 2016). Maps showing the extent of 'Reef' habitat are available from the JNCC, which classifies the area according to confidence in the presence of the habitat. The JNCC maps indicate a slightly higher estimate of Reef in the SAC although confidence in some areas is given as low. The habitat maps indicate Bedrock Reef covers an area of 377km^2, whilst Stony Reef covers 70km^2. In addition, the Reef extends outside of the SAC boundaries. No areas of Biogenic Reef have been indicated as present within the SAC.

Three aspects of the Proposed Development have the potential to have a LSE on the Qualifying Feature (QF): boulder clearance, cable burial, and deposition of external cable protection. Table 5-2 provides a summary of the footprints of these aspects in relation to each Reef sub-type. Table 5-3 presents calculations to show that the extent of Reef effected is equivalent to 0.031% of the habitat within the SAC.

Table 5-2 Footprint of activities within Reef habitat

Reef sub-type	Aspect	Location	Footprint (km^2)	Extent of QF in SAC (km^2)	% of QF affected
Bedrock Reef	External cable protection	KP2.38 - KP2.41	0.0003 (10m x 30m)	377	0.00008
Medium Grade Stony Reef	Boulder clearance Cable burial External cable protection	KP15 - KP23	0.08 (10m x 8000m)	70	0.11
Biogenic Reef - Potential	Cable burial	KP43.9 - KP45.23	0.02 (15m x 1330m)	Unknown - not previously recorded in SAC	-
		KP45.6 KP46.6	0.015 (15m x 1000m)		
Low-grade Biogenic Reef		KP40.9 - KP41.7	0.012 (15m x 800m)		

Table 5-3 Percent of Reef Qualifying Feature affected

Aspect	Footprint (km^2)	Extent of QF in SAC (km^2)	% of QF affected
Boulder clearance / cable burial (only)	0.047	409.97	0.011%
External cable protection	0.0803		0.02%
Total	0.1273		0.031%

It should be noted that other areas of Reef were identified in the Proposed Development but there is sufficient room that these areas can be micro-routed around without effects.

The indicative Greenlink centreline also crosses the Bedrock Reef habitat at approximately KP5 for 140m. However in this area, bathymetry data and video transect T06 identify a narrow (approximately 20m wide) channel through which installation is feasible. It is possible that this may be a thin veneer of sediment over the bedrock and therefore external cable protection will be required, but Appendix C, Figure 7-16 (Drawing P1975-SURV-008) shows that the Bedrock Reef habitat is not present in this channel. Sediments are sandy and similar to those identified on Turbot Bank, directly to the west.

The preference is to bury the cables in the seabed as this provides the best protection, and minimises environmental effects (embedded mitigation EM15). Table 5-3 identifies that the cable routes crosses low grade and potential Biogenic Reef where cable burial will be possible but that the features cannot be avoided i.e. through micro-routeing. It is calculated that 0.047km^2 of Biogenic Reef habitat will be disturbed by cable installation.

External cable protection will be required in two habitats; Bedrock Reef and medium grade Stony Reef. It is calculated that 0.0803km^2 of habitat would be affected by external cable protection. The external cable protection will change the seabed in this area, but will provide a similarly hard substrate for colonisation.

The habitats within the affected areas has been classified by the cable route survey as:

- A4.138 - *Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock (Bedrock Reef);
- A5.141 *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles (medium grade Stony Reef); and
- A5.611 *Sabellaria spinulosa* on stable circalittoral mixed sediment (Biogenic Reef).

It is likely that a high proportion of the benthic invertebrates within the width of the footprint, will be susceptible to mortality, injury or displacement as a result of the activities. The habitat beneath the external cable protection will be completely removed. The three habitats identified are characterised by fragile sessile or slow moving species such as *Sabellaria spinulosa*, ascidians (sea squirts), hydroids, bryozoans and barnacles.

The Marine Life Information Network (MarLIN) was used to determine the sensitivity of habitats to the pressure penetration and disturbance including abrasion. Appendix C, Table 7-8 and Section 7.6.2.1 presents the assessment which concluded:

- Habitat A4.138 (Bedrock Reef) has low sensitivity to abrasion. The characterising species, *Molgula manhattenis* is a small solitary ascidian (sea squirt) which can form dense aggregations. It is short-lived with a life-span of less than 1 year and reproduces several times during this period. Recruitment is generally from existing individuals no more than a few kilometres away, but the fast growth rates means recolonization, and a dense cover can be established within about two months of disturbance (Stamp 2016).
- Habitat A5.141 (medium grade Stony Reef) has low sensitivity to the penetration and abrasion. The fauna associated with this habitat are typically fast-growing epifauna, that are opportunistic as the habitat experiences seasonal and sporadic cycles of severe scour. The pebbles and cobbles are likely to be moved by the tidal streams in the region, which will be more severe during winter storms. The habitat covers an extensive area within the Proposed Development, in comparison to the footprint of cable installation and there will be a good larval supply to support colonisation of the disturbed area. Evidence suggests that recolonization of disturbed habitat will occur within one year post-disturbance (Tillin and Tyler-Walters 2016).
- Habitat A5.611 (Biogenic Reef) has medium sensitivity to the pressure. The Biogenic Reef within the direct path of cable installation is low grade or

potential reef. Recovery rates are likely to be determined by a range of factors such as degree of effect, the season of effect, larval supply and local environmental factors. However, evidence suggests that recovery could be rapid (within weeks) but is more likely to occur within two years (Tillin et al 2018).

Where external cable protection is installed, the underlying Reef habitat will be lost, but it will be replaced by a suitable hard, stable habitat for colonising communities. The rock berm might be a slightly less complex habitat than that which occurs naturally, which might result in a comparative reduction in the diversity of species. However, there is sufficient habitat in the surrounding area to allow recruitment and colonisation of the rock berm.

Based on the information above, in areas where burial in sediment is achieved the Biogenic Reef will recover in the short-term, maintaining the extent of the habitat in the long-term. The external cable protection will also be suitable for colonisation, and given the species present in the area, it is expected that colonisation of the new substrate will also occur in the short-term.

As the habitat will recover following installation, the overall distribution and extent of the habitat will not decrease in the long-term and there will no significant effect on the conservation objective.

Structure and Function

Cable jetting and trenching will not alter or contaminate the underlying sediments. There may be a fractional coarsening of sediments, as finer silts are suspended by the burial process. However, this is unlikely to have any significant effect, given the narrow trench size (1m).

If jetting or trenching is feasible in the area of medium grade Stony Reef, the cobbles will be used to cover the cable, returning the seabed to a similar state as pre-installation.

Where external cable protection is deposited, the seabed height will become elevated in comparison to the surrounds. Large boulders have been observed in the area up to 2m high and therefore structures of this height are not uncommon in the area. Camera drops on these boulders were undertaken during the cable route survey. Imagery indicates the presence of habitat A4.111 - *Balanus crenatus* and *Tubularia indivisa* on extremely tide-swept circalittoral rock. This biotope is characterised by a few species that are capable of maintaining a strong foothold in strong tides, either by forming a flat adherent crust, or by having strong attachment points. Species typically associated with the biotope include hydroids, sponges and anemones, as well as mobile species such as starfish, crab and whelk (Tillin 2016). The species associated with the biotope grow rapidly, are short-lived, and generally thought of as early colonisers of bare surfaces. Tillin (2016) cite evidence of *Balanus crenatus* colonising artificial reef structures and sublittoral rock surfaces within months. For example, the ship, HMS Scylla was colonised by *Balanus crenatus* four weeks after sinking in March; the timing of the sinking would have ensured a good

larval supply. This suggests that the height of the external cable protection will not detrimentally effect the function of the reef habitat, but will provide alternative areas for colonisation by species in the surrounds.

The presence of the external cable protection may cause very localised changes in water flows. This is turn could cause localised scour. Scour will only occur in areas of sediment where bottom current either already exceed the critical bedload parting velocity, or where external cable protection results in an increase in current velocity to above the critical bedload parting velocity. Given that current speeds within the Proposed Development are relatively low, particularly near the seabed due to frictional effect, high scour is unlikely to be a significant issue.

Based on the above, cable burial and external cable protection will not alter the structure or functions necessary for the long-term maintenance of the habitat and there will no significant effects on the conservation objective.

Species (Presence, Abundance, Condition and Diversity of Typical Species)

As noted above, the habitats effected by cable burial and/or external cable protection are characterised by short-lived, fast-growing, opportunistic epifauna which have fast rates of colonisation. The habitats are common within the Proposed Development and the wider area and therefore there will be a good larval supply to support colonisation of disturbed or new substrates. Colonisation of the affected areas is expected within the short-term.

The above conclusions are supported by evidence from post-construction monitoring of offshore windfarms. The examples provided below are from the introduction of a hard substrate into a predominantly sandy environment. This however can be used to infer that colonisation of external protection in areas where there is already rock habitat, will likely be quicker i.e. as colonisation of external protection on sand habitats. This is dependent on the passive transport of adult organisms or the availability of larvae from the surrounding region.

Case studies on the Offshore Windfarm Egmond aan Zee, Prinses Amalia Wind Farm and Horns Rev Wind Farm found that the density of species on scour protection material were high and the number of species observed increased with time. In addition, in many cases the number of rare species had also increased (Waardenburg et al 2017). Studies (Lindeboom et al 2011) at OWEZ identified 11-17 hard substratum benthos species on the rock material, noting the surrounding habitat was sandy. At the Horns Rev Windfarm the scour protection has been colonised by sea anemones and the soft coral *Alcyonium digitatum* (Langhamer 2012). Monitoring of the Nord Stream pipeline in Swedish waters showed that over a period of four years a general increase in epifauna was seen on the introduced hard substrate (pipeline and rock berms) (Nord Stream 2014).

Further studies (although limited) into the effects of artificial structures on adjacent soft sediments have provided contrasting results. Changes in localised community structure as a result of changes in sediment texture have previously been identified by Ambrose and Anderson (1990). Results showed reduced densities

of some taxa near artificial structures which may have either resulted from increased predation as reef-associated fish move over sand to feed or changes in localised sediment composition creating a less suitable habitat for certain species. In contrast to this, Davis et al (1982) identified no measurable decrease in adjacent infauna densities at a distance of 4m from artificial structures over the two year period since their introduction (cited in Pidduck et al 2017).

The external cable protection could be viewed as an artificial reef. The OSPAR Commission (2009) defines an artificial reef, as a 'submerged structure placed on the seabed deliberately, to mimic some characteristics of a natural reef. It could be partly exposed at some stages of the tide'. This places the external cable protection material outside the formal definition on the basis of purpose. However, almost all man-made structures placed on the seabed are rapidly and quickly colonised by marine organisms (Linley et al 2008). The effects of artificial reefs are ambiguous with Linley et al (2008) citing studies such as Ambrose and Anderson (1990) which have shown that some species of infauna were enhanced whilst others were depressed. It is therefore acknowledged that whilst the external cable protection could enhance the productivity and biodiversity of the habitat, it will also represent a variation on the habitat that was previously there.

The external cable protection will form a narrow corridor and it is not anticipated that it will cause significant reduction in community structure in the context of the structure and function of the reef, especially as the key species are widespread and abundant in the surrounding area, and will be able to colonise the rock material.

In light of the above discussion, it is concluded that qualifying habitat will be effected in the short-term, but as species colonise the disturbed sediments and external cable protection the habitat quality will not be degraded in the long-term.

Cumulative effects

Stage 1 Screening concluded that will be no PCEs between the Proposed Development and any other known project or plans.

5.2.1.3 What measures can be implemented to mitigate the significance of the likely adverse impact into insignificance?

The most effective mitigation is to avoid the sensitive habitat. Route development has been an iterative process of desk-based assessment, consultation and marine survey. The route selected avoids large areas of Bedrock Reef identified to the south of the Proposed Development and areas of Reef habitat to the north which would have required more extensive external cable protection. A sediment channel has been identified within outcropping bedrock between KP2 and KP5 which is suitable for cable installation, and which allows the cable route to avoid crossing this feature. It will also be possible to micro-route around other areas of Reef habitat further offshore.

The following Project Specific Mitigation is being proposed and will be included in the Greenlink Marine ES – Wales.

1. No intrusive works will be undertaken at Freshwater West between mean high water springs and mean low water springs.
2. Exclusion zones have been established around Annex I Bedrock Reef features; shown on Drawing P1975-INST-009. No intrusive works (e.g. cable installation, deposit of external cable protection material) will be undertaken within these exclusion zones.
3. The preference is to bury the HDD duct exit and all cables in sediment to the required depth of lowering. No external cable protection should be deposited at the HDD exit point.
4. A burial assessment study will be carried out by the Installation Contractor that defines the feasibility of achieving the required depth of burial. When determining the installation technique for the cable route between KP15 and KP23 (medium grade Stony Reef) the preference shall be to bury the cables in sediment. If ground conditions do not allow this then cutting should be investigated as the next alternative. External cable protection shall only be considered as the final option, and if necessary, the Installation Contractor shall seek to minimise the footprint (length and width) of external cable protection required between KP15 and KP23 (Annex I Stony Reef).
5. Where external cable protection is used between KP15 and KP23 (Annex I Stony Reef) an environmental monitoring plan will be established to monitor colonisation of the external cable protection to demonstrate that the structure and function of the Reef feature has not been adversely affected in the long-term.

   The monitoring programme will be developed in consultation with NRW. It is proposed that one or more of transects MMT (2019) RR_T02, RR_T03 and RR_T04 are re-surveyed as a control, with additional video transects taken along the external cable protection to record epifauna. Monitoring would be planned to coincide with the first two routine cable inspection surveys. It is expected that the first inspection survey will be undertaken within the first three years of installation, with a second survey undertaken within three years of the first survey.

   All footage will also be reviewed for the presence of invasive non-native species.

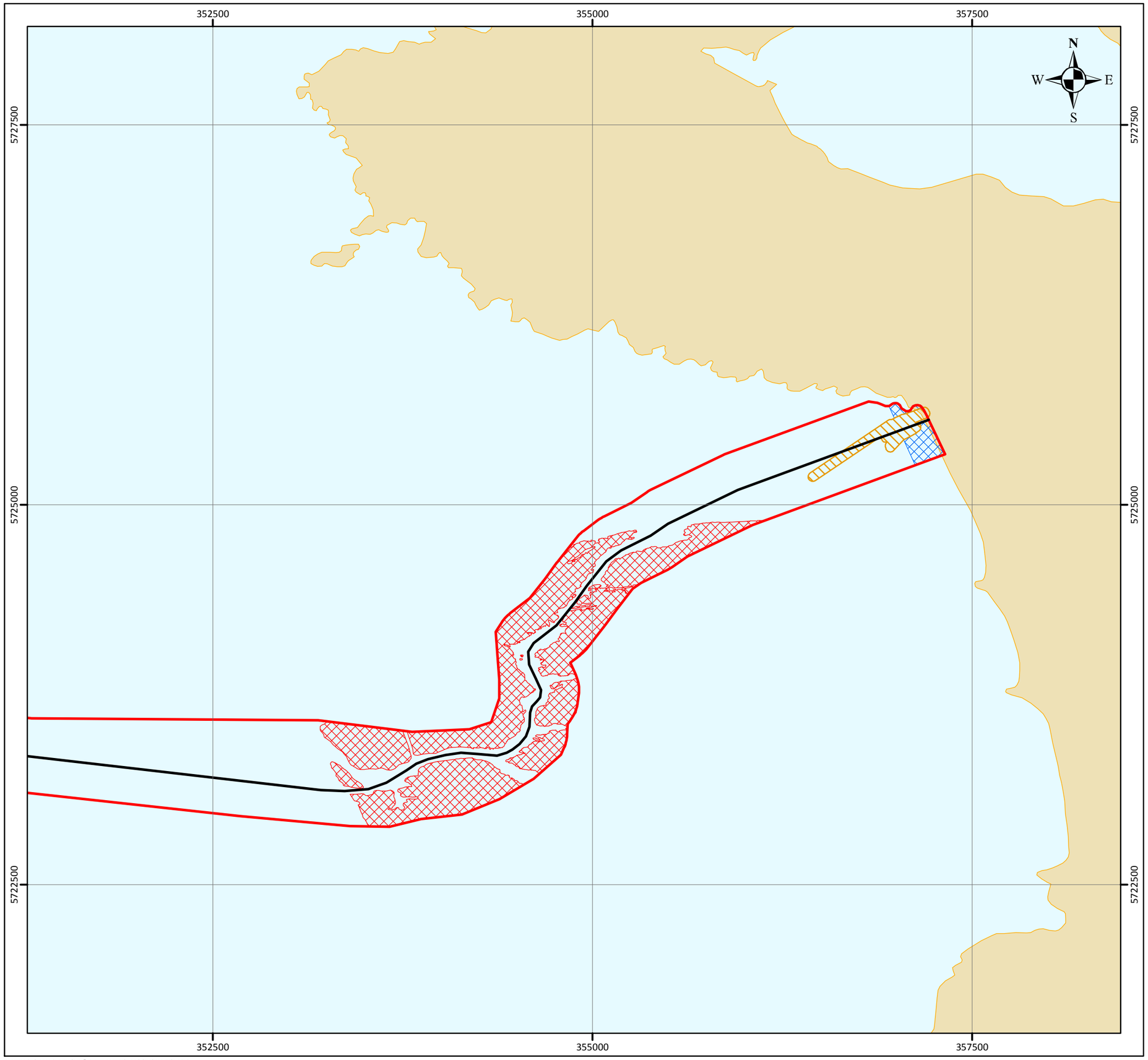
   The objectives of monitoring colonisation of the external cable protection will be to establish an evidence base to inform future development within the Pembrokeshire Marine / Sir Benfro Forol SAC e.g. renewable energy generation. It will also confirm (or otherwise) the conclusion that the deposition of the external protection material adds to the Reef habitat within the SAC; albeit artificially
6. A tool box talk will be given ahead of all works. It will provide key identifying features for slipper limpet. Any slipper limpet found during installation will be kept & destroyed.

5.2.1.4 Conclusion

Cable burial and the deposition of external cable protection will cause short-term habitat disturbance. Mitigation has been proposed to minimise the footprint of the external cable protection as it is acknowledged that burial in sediment is preferred to introducing new rock substrate. Where external cable protection is used monitoring has been proposed. Although monitoring will not reduce the effect, the objective is to validate the conclusion of short-term effects. It is thought monitoring would be beneficial for the management of the SAC given that a number of renewable energy projects are proposed for testing and development within the SAC. Validating the conclusions of this HRA will support the decision making for future applications.

However, the assessment concludes that the short-term effects from the Proposed Development will not adversely affect the long-term achievement of the three conservation objectives for the Qualifying Feature i.e. range, structure and function, and species. In light of this, it is concluded that the Proposed Development will not have an adverse effect on the integrity of the Pembrokeshire Marine / Sir Benfro Forol SAC either alone or in combination with other plans or projects.

Conclusion - No adverse effect on integrity of site, either alone or in combination with other plans or projects.



Contains Ordnance Survey data © Crown copyright and database right 2013

GREENLINK INTERCONNECTOR

INSTALLATION

Annex I Habitat Exclusion Zones - UK Route

Drawing No: P1975-INST-009	A

Legend

- Indicative Greenlink Route Centreline
- Proposed Development
- Annex I Habitat Exclusion Zone
- MOD Listening Cable 30m Avoidance Zone
- Trenching Exclusion Zone

NOTE: Not to be used for Navigation

Date	Monday, April 29, 2019 08:37:30
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	OS; MMT; ESRI; Greenlink
File Reference	J:\P1975\Mxd\15_INST\ P1975-INST-009.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Co-financed by the European Union
Connecting Europe Facility

0 250 500 750 1,000 m

5.2.2 Qualifying Feature – Grey seal

5.2.2.1 Screening conclusion

The AA screening identified that there is the potential for a LSE on grey seal from the pressure underwater noise changes; related specifically to the detonation of UXO.

The conservation objectives for the Qualifying Feature are:

To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status.

- Populations - The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements include: population size; structure, production; condition of the species within the site. Population should not be reduced as a consequence of human activity.
- Range - The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.
- Supporting habitats and species - The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include; distribution; extent; structure; function and quality of habitat; and prey availability and quality.

The AA screening concluded that in relation to the conservation objectives, the detonation of UXO would not affect the range of the species population, nor will it affect the supporting habitats and species required to support the species population. However, if a number of adults and juveniles are within the water and the zone of influence at the time of UXO detonation, they could be killed or injured which will reduce the population size, and may also affect the structure of the population e.g. alter the ratio of adults and juveniles.

5.2.2.2 Assessment of effects

Questions	Response
Will the proposed operation or activity result in death, injury or disturbance of individuals?	Yes. If UXO detonation is required the large and sudden pressure change could cause permanent and temporary injury to grey seal within 17km of the detonation. In addition, seals within 54km could be disturbed by the brief but significant underwater noise change. It should be noted that the estimate of injury ranges is highly conservation; the simple calculation overestimates the noise propagation at long range. In addition, the injury ranges are based on a 794kg detonation; equivalent to the largest explosive device to have been used historically in the region.

Questions	Response
	It should be noted that this size of magnetic anomaly has not been identified in the 2019 UXO data from Castlemartin Firing Range.
Is it possible to estimate the number of individuals that are likely to be affected	Not with certainty. As a mobile species that range over a large area, it is not possible to estimate with certainty how many grey seal could be within the water and zone of influence at the time of a UXO detonation. The population estimate for the SAC is approximately 5000 individuals. It is estimated (based on grey seal at-sea usage maps, Russell et al 2017) that the mean number of individuals in the waters of the Proposed Development will vary from 5 to 10 individuals per 5km^2. Conservatively, this could mean that 1814 animals are in the water within the 17km zone of influence for injury; 36% of the population. As the zone of influence for disturbance is potentially wider than the SAC boundary it would also mean that the whole population could be subject to brief disturbance, but this is highly unlikely as not all animals will be in the water at the same time. Grey seal will be most vulnerable to UXO detonation during summer months (May – August) when they are more likely to be in the water. From August through to December animals are likely to be hauled up on beaches for pupping.
Will individuals be disturbed at a sensitive time or location during their life cycle	Unlikely. The sensitive time for grey seal at the site will be during breeding (August to December), moulting (December – February) and resting (all year). The thresholds for injury are for pinnipeds in water. Animals engaged in the activities listed above will be hauled-out on beaches out of the water. Therefore, noise generated by UXO detonation will not effect breeding, moulting and resting. Sound in air will be a brief event. Although the exact location of the UXO detonation is unknown, the closest haul-out sites to the Proposed Development are Linney Head (4.5km east) and Skokholm Island (4.5km north). It is highly unlikely that this would adversely affect seal that are hauled out, engaged in breeding, resting and moulting behavior.
Are the effects likely to focus on a particular section of the population, e.g., adults vs. juveniles, males vs. females	No. It is possible that both sexes of juveniles and adults could be within the zone of influence during UXO detonation.
Will the operation/activity cause displacement from key functional areas	No. Underwater noise activities will not displace seal. The UXO detonation, if required, will be a brief one-off event and any animals disturbed by the sudden but brief underwater noise change will be able to return to the area rapidly.
Is the habitat of the species likely to deteriorate causing disturbance to individuals or populations	No. The change in underwater noise will be brief and will not effect grey seal habitat.
How quickly is the affected population in the SAC likely to recover once the operation/activity has ceased	If required UXO detonation will be a brief one-off event (less than one day). The zone of influence for injury and disturbance would cover a wide area within the SAC. It is not possible to determine how many grey seal could be injured or killed from UXO detonation. The population was estimated at 5000 individuals. Average pup production remained consistent between 1992 and 2008 averaging 208 pups per year. However, pup production has been steadily increasing with 2013-15 recording the highest average productions at 357 pups. Underwater noise modelling, indicates that the zone of influence for temporary and permanent injury within water will cover an area of

Questions	Response
	approximately 908km$^{2.}$ However, this suggests that, as a worst-case, numbers of animal in the water could be high and effects could be significant. If sufficient numbers of animals were injured there could be a long-term effect on the population. It is not possible to determine how quickly the population will recover, given that exact numbers effected cannot be confidently predicted.
In the absence of mitigation, are the effects of the proposed operation/activity on Annex II species likely to have a significant effect on the favourable conservation condition of the Annex II species at the site	In the absence of mitigation, it is possible that noise generated from UXO detonation would lead to a significant effect on the favourable conservation objective of grey seal in this SAC. If UXO detonation occurs at a time when a significant proportion of the population are within the water, then this could disrupt the population composition of the site.
Is there the potential for cumulative effects with other plans or projects?	Stage 1 Screening concluded that will be no PCEs between the Proposed Development and any other known project or plans.

5.2.2.3 What measures can be implemented to mitigate the significance of the likely adverse impact into insignificance?

The most effective mitigation is to avoid the need for detonation completely. Mitigation embedded into the design of the project (embedded mitigation EM21) seeks to do this by establishing a decision making strategy in which UXO detonation is the last option. If UXO detonation is the only feasible option, the target could either be detonated in-situ (typically the preferred option for health and safety reasons); or relocated on the seabed and then detonated. Relocation could occur when detonating in-situ would compromise the safety of Greenlink, third party assets or the public, or where one UXO is relocated close to another to allow a single detonation to take place.

For UXO detonation it is best practice to follow the JNCC guidelines for minimising the risk of injury to marine mammals from using explosives (JNCC 2010, or as updated) (see embedded mitigation EM23).

However, to further reduce the significance of the effect GIL has selected a range of Project Specific Mitigation, as described below.

GIL will apply for an EPS Licence for UXO detonation.

In consultation with NRW, acoustic deterrent devices (ADDs) will be selected and deployed. ADDs will be activate 20 to 60 minutes prior to UXO detonation dependant on the UXO charge size. ADDs are used to exclude animals from a mitigation zone and are used in conjunction with visual and / or acoustic monitoring and should normally be used for as short period as necessary to minimise the introduction of additional noise. These devices emit medium to high frequency sounds that deter animals from injury zones. They have been widely used by offshore industries during pile-driving, and at windfarms for UXO clearance activities (McGarry et al. 2018). McGarry et al. (2017) observed that fleeing

individuals were at least 1,500 m from the sound source when exposed to the ADD for 15 minutes. It is therefore considered that the use of ADDs combined with marine mammal observations for this purpose would be more effective than traditional passive mitigation methods.

The use of Passive Acoustic Monitoring (PAM) systems has also been identified as a further mitigation measure. PAM is a software system that utilises hydrophones to detect the vocalisations of marine mammals. It is useful during periods of darkness, poor visibility or when the sea state is not conducive to visual mitigation. A PAM system would be used to support the marine mammal visual observations and will be used during periods of darkness and/or poor visibility. It would be operated by a suitably trained and experienced marine mammal observer (MMO). The PAM system typically comprises signal processing equipment located in a control room, an intermediary deck cable, and a towing cable terminating with a hydrophone array. The PAM system would be optimised for the real-time detection (i.e. live visual display and audible output) of marine mammals know to be present within the Proposed Development. A PAM system could be used in conjunction with ADDs – this would enable the MMO to monitor the presence or absence of marine mammals within the zone of influence prior to detonating any UXO.

If the UXO identified is great than 10kg than a soft-start procedure will also be used in combination with the ADDs. In this scenario, the marine mammal observers would conduct a pre-start search, the ADDs would be activated and then a sequence of small to large charges would be implemented to allow additional time for marine mammals to leave the area of potential effect. Typically, charges of 50g, 100g, 150g and 200g would be deployed 5 minutes after the deactivation of the ADD, and would be sequenced to commence at 5 minute intervals, with the a further 5 minute interval before the detonation of the UXO. An additional 250g charge may be added to the sequence if the UXO requiring detonation is greater than 250kg. This soft start procedure would give a minimum deterrence time of 50 minutes (25 minutes ADD and 25 minutes soft start) prior to detonation. Based on a swimming speed of 1.5m/s (Otani et al 2000) marine mammals should clear a radius of 4.5km over this duration.

Whilst this range is not beyond the predicted range of effect for injury, it must be noted that the predicted ranges are based on highly conservative assumptions. No consideration has been given to the effects bathymetry, seabed sediments and temperature and salinity profiles will have on propagation; all which will attenuate sound, reducing the range of effect. In addition, the noise level at the water's surface (where marine mammals are expected to be fleeing) would be much lower than modelling suggests. This point is supported by von Benda-Beckmann et al (2015) which cites uncertainty in predicted impact ranges beyond 2km due to calculations not considering the effects of cavitation and wind-generated bubbles which supports attenuation. Taking this into account, this Industry Best Practice is considered appropriate.

5.2.2.4 Conclusion

It is possible that grey seal could be located in the water and zone of influence at the time of UXO detonation. If grey seal are killed or injured, this could disrupt the population composition of the site. Given the uncertainties in determining the number of grey seal which could be effected, measures have been proposed in line with Industry Best Practice for UXO detonation. It is expected that implementation will reduce the significance of the effect to a level whereby the three conservation objectives for the Qualifying Feature (i.e. populations, range, and supporting species and habitats) will not be adversely affected.

In light of this, it is concluded that the Proposed Development will not have an adverse effect on the integrity of the Pembrokeshire Marine / Sir Benfro Forol SAC either alone or in combination with other plans or projects.

Conclusion – No adverse effect on integrity of site, either alone or in combination with other plans or projects.

5.3 *West Wales Marine / Gorllewin Cymru Forol SAC*

5.3.1 *Screening conclusion*

The AA screening identified that there was potential for a LSE on harbour porpoise from the pressure underwater noise changes; related specifically to the detonation of UXO.

The conservation objective for this site is to avoid deterioration of the habitats of harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring the integrity of the site is maintained and the site makes an appropriate contribution to maintaining Favourable Conservation Status for the UK harbour porpoise. The following attributes are maintained or restored in the long term:

a. The species is a viable component of the site.
b. There is no significant disturbance of the species.
c. The supporting habitats and processes relevant to harbour porpoises and their prey are maintained.

The AA screening concluded that in relation to the conservation objectives, UXO detonation will not affect harbour porpoise habitat and following detonation, harbour porpoise will still remain a viable component of the site. However, as the UXO detonation could be within the boundary of the SAC, if animals are within the zone of influence at the time of UXO detonation, they could be injured or significantly disturbed.

5.3.2 Assessment of effects

Questions	Response
Will the proposed operation or activity result in death, injury or disturbance of individuals?	Yes. If UXO detonation is required, the large and sudden pressure change could cause permanent and temporary injury to harbour porpoise within 27km of the detonation. In addition, animals within 54km could be disturbed by the brief but significant underwater noise change. These distances are based on a 794kg detonation; equivalent to the largest explosive device to have been used historically in the region. It should be noted that this size of magnetic anomaly has not been identified in the 2019 UXO data from Castlemartin Firing Range.
Is it possible to estimate the number of individuals that are likely to be affected	Not with certainty. As a mobile species that range over a large area, it is not possible to estimate with certainty how many harbour porpoise could be within the zone of influence at the time of a UXO detonation. Baines and Evans (2012) suggests densities could exceed 10 animals per $10km^2$. Hammond et al (2017) suggests densities are lower, in the range of 0.118 – 0.239 animals per km^2. It is estimated that the SAC supports over 5,000 individuals for at least part of the year. Densities will be higher during summer months.
Will individuals be disturbed at a sensitive time or location during their life cycle	Possibly. A single UXO detonation could cause sound levels sufficient to cause temporary injury to harbour porpoise over a 27km radial distance; $2290km^2$. This is equivalent to noise disturbance over 31% of the SAC. The SAC is part of a network of European sites within the Celtic and Irish Sea Management Unit that have been designed to encompass areas of high porpoise density. Within the MU animals are thought to move between preferred summer and winter grounds. The West Wales Marine / Gorllewin Cymru Forol SAC has been identified as important during the summer season (containing persistent high densities). Although it is not known, where, when or even if UXO detonation will be required, if it does occur it is likely to be within the summer season as this is the preferred season for cable installation works.
Are the effects likely to focus on a particular section of the population, e.g., adults vs. juveniles, males vs. females	No. It is possible that both sexes of juveniles and adults could be within the zone of influence during UXO detonation.
Will the operation/activity cause displacement from key functional areas	No. The UXO detonation, if required, will be a brief one-off event and any animals disturbed by the sudden but brief underwater noise change will be able to return to the area rapidly.
Is the habitat of the species likely to deteriorate causing disturbance to individuals or populations	No. The change in underwater noise will be brief and will not affect supporting habitat or species.
How quickly is the affected population in the SAC likely to recover once the operation/activity has ceased	If required UXO detonation will be a brief one-off event (less than one day). The SAC is within the zone of influence for injury and disturbance. It is not possible to determine how many harbour porpoise could be injured or killed from UXO detonation. The population is estimated at 5000 individuals but the population forms part of the large MU where numbers are estimated to be around 47,229 (DECC 2006).

Questions	Response
	As a worst-case, numbers of animal in the water could be high and effects could be significant. If sufficient numbers of animals were injured there could be a long-term effect on the population. It is not possible to determine how quickly the population will recover, given that exact numbers effected cannot be confidently predicted.
In the absence of mitigation, are the effects of the proposed operation/activity on Annex II species likely to have a significant effect on the favourable conservation condition of the Annex II species at the site	In the absence of mitigation, it is possible that noise generated from UXO detonation would lead to a significant effect on the favourable conservation objective of harbour porpoise in this SAC. If UXO detonation occurs at a time when a significant proportion of the population are within the site, then this could disrupt the population composition of the site.
Is there the potential for cumulative effects with other plans or projects?	Stage 1 Screening concluded that will be no PCEs between the Proposed Development and any other known project or plans.

5.3.3 What measures can be implemented to mitigate the significance of the likely adverse impact into insignificance?

Embedded mitigation and Project Specific Mitigation proposed in Section 5.2.2.3 will be directly applicable to managing the effects on this SAC. It has not been repeated in full, but in summary it includes:

- Avoid the need for detonation completely by following embedded mitigation EM21.
- Follow JNCC guidelines for minimising the risk of injury to marine mammals from using explosives (embedded mitigation EM23).
- GIL will apply for an EPS Licence for UXO detonation.
- In consultation with NRW, acoustic deterrent devices (ADDs) will be selected and deployed for 20 to 60 minutes prior to UXO detonation depending on UXO charge size.
- Use of a PAM system in conjunction with ADDs – this would enable the MMO to monitor the presence or absence of harbour porpoise within the zone of influence prior to detonating any UXO.
- Use of soft-start procedures including deployment of small to large charges (50g – 250g) to allow additional time for marine mammals to flee the area.

5.3.4 Conclusion

It is possible that harbour porpoise from this site could be in zone of influence at the time of UXO detonation and therefore could be injured or disturbed. Given the uncertainties in determining the number of harbour porpoise from this site that

could be affected, measures have been proposed in line with Industry Best Practice for UXO detonation. It is expected that implementation will reduce the significance of the effect to a level whereby the three conservation objectives for the Qualifying Feature (i.e. populations, range, and supporting species and habitats) will not be adversely affected.

In light of this, it is concluded that the Proposed Development will not have an adverse effect on the integrity of the West Wales Marine / Gorllewin Cymru Forol SAC either alone or in combination with other plans or projects.

Conclusion – No adverse effect on integrity of site, either alone or in combination with other plans or projects.

6. Summary

The Proposed Development has been subject to the HRA process as it crosses the Pembrokeshire Marine / Sir Benfro Forol SAC (site code: UK0013116), the West Wales Marine / Gorllewin Cymru Forol SAC (site code: UK0030397), Skomer, Skokholm and the Seas Off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA (site code: UK9014051) and the landfall is within the Castlemartin Coast SPA (site code: UK9014061) and the Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC (site code: UK0014787). The Proposed Development consists of the following features:

- Two high voltage direct current (HVDC) electricity power cables;
- A smaller fibre-optic cable for control and communication purposes; and
- All associated works required to install, operate, maintain, repair and decommission the aforementioned cables.

A detailed screening assessment has been conducted on the Proposed Development which concluded that significant effects are likely or uncertain on the Qualifying Features and conservation objectives of two sites:

- Pembrokeshire Marine / Sir Benfro Forol SAC; and
- West Wales Marine / Gorllewin Cymru Forol SAC.

The assessment concluded that there was no potential for cumulative effects with other plans or projects.

Further to screening, Information to Inform Appropriate Assessment has been provided, which concludes:

- Effects on the Pembrokeshire Marine / Sir Benfro Forol SAC Qualifying Feature Reef from cable installation and external cable protection during installation and repair and maintenance will be short-term and will not adversely affect the long-term achievement of conservation objectives. The Proposed Development will not affect the integrity of the SAC, either alone or in combination with other plans or projects.
- Significant effects on the Pembrokeshire Marine / Sir Benfro Forol SAC and West Wales Marine / Gorllewin Cymru Forol SAC Qualifying Features grey seal and harbour porpoise, from the detonation of UXO (if required) can be reduced to levels whereby the conservation objectives of the European sites are not adversely effected, by the implementation of Industry Best Practice mitigation i.e. the use of acoustic deterrent devices, soft-start and passive acoustic monitoring. The Proposed Development will not affect the integrity of the SAC, either alone or in combination with other plans or projects.

REFERENCES

1 1st Line Defence (2018) Greenlink Detailed Unexploded Ordnance (UXO) Risk Assessment. Report DA-2985-00 January 2018.

2 Ambrose, R.F. and Anderson, T.W. (1990). Influence of an artificial reef on the surrounding infaunal community. Marine Biology, 107, 41-52

3 Arup (2013). Breeding Bird Survey Report 2012. Unpublished report on behalf of Horizon Nuclear Power (Wylfa) Ltd.

4 Arup (2018). Greenlink Preliminary Habitats Regulations Assessment (Welsh Onshore) 25 July 2018.

5 Arup (2019). Greenlink Onshore Wales. Winter Bird Survey (2018/2019) Summary Note.

6 Baines, M.E. and Evans, P.G.H. (2012). Atlas of the Marine Mammals of Wales. CCW Monitoring Report No. 68. 2nd edition. 139pp.

7 BEIS (2018). Offshore Oil & Gas Licensing 30th Seaward Round. Habitat Regulations Assessment. Draft Appropriate Assessment: Southern North Sea. February 2018. [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/681627/30th_Round_Draft_AA_-_Southern_North_Sea_Blocks.pdf (Accessed April 2018).

8 Bellefleur, D., Lee, P and Ronconi, R.A. (2009). The impact of recreational boat traffic on Marbled Murrelets (Brachyramphus marmoratus). [online] Available at: https://www.ncbi.nlm.nih.gov/pubmed/18222029 (Accessed April 2018).

9 BERR (2008). Review of Cabling Techniques and Environmental Effects Applicable to Offshore Wind Farm Industry.

10 CCW (2008). Core management plan including conservation objectives for Grassholm SPA. Version 2. April 2008. [online] Available at: https://www.naturalresources.wales/media/674134/Grassholm%20SPA%20Management%20Plan%2021[1].4.08%20(English).pdf (Accessed January 2018).

11 Department of Energy and Climate Change (DECC) (2016). Offshore Energy Strategic Environmental Assessment. Department of Energy and Climate Change. March 2016. [online] Available at: https://www.gov.uk/government/consultations/uk-offshore-energy-strategic-environmental-assessment-3-oesea3 (Accessed April 2019).

12 European Commission (2002). Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC. Office for Official Publications of the European Communities, Luxembourg.

13 European Commission (2007). Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC [online] Available at: http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/guidance_art6_4_en.pdf (Accessed May 2019)

14 European Commission (2018a). Commission notice "Managing Natura 2000 sites The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC". Brussels, 21.11.2018 C(2018) 7621 final.

15 European Commission (2018b). Guidance on Energy Transmission Infrastructure and EU nature legislation. [Online] Available at: http://ec.europa.eu/environment/nature/natura2000/management/docs/Energy%20guidance%20and%20EU%20Nature%20legislation.pdf [Accessed 31/05/2018]

16 Hammond P.S., Lacey C., Gilles A., Viquerat S., Börjesson P., Herr H., Macleod K., Ridoux V., Santos M.B., Scheidat M., Teilmann J., Vingada J. and Øien N (2017). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. May 2017.

17 Hill, D., Hockin, D., Price, D., Tucker, G., Morris, R., & Treweek, J. (1997). Bird disturbance: improving the quality and utility of disturbance research. Journal of Applied Ecology, 275-288.

18 Intertek EWCS (2019a). Greenlink Interconnector Limited - Marine Technical Appendix D – Underwater Noise Modelling.

19 Intertek EWCS (2019b). Greenlink Cable Burial Risk Assessment. P1975.

20 JNCC (2004) Grassholm SPA. [Online] Available at: http://jncc.defra.gov.uk/default.aspx?page=2060.

21 JNCC (2010). JNCC guidelines for minimising the risk of injury to marine mammals from using explosives. [Online] Available at: http://jncc.defra.gov.uk/pdf/JNCC_Guidelines_Explosives%20Guidelines_August%202010.pdf.

22 JNCC (2016). Habitat account - Marine, coastal and halophytic habitats. Available at: http://jncc.defra.gov.uk/protectedsites/saselection/habitat.asp?FeatureIntCode=H1310.

23 JNCC (2017a). JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys. August 2017. [online] Available at: http://jncc.defra.gov.uk/pdf/jncc_guidelines_seismicsurvey_aug2017.pdf (Accessed January 2018).

24 JNCC (2017b). Joint SNCB Interim Displacement Advice Note (2017). [online] http://jncc.defra.gov.uk/pdf/Joint_SNCB_Interim_Displacement_AdviceNote_2017.pdf (accessed January 2018).

25 JNCC (2018). Grassholm SPA [online] Available at: http://jncc.defra.gov.uk/default.aspx?page=2060 (Accessed January 2018).

26 JNCC (2019). Harbour Porpoise (Phocoena phocoena) Special Areas of Conservation: West Wales Marine / Gorllewin Cymru Forol. Conservation Objectives and Advice on Operations. March 2019.

27 Jones, E., McConnell, B., Sparling, C., and Matthiopoulos, J. (2013) Grey and harbor seal usage maps. Marine Mammal Scientific Support Research Programme MMSS/001/11.

28 Keevin, T.M. and Hempen G.L. (1997). The environmental effects of underwater explosions with methods to mitigate impacts. Corps Of Engineering St Louis Mo St Louis District.

29 Kerbiriou, C., Gourmelon, F., Jiguet, F., Le Viol, I., Bioret, F., & Julliard, R. (2006). Linking territory quality and reproductive success in the Red-billed Chough Pyrrhocorax pyrrochorax: implications for conservation management of an endangered population. Ibis, 148(2), 352-364.

30 Langhamer, O (2012). Artificial reef effect in relation to offshore renewable energy conversion. State of the art. Scientific word journal.

31 Lindeboom, H.J., Kouwenhoven, H.J., Bergman, M.J.N., Bouma, S., Brasseur, S., Daan, R., Fijn, R.C., de Haan, D., Dirksen, S., van Hal, R., Hille Ris Lambers, R., ter Hofstede, R., Krijgsveld, K.L., Leopold, M. and Scheidat. (2011) Short term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation. Environmental Research Letters, 6.

32 Linley E.A.S., Wilding T.A., Black K., Hawkins A.J.S. and Mangi S. (2007) Review of the reef effects of offshore wind farm structures and their potential for enhancement and mitigation. Report from PML Applications Ltd and the Scottish Association for Marine Science to the Department for Business, Enterprise and Regulatory Reform Contract No: RFCA/005/0029P (BERR).

33 MarLIN (2019). Species and habitat Sensitivity Assessment. [online] Available at: https://www.marlin.ac.uk (Accessed April 2019)

34 McGarry, T., Boisseau, O., Stephenson, S., Compton, R. (2017). Understanding the Effectiveness of Acoustic Deterrent Devices (ADDs) on Minke Whale (Balaenoptera acutorostrata), a Low Frequency Cetacean. ORJIP Project 4, Phase 2. RPS Report EOR0692. Prepared on behalf of The Carbon Trust. November 2017.

35 McSorley, C.A., Wilson, L.J., Dunn, T.E., Gray, C., Dean, B.J., Webb, A. and Reid, J.B (2008). Manx shearwater Puffinus puffinus evening rafting behaviour around colonies on Skomer, Rum and Bardsey: its spatial extent and implications for recommending seaward boundary extensions to existing colony Special Protection Areas in the UK. JNCC Report No: 406 [online] Available at: http://jncc.defra.gov.uk/pdf/jncc406_web.pdf (Accessed April 2018).

36 MMT (2019). Environmental Field Report. Greenlink Ireland Wales Interconnector Offshore Surveys.

37 Natural England and Suffolk Coast and Heaths (2012). A simple method for assessing the risk of disturbance to birds at coastal sites. November 2012. [Online] Available at: http://www.suffolkcoastandheaths.org/assets/Projects--Partnerships/Stour--Orwell/disturbance/A-simple-method-for-assessing-the-risk-of-disturbance-to-birds-at-coastal-sites.pdf (Accessed April 2018).

38 Nedwell, J., Mason, T., Barham, R and Cheesman, S (2012). Assessing the environmental impact of underwater noise during offshore windfarm construction and operation. Proceedings of Acoustics 2012 - Fremantle. 21-23 November 2012, Fremantle, Australia [online] Available at: https://www.acoustics.asn.au/conference_proceedings/AAS2012/papers/p116.pdf (Accessed April 2019).

39 Nedwell, J.R., Parvin, S.J., Edwards, B., Workman, R., Brooker, A.G. and Kynoch, J.E. (2007). Measurement and interpretation of underwater noise during construction and operation of offshore wind farms in UK water.

40 National Marine Fisheries Service (NMFS) (2018). 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-59, 167 p.

41 Nord Stream (2014) Results of Environmental and Socio-Economic Monitoring 2014. August 2015 [Online] Available at: https://www.nord-stream.com/press-info/library/?pk=250 (Accessed April 2019)

42 NPWS (2012) Marine Natura Impact Statements in Irish Special Areas of Conservation. A working document. April 2012

43 NRW (2015). Proposals to extend Skokholm and Skomer Special Protection Area and rename it as Skomer, Skokholm and the Seas off Pembrokeshire Special Protection Area. Advice to the Welsh Government and UK Government. June 2015 [online] Available at: https://naturalresources.wales/media/675732/departmental-brief-skomer-skokholm-and-the-seas-off-pembrokeshire-pspa-final.pdf (Accessed January 2018).

44 ODPM (2005) Office of the Deputy Prime Minister Circular 06/2005: Government Circular - Biodiversity and geological conservation - Statutory obligations and their impact within the planning system. August 20015. Available online: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7692/147570.pdf.

45 OSPAR Commission (2009) Assessment of construction or placement of artificial reefs. Biodiversity Series Publication 438/2009.

46 OSPAR Commission (2009). Assessment of the Environmental Impact of Underwater Noise -Biodiversity Series, Publication Number 436/2009, 43 pp.

47 OSPAR Commission (2011). Intersessional Correspondence Group on Cumulative Effects - Amended 25th March 2011. Pressure lists and descriptions. [Online] http://jncc.defra.gov.uk/PDF/20110328_ICG-C_Pressures_list_v4.pdf (Accessed January 2018).

48 OSPAR Convention (2012). Guidelines on Best Environmental Practice (BEP) in Cable Laying and Operation. Agreement 2012-2. Source: OSPAR 12/22/1, Annex 14. [online] Available at: https://www.gc.noaa.gov/documents/2017/12-02e_agreement_cables_guidelines.pdf (Accessed March 2019).

49 Otani, S., Naito, T., Kato, A., and Kawamura, A. (2000). Diving behaviour and swimming speed of a free-ranging harbour porpoise (Phocoena phocoena). Marine Mammal Science, Volume 16, Issue 4, pp 811-814, October 2000.Russell, D.J.F., Jones, E.L and Morris, C.D. (2017). Updated Seal Usage Maps: The Estimated at-sea Distribution of Grey and Harbour Seals. Scottish Marine and Freshwater Science Vol 8 No 25.

50 Owen, D. A. L. (1988). Vigilance by foraging choughs in relation to tourist disturbance. Bignal E and Curtis DJ (eds).

51 Pidduck, E., Jones, R., Daglish, P., Farley, A., Morley, N., Page, A. and Soubies, H. (2017). Identifying the possible impacts of rock dump from oil and gas decommissioning on Annex I mobile sandbanks – JNCC Report No: 603. [online] Available at: http://jncc.defra.gov.uk/pdf/Report_603_web.pdf (Accessed April 2019)

52 Poole, A. (2003). Analysis of chough productivity and recreational use in Pembrokeshire, Rep. No. 553. CCW, Bangor.

53 Popper, E.N. and Hastings, M.C. (2009). The effects of human-generated sound on fish. Integrative Zoology. Volume 4. Pg 43-52.

54 Popper, A. N., Hawkins, A. D., Fay, R. R., Mann, D. A., Bartol, S., Carlson, T. J.,

Coombs, S., Ellison, W. T., Gentry, R. L., Halvorsen, M. B., Løkkebog, S., Rogers, P. H., Southall, B. L., Zeddies, D. G., and Tavolga, W. N. (2014). Sound Exposure Guidelines for Fishes and Sea Turles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI.

55 Richardson, W.J., Greene, C.R. Jr., Malme, C.I., and Thomson, D.H. (1995). Marine Mammals and Noise. Academic Press, San Diego, CA, USA.576p.

56 Ronconi, R.A. and St Clair, C.C. (2002). Management options to reduce boat disturbance on foraging black guillemots (Cepphus grylle) in the Bay of Fundy. [online] Available at: https://www.researchgate.net/publication/222986181_Management_options_to_reduce_boat_disturbance_on_foraging_black_guillemots_Cepphus_grylle_in_the_Bay_of_Fundy (Accessed April 2018).

57 RSPB (2019). Chough - breeding and nesting habitats). [online] Available at: https://www.rspb.org.uk/birds-and-wildlife/wildlifeguides/bird-a-z/chough/breeding-and-nesting-habits/ (Accessed February 2019).

58 Rylands, K., Mucklow, C. and Lock, L. (2012). Management for choughs and coastal biodiversity in Cornwall: the need for grazing. The RSPB South West England Regional Office. June 2012. http://ww2.rspb.org.uk/Images/Management_for_choughs_and_coastal_biodiversity_tcm9-330224.pdf (Accessed April 2019).

59 Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr, C.R., Kastak, Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A. and Tyack, P.L. (2007). Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals, 33: Number 4.

60 Stamp, T.E. (2016). Molgula manhattensis with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [online]. Plymouth: Marine Biological Association of the United Kingdom. Available at: https://www.marlin.ac.uk/habitat/detail/1063 (Accessed April 2019)

61 Thaxter, C. B., Lascelles, B., Sugar, K., Cook, A. S. C. P., Roos, S., Bolton, M., Langston, R. H. W., and Burton, N. H. K., (2012). Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas, Biological Conservation, 156: 52-61.

62 The Wildlife Trust of South and West Wales (2011). Skomer Island Chough Factsheet [online] Available at: https://www.welshwildlife.org/wp-content/uploads/2011/05/Chough.pdf (Accessed April 2019).

63 Tillin, H.M. 2016. [Balanus crenatus] and [Tubularia indivisa] on extremely tide-swept circalittoral rock. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 16-05-2019]. Available from: https://www.marlin.ac.uk/habitat/detail/349

64 Tillin, H.M. and Tyler-Walters, H. (2016). Spirobranchus triqueter with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key

Information Reviews, [online]. Plymouth: Marine Biological Association of the United Kingdom. Available at: https://www.marlin.ac.uk/habitat/detail/177 (Accessed April 2019)

65 Tillin, H.M., Marshall, C. and Gibb, N. (2018). Sabellaria spinulosa on stable circalittoral mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [online]. Plymouth: Marine Biological Association of the United Kingdom. Available at: https://www.marlin.ac.uk/habitat/detail/377 (Accessed April 2019)

66 USACE (2019) Depth of Closure http://cirp.usace.army.mil/products/depth-of-closure.php [accessed March 2019]

67 von Benda-Beckmann, A.M., Aarts, G., Özkan Sertlek, H., Lucke, K., Verboom, W.C., Kastelein, R.A., Ketten, D.R., van Bemmelen, R., Lam, F.P.A., Kirkwood, R.J., and Ainslie, M.A. (2015). Assessing the Impact of Underwater Clearance of Unexploded Ordnance on Harbour Porpoises (*Phocoena phocoena*) in the Southern North Sea. Aquatic Mammals 2015, 41(4), 503-523, DOI 10.1578/AM.41.4.2015.503

68 Waardenburg, B., Lengkeek, W., Didderen, K., Teunis, M., Driessen, F., Coolen, J.W.P., Vergouwen, S.A., Raaijmakers, T.C., Vries de M.B AND Koningsveld van M (2017). Eco-friendly design of scour protection: potential enhancement of ecological functioning in offshore wind farms. [online] Available at: http://edepot.wur.nl/411374 (Accessed April 2019)

69 Welsh Government (2017) The Planning Series: 16 – Habitats Regulations Assessment. December 2017.

Appendix A

Supporting Information – Underwater noise assessment

A.1 INTRODUCTION

Marine cable installation, operation and decommissioning will generate underwater sound from a number of sources:

- Cable laying and rock placement (including presence of vessels);
- Geophysical survey; and
- UXO detonation (if required).

To determine the zone of influence for each activity (the spatial extent over which the activities are predicted to have an effect on the receiving environment) an assessment has been conducted for Greenlink, which combines literature review with underwater sound modelling. Sound propagation modelling, using a geometric spreading calculation, was used to determine the range at which the received sound attenuates to levels below defined thresholds for injury and disturbance for marine mammals and fish. The sound levels, injury and disturbance thresholds, the calculations and the resulting zones of influence are described and provided in full in the Greenlink Marine ES - Technical Appendix D; and key information relevant to the assessment is summarised below.

A.2 MARINE MAMMALS

Cetaceans have evolved to use sound as an important aid in navigation, communication and hunting (Richardson et al. 1995). It is generally accepted that exposure to anthropogenic sound can induce a range of behaviour effects to permanent injury in marine mammals. Loud and prolonged sound above background levels is considered to be noise and may have an effect on marine life. This may mask communicative or hunting vocalisations, preventing social interactions and effective hunting.

High intensity noises such as from seismic survey, explosions and pile driving can cause temporary or permanent changes to animals' hearing if the animal is exposed to the sound in close proximity and, in some circumstances, can lead to the death of the animal (Richardson et al. 1995). Where the threshold of hearing is temporarily damaged, it is considered a temporary threshold shift (TTS), and the animal is expected to recover. If there is permanent damage (permanent threshold shift (PTS)) where the animal does not recover, social isolation and a restricted ability to locate food may occur, potentially leading to the death of the animal (Southall et al. 2007).

Behavioural disturbance from underwater sound sources is more difficult to assess than injury and is dependent upon many factors related to the circumstances of the exposure (Southall et al. 2007, NFMS 2018). An animal's ability to detect sounds produced by anthropogenic activities depends on its hearing sensitivity and the magnitude of the noise compared to the amount of natural ambient and background anthropogenic sound. In simple terms for a sound to be detected it must be louder

than background and above the animal's hearing sensitivity at the relevant sound frequency.

Behavioural responses caused by disturbance may include animals changing or masking their communication signals, which may affect foraging and reproductive opportunities or restrict foraging, migratory or breeding behaviours; and factors that significantly affect the local distribution or abundance of the species. An animal may swim away from the zone of disturbance and remain at a distance until the activities have passed. Behavioural disturbance to a marine mammal is hereafter considered as the disruption of behavioural patterns, for example: migration, breeding and nursing.

To calculate the zone of influence for both levels of effect (injury and disturbance), the assessment provided in the Greenlink Marine ES – Technical Appendix D, used both the recently published American National Marine Fisheries Service (NMFS) (2018) thresholds for the onset of PTS and TTS and the thresholds defined by Southall et al. (2007). These reflect the current peer-reviewed published state of scientific knowledge.

The sound levels, injury and disturbance thresholds, the calculations and the resulting zones of influence are described and provided in full in the Greenlink Marine ES - Technical Appendix D; and key information relevant to the assessment is summarised below.

Southall et al. (2007) and the NFMS (2018) separate marine mammals into five groups based on their functional hearing as summarised in Table A-1.

Table A-1 Marine mammal groups based on auditory bandwidth

Group (based on auditory bandwidth) *	Species observed along Greenlink route
Low-frequency cetaceans (LFC)	Minke whale, Humpback whale and Fin whale
Mid-frequency cetaceans (MFC)	Short-beaked common dolphin, Common bottlenose dolphin, Stripped dolphin, Risso's dolphin, Atlantic white-sided dolphin, White-beaked dolphin, Long-finned pilot whale and Killer whale
High-frequency cetaceans (HFC)	Harbour porpoise
Pinnipeds (Phocid) in water (PIW)	Grey seal, harbour seal

* Based on NFMS (2018)

In addition, underwater noise is categorised into two distinct types: impulsive and continuous (i.e. non-pulse). Activities proposed during the Proposed Development fall into both categories. Table A-2 summarises the zones of influence for each sound category, activity and marine mammal group as calculated in the Greenlink Marine ES – Technical Appendix D.

Table A-2 Zones of influence for each sound category, activity and marine mammal group

Type of Noise	Activity	I	O	D	Zone of influence							
					Injury				Disturbance			
					LFC	MFC	HFC	PIW	LFC	MFC	HFC	PIW
Impulsive	UXO detonation*	✓	✓		13km	5.8km	23km	13km	54km			
Continuous	Geophysical survey	✓	✓	✓	40m	7m	180m	40m	2.6km			
	Vessel dynamic positioning (DP) thrusters	✓	✓	✓	Threshold not exceed - No effect				50m			
	Cable trenching	✓	✓	✓	Threshold not exceed - No effect				17m			
	Rock placement	✓	✓		Threshold not exceed - No effect				130m			

Key: I = Installation, O= Operation (including maintenance and repair), D = Decommissioning

* denotes worst-case, based on 794kg explosive detonation.

Although modelling indicates the risk of injury, it should be noted that the calculation for injury and disturbance does not account for the directional quality of the noise source, seabed interactions, seabed type, change in salinity, bathymetry, temperature or density, which would reduce the zone of influence. In addition to cylindrical spreading loss for acoustic propagation in the water column, higher frequency acoustic energies are more quickly absorbed through the water column than sounds with lower frequencies. Due to these factors, the distances for the zones of influence are highly conservative and worst case.

The marine mammals identified as Qualifying Features of European sites near the Proposed Development are harbour porpoise, bottlenose dolphin and grey seal, which fall into the categories of high frequency cetacean, mid frequency cetacean and pinniped in water respectively. The below discussion therefore focuses on these three groups.

Injury from continuous sound - cable installation

There is little information on potential effects of sound on marine mammals, resulting from the installation and operation of subsea cables; research has typically focused on high intensity impulsive sound sources such as seismic survey and piling. The Oslo and Paris (OSPAR) Convention (2012) considered that sound associated with the installation, removal or operation of submarine cables is less harmful compared to impulsive sound activities such as seismic surveys, military activities or construction work involving pile driving (OSPAR Convention 2012). However, frequent noise exposure can lead to longer term effects associated with continuous

stress (National Research Council 2003). Chronic stress in marine mammals can result in infectious, neoplastic, allergic, inflammatory and autoimmune diseases, and also can reduce reproduction; however, stress-induced reactions are hard to identify (National Research Council 2003).

Table A-2 concludes that sound resulting from cable installation activities (DP vessel, trenching, rock placement etc.) does not exceed the thresholds for permanent (permanent threshold shift, PTS) or temporary (temporary threshold shift, TTS) injury. Harbour porpoise, bottlenose dolphin and grey seal are therefore not at risk of injury from the cable installation (rock placement and vessel noise).

Injury from continuous sound – geophysical survey
Geophysical survey will be used pre-installation to confirm that no new obstructions have appeared on the seabed since the cable route survey was undertaken. It will also be used post-installation to confirm burial depth or conduct inspection surveys.

Table A-2 concludes that:

- Bottlenose dolphin (MFC) are vulnerable to permanent injury within 2.6m and to temporary injury within 7m of the multi-beam echosounder.
- Harbour porpoise (HFC) are vulnerable to sound generated by the multi-beam echosounder, sidescan sonar and sub-bottom profilers with the largest zone of influence being from the multibeam echosounder. Permanent injury could occur within 110m and temporary injury within 180m of the multi-beam echosounder.
- Grey seal in water are vulnerable to sound from the multi-beam echosounder and sidescan sonar, with permanent injury potentially occurring within 15m and temporary injury within 40m of the multi-beam echosounder.

For geophysical survey it is best practice to follow the JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys' (JNCC 2017a). Adherence to the guidelines constitutes best practice and will, in most cases, reduce the risk of deliberate injury to marine mammals to negligible levels. Adherence to the guidelines has been incorporated into the Proposed Development as embedded mitigation EM20.

Disturbance from continuous sound – cable installation
Table A-2 concluded that all marine mammals are vulnerable to disturbance from cable installation activities, but the zone of influence is small; 130m radial distance from activities. The cable installation activities will move slowly along the cable route and although animals may briefly avoid the activity they will return to an area once the activity has passed through. The current level of shipping and ambient sound within the Celtic Sea will not increase significantly from the presence of the project vessels during the cable installation.

Disturbance from continuous sound – geophysical survey
Table A-2 concluded that disturbance could occur within up to 2.6km.

Evidence of the effects of geophysical surveys on cetaceans is limited but BEIS (2018) summarises the results of a study carried out in the Moray Firth. It observed responses to a 10-day 2D seismic survey which exposed a 200km^2 area to noise throughout that period. A relative decrease in density of harbour porpoise within 10km of the survey vessel was reported, but effects were brief with animals returning to the area within 19 hours of cessation of activities.

The underwater sound changes associated with the cable installation and the geophysical survey, and therefore the associated potential for disturbance is generally acknowledged to be lower when compared to an activity such as use of air guns during 2D and 3D seismic and wind farm piling. Animals will have sufficient time to avoid the installation and survey vessels, and it is unlikely that they will swim over operating equipment.

The proposed activities will be restricted in duration and will progress slowly within the Proposed Development. Animals may actively avoid the activity, but will return to the area once the vessels have passed through. The Proposed Development will therefore not act as a barrier to movement between sites, or cause significant short or long-term disturbance.

Injury from impulsive sound

It is unknown how many, if any, UXO detonations will be required within the Proposed Development. However, as the Proposed Development crosses the Castlemartin Firing range it is possible that UXO may be encountered during installation and possibly maintenance activities.

A UXO survey along the proposed centreline will be completed by the Installation contractor ahead of the installation campaign to identify any UXO along the route. In line with embedded mitigation EM21 a decision making process will be followed for any potential UXO whereby the target is first avoided, then removed and if neither previous option is feasible, detonation is undertaken. It has been assumed that one UXO detonation will be required.

Should UXO be found which require clearance by detonation it is assumed that there would be a relatively large release of impulsive sound energy, creating high amplitude shock waves (von Benda-Beckmann et al. 2015). Peak source levels would depend on the quantity and nature of explosive material. At close range there would be risk of mortality as relatively small quantities of explosive can result in significant SPLs, e.g. Richardson et al. (1995) reported that 0.5kg of TNT was associated with a peak of 267dB re 1µPa @ 1m.

The precise injury effect range cannot be stated in advance of information on the nature and quantity of explosive material potentially involved, which will not be known until a UXO is identified. To provide a worst-case, the Greenlink Marine ES - Technical Appendix D modelled the sound from a 794kg explosive (equivalent to a sea mine), which 1st Line Defence (2018) identified as the largest explosive device

to have been used historically in the region. It should be noted that this size of magnetic anomaly has not been identified within the Proposed Development.

Results from the assessment are highly conservative, due to the high explosive weight used to estimate the sound levels. In addition, the geometric spreading modelling does not take into consideration variables such as water depth, source and receiver depths, temperature gradients, salinity, seabed ground conditions bathymetry, water depth or sediment type and thickness, all of which affect received levels.

The modelling results conclude that cetaceans and pinniped are at risk of temporary and permanent injury from UXO detonation. At close range there would be risk of mortality as relatively small quantities of explosive can result in significant sound pressure levels.

- Bottlenose dolphin (MFC) are vulnerable to permanent injury within 5.8km and to temporary injury within 8.6km of the UXO detonation;
- Harbour porpoise (HFC) are vulnerable to permanent injury within 23km and to temporary injury within 27km of the UXO detonation; and
- Grey seal in water are vulnerable to permanent injury with 13km and to temporary injury within 17km from the UXO detonation.

Von Benda-Beckmann et al. (2015) studied the effect of UXO detonations on harbour porpoise in the North Sea. The study showed that a detonation of 263kg of explosive (734kg explosive weight has been used for this assessment) could result in physical injury within 500m of the explosion.

Disturbance from UXO detonation

An UXO detonation is likely to result in disturbance to harbour porpoise over a large area, regardless of the weight of the explosive. The case specific disturbance range cannot be stated in advance of information on the nature and quantity of explosive material potentially involved; this assessment therefore presents a worst-case. Disturbance resulting from a single 794kg UXO detonation would cover an area of up to 9,160km^2.

A.3 FISH

The ability of fish to hear noise is dependent on their hearing structures, which indicate their sensitivity to sound. Sound pressure is only detected by those species possessing a swim bladder; the otolith organ acts as a particle motion detector and where linked to the swim bladder, converts sound pressure into particle motion, which is detected by the inner ear. High sensitivity hearing species such as clupeids (twaite and allis shad) have specialisations of the auditory apparatus where the swim bladder and inner ear are intimately connected and are able to detect frequencies to over 3kHz; with optimum sensitivity between 300Hz-1kHz (Nedwell et al. 2007). Medium sensitivity species (including cod and European eel) have a swim bladder but no specialisation of the auditory apparatus. Low sensitivity species with no swim bladder include bass, cod and flat fish such as plaice (Nedwell et al. 2004). There is also potential for some fish and shellfish species to be vulnerable to acoustic survey activities during sensitive life stages, for example during the egg and larvae development stages.

Existing environmental conditions of background noise within the sea are considered when assessing anthropogenic activities that produce additional sound. Sources of background noise come from shipping, interaction of waves and currents with the sea bed, seabed development and operation, fishing industry and recreational activities (Bass and Clark 2003, Southall et al. 2007, OSPAR 2009, Hawkins and Popper 2012, Popper et al. 2014). Fish are likely to become habituated to levels of background noise. A decreased responsiveness over time could arise through a change in tolerance, through habituation (Radford et al. 2016, Nedelec et al. 2016). Therefore, effects are only expected if sound produced during the Proposed Development is significantly above the background noise levels.

To calculate the zone of influence for recoverable and temporary injury to fish the Greenlink Marine ES – Technical Appendix D used thresholds for injury derived from Poppler et al (2014). These reflect the current state of scientific knowledge.

The sound levels, injury thresholds, the calculations and the resulting zones of influence are described and provided in full in the Greenlink Marine ES - Technical Appendix D; and key information relevant to the assessment is summarised below.

Cable laying, rock placement and geophysical survey

Cable laying activities together with related activities including rock placement are continuous (non-pulse) activities expected to generate sounds up to 191dB re 1µPa @1m (0-peak). For non-pulse activities it is unlikely that death or tissue damage (barotrauma) will occur to fish. The typical behavioural response to sounds by fish might range from no change in behaviour, to a mild awareness (startle response) to larger movements of temporary displacement for the duration of the sound (Popper and Hastings 2009). Popper et al. (2014) identified that there is no direct evidence of permanent injury to fish species from shipping and other continuous noise (such as cable installation).

Nedwell et al. (2012) reviewed herring (also in the clupeid family) sensitivity to sources of noise from non-pulse cable laying operations (i.e. cable lay and trenching) and proposed effect ranges. Clupeids are expected to show strong avoidance behaviour (i.e. reaction by virtually all individuals) within 8m of the works, whilst significant avoidance (85% of individuals will react to noise) is expected within 66m.

The Greenlink Marine ES - Technical Appendix D concluded that for vessel noise, rock placement and cable trenching the zone of influence for fish recoverable injury is 17m, and the zone of influence for temporary injury is 110m. These results are slightly more conservative than the study by Nedwell et al (2012) but are generally consistent.

During cable installation, the presence of several vessels and continued noise with 24-hour operations means it is likely that the most hearing specialist fish will demonstrate temporary avoidance behaviour from early on in and remain outside the zone of influence (conservatively 110m radius) of operations for the duration of the installation activities.

Most noise from a geophysical survey is likely to be generated at frequencies greater than 1kHz, above the auditory capacity of fish (generally between 0.2Hz to 1kHz). In addition, sound from survey equipment is targeted towards the seabed, meaning that effects to fish are only expected if they are within the immediate zone of ensonification below the survey vessel.

For geophysical survey the zone of influence for temporary injury is 2.2km. However, it should be noted that the spreading model assumes that sound is spread geometrically away from the source with an additional frequency-dependent absorption loss; it therefore provides conservative estimates. It does not take into consideration the conditions within the area, such as bathymetry, water depth or sediment type and thickness; all of which reduce the propagation of sound, and would reduce the zone of influence.

For geophysical works the potential zone of influence is transient as it moves slowly in a constant direction along the principal survey line orientation. It is expected that fish will avoid the area once operations have started and are extremely unlikely to move towards the sound source.

The works will not lead to any long term displacements as they are transient and temporary. Individuals would be expected to be able to return once the operation had passed through. However, it should be noted that the ability of small fish to take avoiding action may be limited, and temporary displacement may not therefore occur.

Temporary displacement of mobile species in the marine environment is not expected to result in significant adverse effects for the individuals concerned unless it interferes with a critical lifecycle activity such as spawning. However, juvenile

shad are known to forage in the nearshore environment, so some interaction may be possible.

Based on the above discussion, any disturbance effects from noise associated with operations will be localised, temporary and transient. There will be no effect on the distribution of the species. In addition, the Proposed Development will not effect the population structure, spawning extent or habitat extent, or water quality. Considering the extent of inshore habitat available the likely effect on juvenile twaite and allis shad has been assessed as not significant.

UXO detonation (if required)

It is unknown how many, if any, UXO detonations will be required within the Proposed Development. However, as the Proposed Development crosses the Castlemartin Firing range it is possible that UXO may be encountered during installation and possibly maintenance activities.

A UXO survey along the proposed centreline will be completed by the Installation contractor ahead of the installation campaign to identify any UXO along the route. In line with embedded mitigation EM21 a decision making process will be followed for any potential UXO whereby the target is first avoided, then removed and if neither previous option is feasible, detonation is undertaken.

The Greenlink Marine ES - Technical Appendix D concluded that UXO detonation could cause fish mortality within 6.2km of the detonation site.

Underwater explosion produces a pressure waveform with rapid oscillations from positive pressure to negative pressure which results in rapid volume changes in gas-containing organs (i.e. swim bladders). Damage to visceral organs is most often the cause of fish mortality following exposure to underwater explosions. The most commonly injured organs are those with air spaces that are affected by the explosion's shock wave passing through the body of the fish, these include the body cavity, the pericardial sack and gut, however injuries of the swim bladder are most common. The swim bladders are subject to rapid contraction and overextension in response to explosive shock waveforms. Species which do not possess a swim bladder or have small swim bladders are likely to be more resistant to noise generated from explosions (Keevin and Hempen 1997).

Allis and twaite shad are likely to be sensitive to such disturbance. However, the explosion will be brief, with the shock waves attenuating rapidly in the water column, thus resulting in a restricted lethal zone (Continental Shelf Associates, Inc 2004). Although there is the potential that individuals will be killed, the activity, if required, is unlikely to affect the viability of the species, populations or stocks.

Appendix B

Supporting Information – Red-billed chough

A.4 RED-BILLED CHOUGH

Red-billed chough are Qualifying Features of the Castlemartin Coast SPA (of which Broomhill Burrows SSSI and Castlemartin Range SSSI are components), and the Angle Peninsula Coast SSSI. Around 4% of the UK population of chough occur within the SPA. There is regular interchange of the chough from this site and those from the adjacent Angle Peninsula Coast SSSI. The short, grazed maritime grassland turf, which occurs in places along this stretch of coastline is favoured by chough because it supports invertebrate communities that provides good feeding habitat (NRW 2003).

The availability of suitable nest sites and the extent and quality of foraging habitat are the two main limiting factors for chough (Newbery et al 1998 cited in Rylands et al 2012). Their preferred habitat is grazed grassland and heathland close to suitable nesting sites on rock faces and in caves. Chough prefer short pasture less than 5cm in height and soft soil it can probe with its long bill to feed on invertebrates. As such, coastal strips of maritime heath and short grazed pasture are extremely important to them (RSPB 2019 and The Wildlife Trust of South & West Wales 2011).

The breeding season for chough begins in late March to early April when they begin to build nests. In Pembrokeshire, this is usually deep inside an inaccessible sea cave or cliff crevice. Chough are central place foragers whilst breeding, and to improve fledgling success it is critical that they can spend most of their time foraging close to the nest. Where suitable habitat exists, they spend over half their time within 100m of the nest and a major part of the time within 300m of the nest (Kerbiriou et al. 2006 cited in Rylands et al. 2012).

Although found along rocky coastlines they are essentially terrestrial birds which feed onshore.

The CCW Science Report Analysis of Chough productivity and recreational use in Pembrokeshire (Poole 2003) identified that the bulk of the Pembrokeshire red-billed chough population are located away from the Proposed Development, along the south coast of Pembrokeshire; principally, around the Castlemartin Range (Elegug Stacks), St. Govan's Head, Stackpole Head and Lydstep Point.

The report indicates that the nearest nesting roost of the satellite population on the Angle Peninsula is approximately 1.5km to the east in Parsons Quarry Bay. The report also identifies an intermittently held feeding territory, occupied during only two of the nine monitoring years, at the Furzenips on Freshwater West beach; approximately 1.5km to the south of the landfall site (Arup 2018).

Bird surveys were conducted for the Welsh Onshore components of Greenlink and although largely focused on inland areas, they did include the area up to the HDD compound close to the landfall at Freshwater West. The survey methodology was agreed with NRW.

Chough were not recorded during the two breeding bird surveys conducted in May and July 2013 (Arup 2013). Initial discussion with NRW on 18th November 2013, confirmed that specific chough surveys were not required. The only area that is likely to be utilized by chough is the working "compound" above Freshwater West beach.

NRW requested an assessment of the "compound" area for use by wintering birds. A wintering bird survey of this area would show whether chough use the area over winter and therefore provide a year-round chough usage of the compound area. The wintering bird survey results indicated that a maximum of four red-billed chough were observed in the compound area at any given time (assumed to be two pairs) which represents 8% of the wintering Castlemartin Coast SPA population (cited as 24 pairs).

The preliminary onshore HRA (Arup 2018) and the wintering bird survey (Arup 2019) concluded that there would be no likely significant effects on red-billed chough taking into account the distance from individual territories, the limited area affected by the works in relation to the available feeding habitat, combined with the temporary nature of the cable installation works, the subsequent reinstatement of the construction area and maintenance of the existing land management regime post-installation.

With respect to the Proposed Development, the main cause of concern for chough is disturbing them when they are foraging. When foraging, the birds spend a proportion of their time in 'vigilance' behaviour, when they are keeping a look-out for danger. The more time spent on vigilance, the less time spent feeding, which can lead to subtle effects on the amounts and types of food taken back to the nest, with subsequent effects on the development of the nestlings (Poole 2003).

A study by Owen (1988) on vigilance by foraging choughs in relation to tourist disturbance suggested that chough feeding in open areas had a minimum flight distance of 35m i.e. they would take to flight if walkers got to that distance. In areas of medium to heavy cover, the flight distance reduced to 32 and 22m respectively (Poole 2003).

The two closest chough territories to the landfall site (Parsons Quarry Bay on the Angle Peninsula and Furzenips on Freshwater West beach) are both approximately 1.5km from Proposed Development. During the most sensitive time, during the breeding season, chough is likely to spend most their time foraging between 100m to 300m from the nest, over 1km from the Proposed Development. Since most disturbance occurs when people come within 35m of foraging chough it has been concluded that there would be no likely significant effects on red-billed chough.

Appendix C

Greenlink Marine ES – Wales : Chapter 7

Benthic and Intertidal Ecology

7. Benthic and Intertidal Ecology

This Chapter describes the existing baseline environment in terms of benthic and intertidal ecology, identifies the pressures associated with the Proposed Development on the receptor, presents the findings of the environmental impact assessment, and describes how significant effects (if any) will be mitigated.

The Proposed Development comprises the Welsh Marine components of Greenlink from mean high-water springs (MHWS) at the Welsh landfall at Freshwater West, Pembrokeshire to the UK / Republic of Ireland median line. It comprises:

- Two high voltage direct current (HVDC) electricity power cables;
- A smaller fibre-optic cable for control and communication purposes;
- All associated works required to install, test, commission and complete the aforementioned cables; and
- All associated works required to operate, maintain, repair and decommission the aforementioned cables, including five repair events over the 40 year lifetime of Greenlink.

The Proposed Development includes the following phases, all of which are assessed within this chapter:

- Installation;
- Operation (including repair and maintenance activities); and
- Decommissioning.

Where relevant, any limitations related to the baseline conditions, data sources or scientific understanding / interpretation within the process of assessing the effects have been highlighted.

7.1 Data Sources

Greenlink Interconnector Limited (GIL) has commissioned environmental and intertidal surveys to inform the baseline description and assessment. These have been supplemented where necessary by a review of published information and consultation with relevant bodies. The data sources used in this Chapter include, but are not limited to the following:

- Greenlink Interconnector Environmental Survey Report (MMT 2019) – provided as Technical Appendix J;
- Greenlink Interconnector Cable Landfall Locations (Wales and Ireland) – Intertidal Walkover Survey Report 2018 (MarineSpace 2018) – provided as Technical Appendix K;
- Greenlink Marine Habitat Regulation Assessment (HRA) (Intertek EWCS 2019) – provided as Technical Appendix C
- The Marine Life Information Network (MarLIN) website; and

- Other data sources as listed at the end of the Chapter.

7.1.1 Intertidal survey

Data regarding the intertidal area of Freshwater West is not readily available. Therefore, GIL commissioned MarineSpace to undertake a phase 1 intertidal walkover survey of the Freshwater West landfall to inform the baseline description and assessment.

Conducted on the 11 September 2018, it involved surveying all intertidal habitats between MHWS and mean low water springs (MLWS) across a 500m wide area centred on the indicative cable centreline. The Proposed Development lies within the surveyed area.

The intertidal survey was undertaken during spring tides in line with guidance in the Marine Monitoring Handbook (Davies et al. 2001) and Countryside Council for Wales (CCW) Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn et al. 2006). During the walkover survey, biotopes were identified according to the European Nature Information System (EUNIS) classification in line with relevant guidance (Parry 2015) (and correlated to the Marine Nature Conservation Recorder (MNCR) biotopes). Where possible, boundaries of biotopes were tracked using handheld Garmin E-Trex 10 GPS devices and the Phase One Habitat Survey Tool Kit application (v1.4.0).

Soft and hard substrate quadrat sampling was undertaken to gather detailed information on the benthic communities present for biotope mapping purposes. Areas representative of each key soft sediment habitat at different tidal heights were assessed by sampling the upper 10 cm of a 0.04m^2 (0.2 m x 0.2 m) quadrat using a spade and screened on a 0.5 mm sieve. Any macrobenthos retained on the sieve was identified to species level where possible in the field. The quadrats were then dug to approximately 30 cm depth to check for the presence of larger, burrowing species. Any soft sediment samples were subject to a visual inspection and observations of colour, smell, redox potential discontinuity (RPD) depth layer, texture and presence of surface features (accretions, algae, fauna, etc.) recorded.

The survey report is provided as Technical Appendix K.

7.1.2 Offshore survey

As part of the comprehensive survey of the Greenlink cable route, MMT was commissioned by GIL to characterise the benthic ecological conditions and map the distribution and extent of the marine benthic habitats along the route. Marine survey work was undertaken between the 30 September 2018 and the 01 January 2019.

Geophysical, geotechnical and benthic survey techniques were used to:

- Identify obstructions and debris on the seabed;
- Determine whether any features of conservation importance were present;

- Map benthic habitats;
- Characterise burial conditions; and
- Characterise the seabed conditions.

The scope of the geophysical and geotechnical survey is outlined in detail in Chapter 6, Section 6.1.

Geophysical data was used to focus the environmental survey strategy and subsequent data interpretation.

An initial reconnaissance survey along two alternative routes was undertaken to determine the presence of reef habitat prior to the establishment of a cable route. The reconnaissance survey comprised of habitat identification from a 500m swathe geophysical survey, ground-truthed by drop down video transects. The reconnaissance survey identified significant areas of Annex I bedrock and biogenic reef habitat along both routes. Through consultation with Natural Resources Wales (NRW) and additional survey, the final route was developed between the two alternatives, and a benthic survey completed. The work undertaken to define the final route is presented in Chapter 3.

Survey operations were undertaken in accordance with the procedural guidelines contained within the marine monitoring handbook (Davies *et al*. 2001).

Benthic samples were collected using two types of grab samples (Day grab and Hamon grab); selection depended on the sediment size. Sample locations were selected based on the geophysical interpretation, emphasising variations in the seabed characteristics, along with investigation of areas of notable interest (e.g. areas of potential conservation importance).

Prior to grab sampling, seabed still images were collected using a SeaSpyder drop-down video (DDV) system. Images were reviewed by experienced marine biologists on board to confirm the presence/absence of any potentially sensitive habitats or features of conservation importance. Where grab sampling was not possible due to hard seabed or coarse substrates, only video/still photo was used for sampling.

Underwater visibility was generally good, although poor conditions were experienced at KP46.9 (grab sample stations S23 and S24).

Three grab samples were retrieved at each selected site; two samples for macrofaunal analysis; and one sample for particle size and chemical analysis. Sidescan sonar data interpretation was confirmed using selected drop-down video/photo transects and/or grab samples.

A total of 21 sites were sampled within the Proposed Development; Stations S17 to S37. Additional 35 photo transects were completed; of which 13 were along the final route (the remainder were carried out on alternative routes to inform route selection). Sampling locations are shown in Figure 7-1.

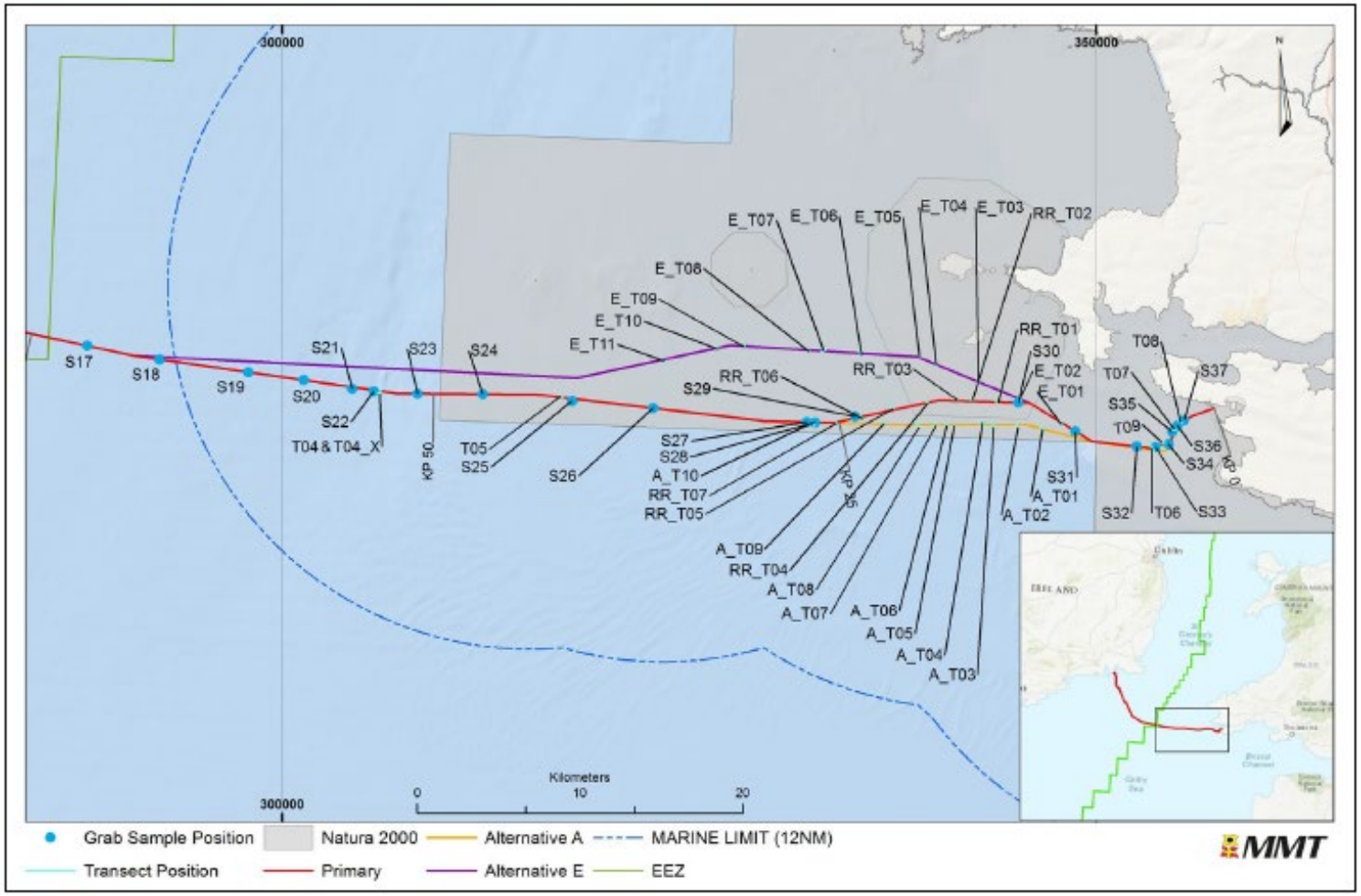
Collectively, information from the grab sampling, video / photo analysis, sidescan sonar and multi-beam echosounder was used to classify habitats and associated

epibenthic communities to biotopes where possible and/or to habitat/biotope complex according to the European Union Nature Information System (EUNIS) classification code and Annex I habitats. Particular attention was paid to habitats above the elevated seabed level, together with their spatial extent, percentage biogenic cover and patchiness, as these are key criteria for evaluating areas of conservation importance and reef structures.

Faunal identification and quantification were carried out for grab samples and still photographs to obtain species density data of individuals per m^2 and percentage cover for colonial species.

The survey report is provided as Technical Appendix J.

Figure 7-1 Grab sample and drop down video transect positions



7.2 Consultation

Table 7-1 summarises the relevant consultation responses on benthic and intertidal ecology. The steps taken to contact stakeholders for comments on the EIA scope is documented in Chapter 5.

Table 7-1 Consultation responses – benthic and intertidal ecology

Stakeholder	Summary of Consultation Response	How response has been addressed
Comments received on Natural Resources Wales (NRW) Scoping Opinion SC1816		
NRW	The EIA must clarify whether a cable joint will be located within a sensitive area, and what the significance of effects from this would be.	A cable joint is not planned to occur within a sensitive benthic habitat.
NRW	If mattressing/use of aggregates is needed in sensitive/designated areas there must be consideration of the effect of this.	External cable protection will be required within the Pembrokeshire Marine SAC due to hard ground conditions. The significance of effects on the habitats and SAC have been assessed in Section 7.6 and the Greenlink Habitats Regulations Assessment (HRA) – Technical Appendix C.
NRW	All available information, including NRWs pre-application advice and the MarLIN's habitat sensitivity assessments must be used to evaluate the significance of effects in the EIA.	This chapter draws on site specific information obtained by the Greenlink cable route survey, as well as the NRW pre-application advice and MarLIN sensitivity assessments.
NRW	NRW TE provided advice on known survey results. If gaps in knowledge exist and there are areas of low confidence, we recommend that an exercise is undertaken in which degrees of confidence in the areas mapped is provided.	The entire Proposed Development has been successfully mapped in full. The survey reports are provided as Technical Appendices I, J and K and have been used to inform the baseline description (Section 7.3) and the significance assessment (Section 7.6).
NRW	Micro-siting to avoid reef features would be preferable to movement of boulders. Boulders may likely form part of the 'Reef' feature of the Pembrokeshire Marine SAC.	Post-survey route development has been undertaken to avoid large boulders. It is anticipated that the Installation Contractor will undertake further micro-routeing but to ensure a robust worst-case assessment, areas where boulder clearance may be required have been assessed in Section 7.6.2.
NRW	The HDD exit hole is considered as a potential impact pathway as Freshwater West intertidal is a SAC habitat with the 'Mudflats and sandflats' feature. This must be appropriately assessed in the ES.	Chapter 6 concluded that trenching within the intertidal zone at Freshwater West has the potential to have a Significant effect on coastal processes. Project Specific Mitigation has therefore been proposed (PS1, PS4) and an

Stakeholder	Summary of Consultation Response	How response has been addressed
		exclusion zone established at Freshwater West. No intrusive works will be undertaken between MHWS and mean low water (LWM). The effects of cable installation on subtidal habitats has been assessed in Section 7.6.
NRW	The ES and HRA should consider the effects of seabed preparation (e.g. pre-sweeping) on the Turbot Bank which is an Annex 1 habitat and is part of the 'Sandbanks which are slightly covered by seawater all the time' features of Pembrokeshire Marine SAC.	The Greenlink HRA (Technical Appendix C) and Section 7.6.2 assess the effect of pre-sweeping on Turbot Bank.
NRW	It is not clear how the habitats identified in Table 5-1 relate to biotopes identified within the surveys and for which sampling locations. We recommend that NRW TE preliminary advice on biotope mapping provided to Greenlink should also be used to establish the biotope maps for the chosen cable route.	The UK Scoping Report was submitted ahead of the cable route survey taking place, and therefore Table 5-1 of the UK Marine Scoping Report provided indicative EUNIS habitats based on broadscale maps of the region. The baseline presented in Section 7.3 has been informed by the cable route survey and provides site specific information, which has taken into consideration recommendations received from NRW.
NRW	There does not appear to be any reference to invasive species in the report or to any biosecurity measures planned. These must be considered within the ES.	The UK Scoping Report had proposed to scope the pressure 'introduction or spread of non-indigenous species' out of the ES but assessment has now been provided in Section 7.6.5.
Comments received on Superseded Scoping Report which are relevant to the Proposed Development		
MMO	The introduction of such external cable protection into an otherwise soft sediment environment needs to be investigated in the ES as this constitutes a permanent seabed effect. In addition, the use of external cable protection could cause significant effect to seabed features, particularly reef habitat.	The introduction of external cable protection and the associated pressures on subtidal habitats has been assessed fully in Section 7.6.
NRW	Grapnel has potential to damage seabed habitats through clearance of sessile organisms. This should be considered for relevant SAC habitats.	The potential damage by seabed clearance (including grapnel) on subtidal habitats has been addressed in Section 7.6.2 under the pressure penetration / and or disturbance of the seabed'.
NRW	The most up to date habitat shapefile should be acquired from JNCC.	The most recent habitat shapefile updates (14-03-19) have been acquired from the JNCC website.

7.3 Existing Baseline

7.3.1 Overview

Benthic ecology describes the assemblages of organisms living in (infauna) or on (epifauna) the seabed, and their diversity, abundance and function. Benthic communities include those found on the sea floor from the intertidal zone to the deepest parts of the marine environment. The structure of benthic communities varies temporally and spatially depending on a wide range of physical factors of which water depth, sediment type, particle size and supply of organic matter are key variables.

The Proposed Development crosses the Pembrokeshire Marine / Sir Benfro Forol Special Area of Conservation (SAC) from KP0 to KP49.59. The SAC supports habitat features of varying individual scale, distribution, significance, quality and sensitivity. Biogeographically, the SAC sits on the boundary between northern and southern species, making the area high in biological diversity. The mixed sediments support burrowing macrofauna living within and on the sediment surface. More specifically, this area is inhabited by rare infauna including, molluscs (Ensis and Arctica); anthozoans (Mesacmea, Peachia, Aureliania); tube living polychaetes and echinoderms. Epifauna includes a relatively isolated population of great scallop (*Pecten maximus*) and various species living on reefs and in stony beds, molluscan shell debris and in association with species consolidating mobile substrates, e.g. Ross coral (*Pentapora folicea*) (CCW 2005).

A primary reason for the selection of the Pembrokeshire Marine / Sir Benfro Forol SAC is the presence of extensive areas of the Annex I listed 'Reef' habitat. Extensive areas of sublittoral rocky reef stretch offshore from the coastline and between the Pembrokeshire islands. These reefs support extensive areas of tide-swept kelp and species-rich red algal populations and, across the large areas of deeper rock reef, a wide range and abundance of invertebrate animal communities, with hydroid, bryozoan, soft coral and anemone species (JNCC 2019).

Other Annex I habitats present as a qualifying feature, but not a primary reason for selection of the SAC include (but are not limited to) 'Sandbanks which are slightly covered by sea water all the time', and 'Mudflats and sandflats not covered by seawater at low tide'[1].

Further offshore at the UK/Republic of Ireland median line, bottom-dwelling communities are dominated by highly abundant and diverse polychaetes. The substrate is predominantly soft sediments containing patches of muddy, sandy gravel (DTI 2005).

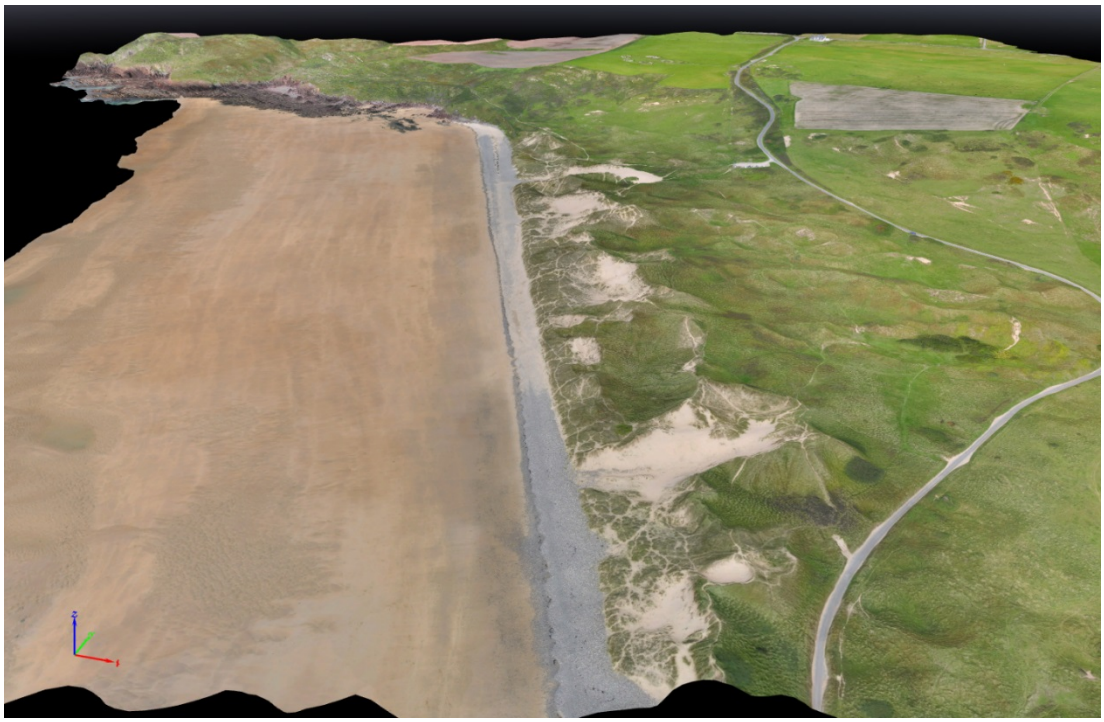
A total of 22 habitats were identified by the benthic survey within the Proposed Development.

[1] The Greenlink Marine HRA (Technical Appendix C) provides details of all qualifying habitat features of the Pembrokeshire Marine / Sir Benfro Forol SAC. The ones mentioned in the text are those relevant to the Proposed Development.

7.3.2 Freshwater West intertidal ecology and habitats

The baseline intertidal ecology at Freshwater West is detailed in the intertidal survey report, see Technical Appendix K. Figure 7-2 shows the beach as seen from the air; the image was taken during the Greenlink drone survey to establish the topography.

Figure 7-2 Aerial image of Freshwater West September 2018



Source: MMT

The habitat map produced by the intertidal Phase 1 walkover survey is provided as Figure 7-3.

Freshwater West consists predominantly of hard rocky substrate, shingle and fine sand habitats. The majority of the intertidal area within the survey area was characterised by barren littoral coarse sand (EUNIS biotope A2.111) (Table 7-2). This dominant biotope was fringed by barren littoral shingle (A2.111) along the upper shore overlain by a narrow strandline biotope constituted by decomposing seaweed supporting sandhopper (Talitrid amphipods) communities (A2.211). The lower extent of the dominant A2.111 biotope was fringed by littoral medium-fine sand supporting amphipods and the polychaete worms *Scolelepis spp.* (A2.223). The north of the survey area extended across a complex mosaic of littoral rock biotopes spanning the full range of the typical zonation expected on an exposed rocky coastline. This included lichen and barnacle dominated biotopes in the supralittoral (B3.111 and B3.1132) and upper shore zones (A1.112, A1.1121, A1.1122) and the typical fucoid dominated biotopes in mid-lower shore areas (A1.212, A1.213 and A1.3141) interspersed with coralline crust-dominated (A1.411) and green and red

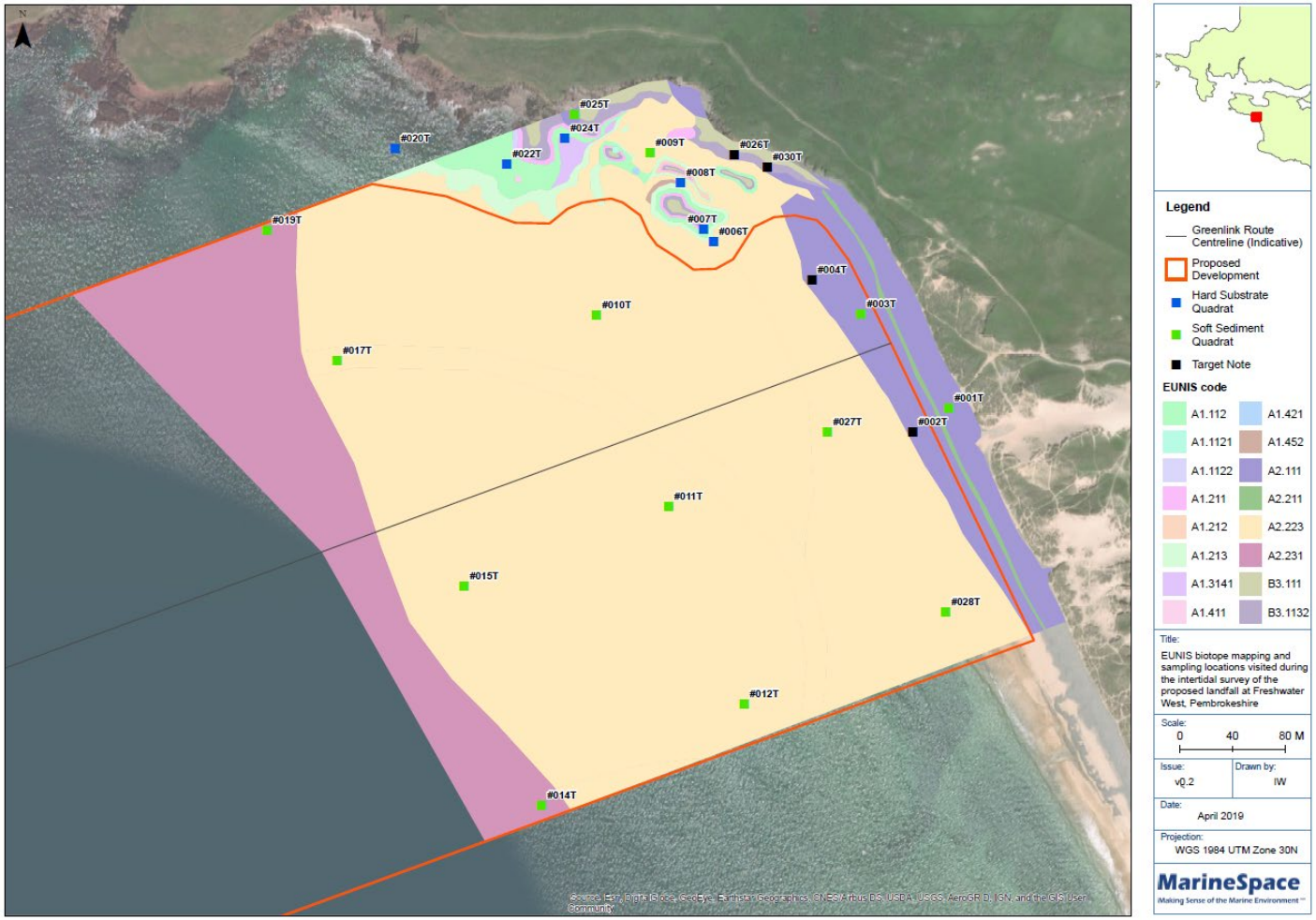
seaweed dominated (A1.421 and A1.452) rock pools. A summary of these biotopes is presented within Table 7-2.

To summarise, Freshwater West was mostly characterised by impoverished sandy shores. The paucity of benthic organisms in these sediments can be explained by the highly mobile nature of sediments in this area due to its exposed location and lack of shelter from prevailing southwesterly winds and swell.

Table 7-2 Key biotopes identified at Freshwater West

Habitat	EUNIS Code	EUNIS Description
A1 - Littoral Rock and other hard substrata	A1.112	*Chthamalus* spp. on exposed upper eulittoral rock
	A1.1121	*Chthamalus montagui* and *Chthamalus stellatus* on exposed upper eulittoral rock
	A1.1122	*Chthamalus* spp. and *Lichina pygmaea* on steep exposed upper eulittoral rock
	A1.211	*Pelvetia canaliculata* and barnacles on moderately exposed littoral fringe rock
	A1.212	*Fucus spiralis* on full salinity exposed to moderately exposed upper eulittoral rock
	A1.213	*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock
	A1.3141	*Ascophyllum nodosum* on full salinity mid eulittoral rock
	A1.411	Coralline crust-dominated shallow eulittoral rockpools
	A1.421	Green seaweeds *Enteromorpha* spp. and *Cladophora* spp. in shallow upper shore rockpools
	A1.452	*Porphyra purpurea* or *Enteromorpha* spp. on sand-scoured mid or lower eulittoral rock
A2 - Littoral sediment	A2.111	Barren littoral shingle
	A2.211	Talitrids on the upper shore and strandline
	A2.223	Amphipods and *Scolelepis* spp. in littoral medium-fine sand
	A2.23	Polychaete/amphipod-dominated fine sand shores
B3 - Rock cliffs, ledges and shores, including the supralittoral	B3.111	Yellow and grey lichens on supralittoral rock
	B3.1132	*Verrucaria maura* on very exposed to very sheltered upper littoral fringe rock

Figure 7-3 EUNIS biotope mapping and sampling locations at Freshwater West



7.3.3 Subtidal ecology and habitats

Review of the geophysical data, ground-truthed by video transects and infaunal grab samples identified 22 habitats within the Proposed Development from mean low water springs to the UK / Republic of Ireland median line. These are mapped and presented in Figures 7-4 to 7-9 (Drawing P1975-HAB-003 Sheet 1 to Sheet 6).

Table 7-3 presents a description of each habitat identified, with images underneath. Two Annex I habitats, including three sub-types were identified in the Proposed Development. These are discussed in detail in Section 7.3.4.

Table 7-3 Habitats present within the Proposed Development

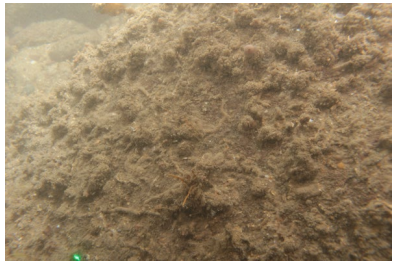
EUNIS Habitat code	Indicative KPs	Associated Sample Station(s)	JNCC Equivalent Habitat	Infaunal analyses from grab samples
A4.111, *Balanus crenatus* and *Tubularia indivisa* on extremely tide-swept circalittoral rock	KP16 - KP21	Four single camera drops (RR_D01 – D04)	CR.HCR.FaT.BalTub, *Balanus crenatus* and *Tubularia indivisa* on extremely tide-swept circalittoral rock	-
A4.13, Mixed faunal turf communities on circalittoral rock	KP2 – KP3	Transects E_T04, E_T05	CR.HCR.XFa, Mixed faunal turf communities	-
A4.138, *Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock	KP2 - KP3, KP4 - KP5	Transects DDV_T06-DDV_T09	CR.HCR.XFa.Mol, *Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock	-
A4.213, *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	KP10 - KP12, KP24 - KP25	Transect A_T01	CR.MCR.EcCr.UrtScr, *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	-
A4.2212, *Sabellaria spinulosa*, didemnid and small ascidians on tide-swept moderately wave-exposed circalittoral rock	KP42 – KP43	Transect T05	CR.MCR.CSab.Sspi.As, *Sabellaria spinulosa*, didemnids and other small ascidians on tide-swept moderately wave-exposed circalittoral rock	-
A5.13, Infralittoral coarse sediment	KP0 – KP1	-	SS.SCS.ICS, Infralittoral coarse sediment	-
A5.14, Circalittoral coarse sediment	KP20 - KP24	-	SS.SCS.CCS, Circalittoral coarse sediment	-
A5.141, *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	KP15 - KP23	Transects RR_T01 - RR_T05	SS.SCS.CCS.SpiB, *Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	-
A5.142, *Mediomastus fragilis*, Lumbrineris spp. and venerid bivalves in circalittoral coarse sand or gravel	KP24 - KP28, KP33 - KP37	Grab Station: S26, S27	SS.SCS.CCS.MedLumVen, *Mediomastus fragilis*, *Lumbrineris spp.* and venerid bivalves in circalittoral coarse sand or gravel	S26, S27 - The fauna comprised *Lanice conchilegala* tubes, Actiniaria, Hydrozoa, bryzoans and echinoderm *Ophiura albida*. The infaunal assemblage was characterised by the echinoderms *E. pusillus*, and *Amphhipholis squamata*, numerous polychaetes such as *Ampharete lindstroemi*, *A. octocirrata*, *L. cingulata*, a high abundance of the amphipod *Ampelisca spinipes* as well as numerous molluscs

EUNIS Habitat code	Indicative KPs	Associated Sample Station(s)	JNCC Equivalent Habitat	Infaunal analyses from grab samples
				A. alba, *Hiatella arctica*, *K. suborbicularis*, *K. bidentate*, *Thracia villosiuscula*, *T. ovata* and *Diplodonta rotundata*.
A5.143, *Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand	KP2 - KP6	Grab station: S36	SS.SCS.CCS.Pkef, *Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand	S36, S33 - Infauna was characterised by low abundances of infauna, consisting of polychaetes *P. kefersteini*, *Glycera lapidum*, *Exogone verugera*, Notomastus and Nematods as well as sipunculid *Phascolion strombus*.
A5.15, Deep circalittoral coarse sediment	KP23 - KP25, KP53 - KP59	Transect RR_T06, Grab station: S22, S29	SS.SCS.OCS, Offshore circalittoral coarse sediment	S22, S29 - The infaunal community was dominated by the echinoderm *Amphiura filiformis* and *E. pusillus, the* polychaetes *Paradoneis lyra* and *Lumbrineris cingulate*, Nemertea and mollusc *Clausinella fasciata*. Small isolated clusters of *S. spinulosa* were present at S29.
A5.24, Infralittoral muddy sand	KP0 – KP1	-	SS.SSa.IMuSa, Infralittoral muddy sand	-
A5.25, Circalittoral fine sand	KP2 - KP4, KP5 - KP11	Grab station: S31, S32, S35	SS.SSa.CFiSa, Circalittoral fine sand	S31, S32, S35- The infauna was characterized by molluscs *A. prismatica*, *T. ovata*, *Kurtiella bidentata*, *Goodallia triangularis*, *Asbjornsenia pygmaea*, polychaetes *O. borealis*, *Lumbrineris cingulate*, *Glycinde nordmanni*, *Nephtys cirrosa* and various species of amphipods The infauna was relatively low in species diversity and abundances at S35. The sample was characterized by molluscs *A. alba* and *Timoclea ovata*, *amphipod Bathyporeia elegans* and different polychaetes
A5.251, *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	KP25 - KP27, KP58 - KP67, KP70 - KP74	Grab station: S17, S19	SS.SSa.CFiSa.EpusOborApri, *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	The infauna at grab stations S17, S19 and S28 included the echinoderms *A. filiformis, E. pusillus, and* polychaetes *O. borealis*, *G. lapidum* and *L. cingulate, the mollusc C.fasciata* and Nemertea.
A5.252, *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	KP3 - KP4	Grab station: S34	SS.SSa.CFiSa.ApriBatPo, *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	S34 - The infaunal community was relatively low in species diversity and abundances. The community species composition was characterized by molluscs *Abra prismatica*, *T. ovata*, polychaetes *Travisia forbesii*, *Ophelia borealis* and amphipod *B. elegans*.
A5.261, *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	KP0 – KP3	Grab station: S37	SS.SSa.CMuSa.AalbNuc, *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	S37 - The infauna comprised predominantly of molluscs *A. alba*, *N. nitidosa*, *Fabulina fabula* as well as polychaetes *Magelona filiformis* and *Spiophanes bombyx*.
A5.27, Deep circalittoral sand	KP27 -34, KP41 - KP43, KP48 - KP51, KP52 - KP53	-	SS.SSa.OSa, Offshore circalittoral sand	-

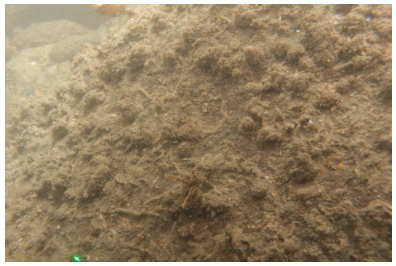
Co-financed by the European Union
Connecting Europe Facility

EUNIS Habitat code	Indicative KPs	Associated Sample Station(s)	JNCC Equivalent Habitat	Infaunal analyses from grab samples
A5.272, *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	KP65 – KP71	Grab station: S18	SS.SSa.OSa.OfusAfil, *Owenia fusiformis* and *Amphiura filiformis* in offshore circalittoral sand or muddy sand	S18 - The infauna was characterised by echinoderm *A. filiformis*, polychaetes *L. cingulate* and Owenia sp. and Nemertea.
A5.44, Circalittoral mixed sediments	KP6 - KP7, KP8 - KP10,	-	SS.SMx.CMx, Circalittoral mixed sediment	-
A5.45, Deep circalittoral mixed sediments	KP42 - KP43	-	SS.SMx.OMx, Offshore circalittoral mixed sediment	-
A5.451, Polychaete-rich deep Venus community in offshore mixed sediments	KP10 - KP15,	Grab station: S30	SS.SMx.OMx.PoVen, Polychaete-rich deep Venus community in offshore gravelly muddy sand	S30 - High diversity and abundance of infaunal species. The infauna was characterised by numerous polychaetes which were dominated by *Sabellaria spinulosa* and *Syllis armillarisa* as well as molluscs *Kellia suborbicularis*, *Modiolula phaseolina*, *Gari telinella*, *Venus casina*, *Hiatella arctica* and *Sphenia binghami*. The sample also contained numerous specimens of echinoderm *Amphipholis squamata*.
A5.611, *Sabellaria spinulosa* on stable circalittoral mixed sediment	KP33 - KP59	Grab station: S20, S21, S23, S24, S25 Transect T04, T04_X	SS.SBR.PoR.SspiMx, *Sabellaria spinulosa* on stable circalittoral mixed sediment	S20, S21, S23 and S24 – Grab samples contained the following infauna: *S. spinulosa*, the echinoderm *A.filiformis, and polychaetes Owenia sp. L. cingulate*, *A.lindstroemi*, *Ampelisca spinipes* and *K. suborbicularis*.

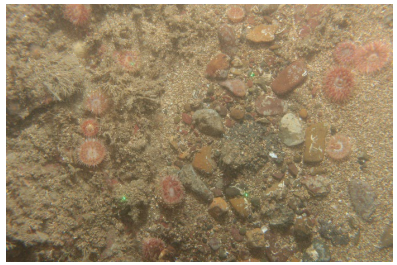
A4.13, Mixed faunal turf communities on circalittoral rock



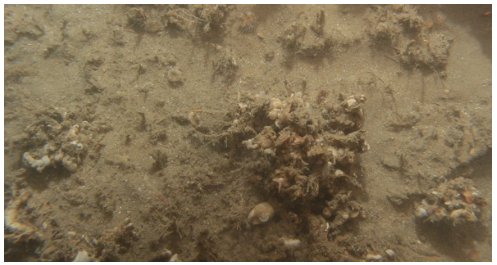
A4.138, Molgula manhattensis with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock



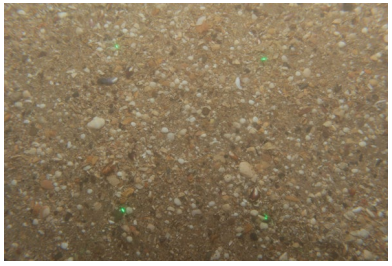
A4.213, *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock



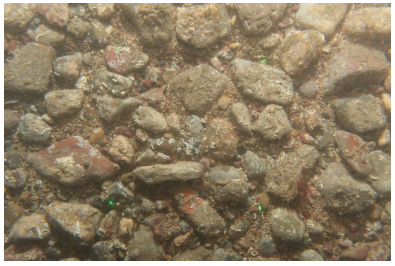
A4.2212, *Sabellaria spinulosa*, didemnid and small ascidians on tide-swept moderately wave-exposed circalittoral rock



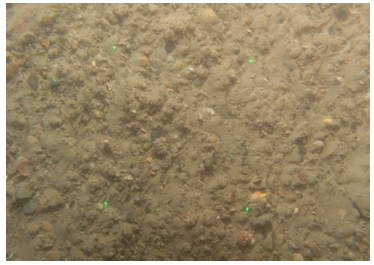
A5.14, Circalittoral coarse sediment



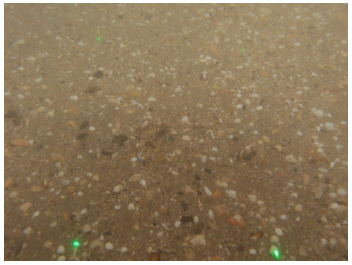
A5.141, *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles



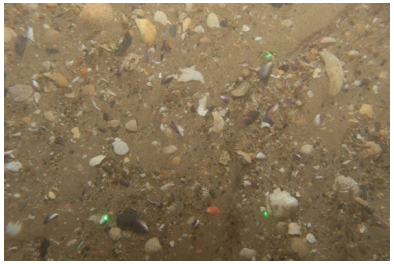
A5.142, *Mediomastus fragilis*, Lumbrineris spp. and venerid bivalves in circalittoral coarse sand or gravel



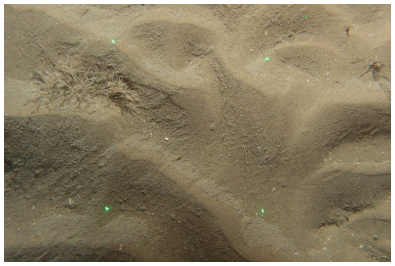
A5.143, *Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand



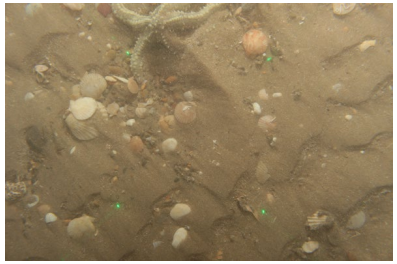
A5.15, Deep circalittoral coarse sediment



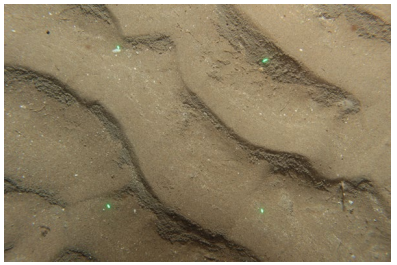
A5.25, Circalittoral fine sand



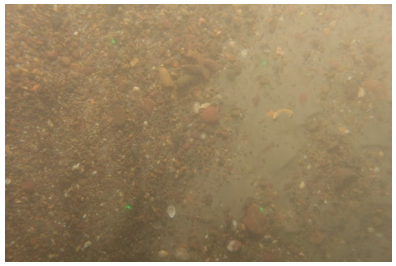
A5.251, *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand



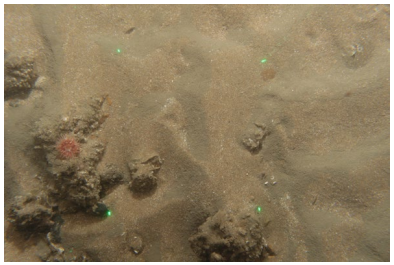
A5.252, *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand



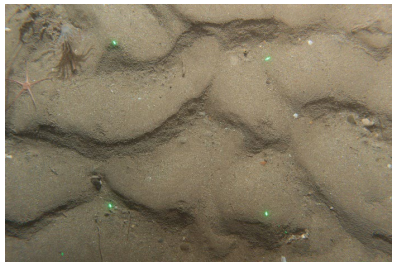
A5.261, *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment



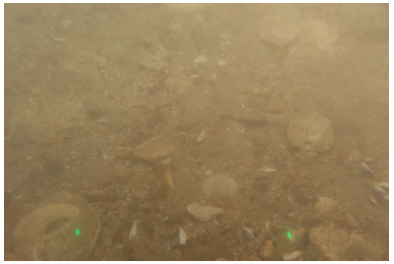
A5.27, Deep circalittoral sand



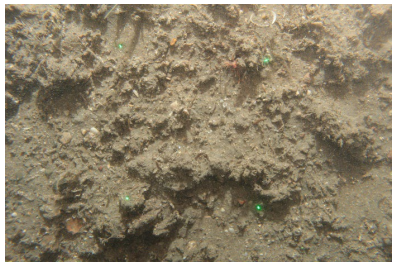
A5.272, *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand



A5.451, Polychaete-rich deep Venus community in offshore mixed sediments



A5.611, *Sabellaria spinulosa* on stable circalittoral mixed sediment

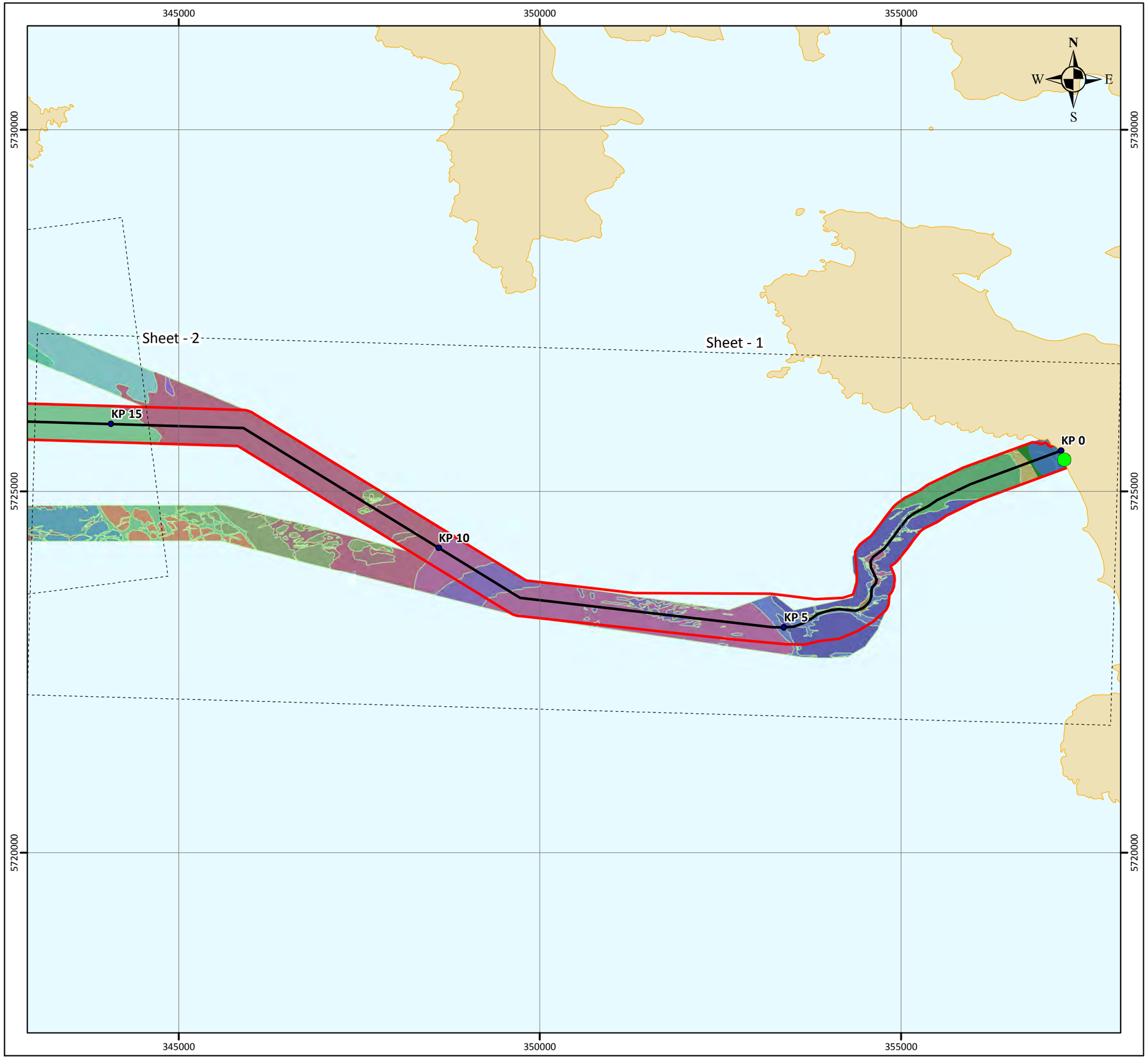


GREENLINK INTERCONNECTOR

BENTHIC HABITATS

Survey Data - Sheet 1

Drawing No: P1975-HAB-003 | **A**



Legend

- Freshwater West
- Greenlink Route Centreline (Indicative)
- Proposed Development

MMT Survey
EUNIS Classification

- A4.13
- A4.138
- A4.213
- A4.213/ A4.241
- A4.221
- A4.241
- A5.13
- A5.14
- A5.141
- A5.143
- A5.15
- A5.24
- A5.25
- A5.252
- A5.261
- A5.44
- A5.451
- A5.611

MarineSpace Survey
EUNIS Classification

- A1.112
- A1.1121
- A1.1122
- A1.211
- A1.212
- A1.213
- A1.3141
- A1.411
- A1.421
- A1.452
- A2.111
- A2.211
- A2.223
- A2.231
- B3.111
- B3.1132

NOTE: Not to be used for Navigation

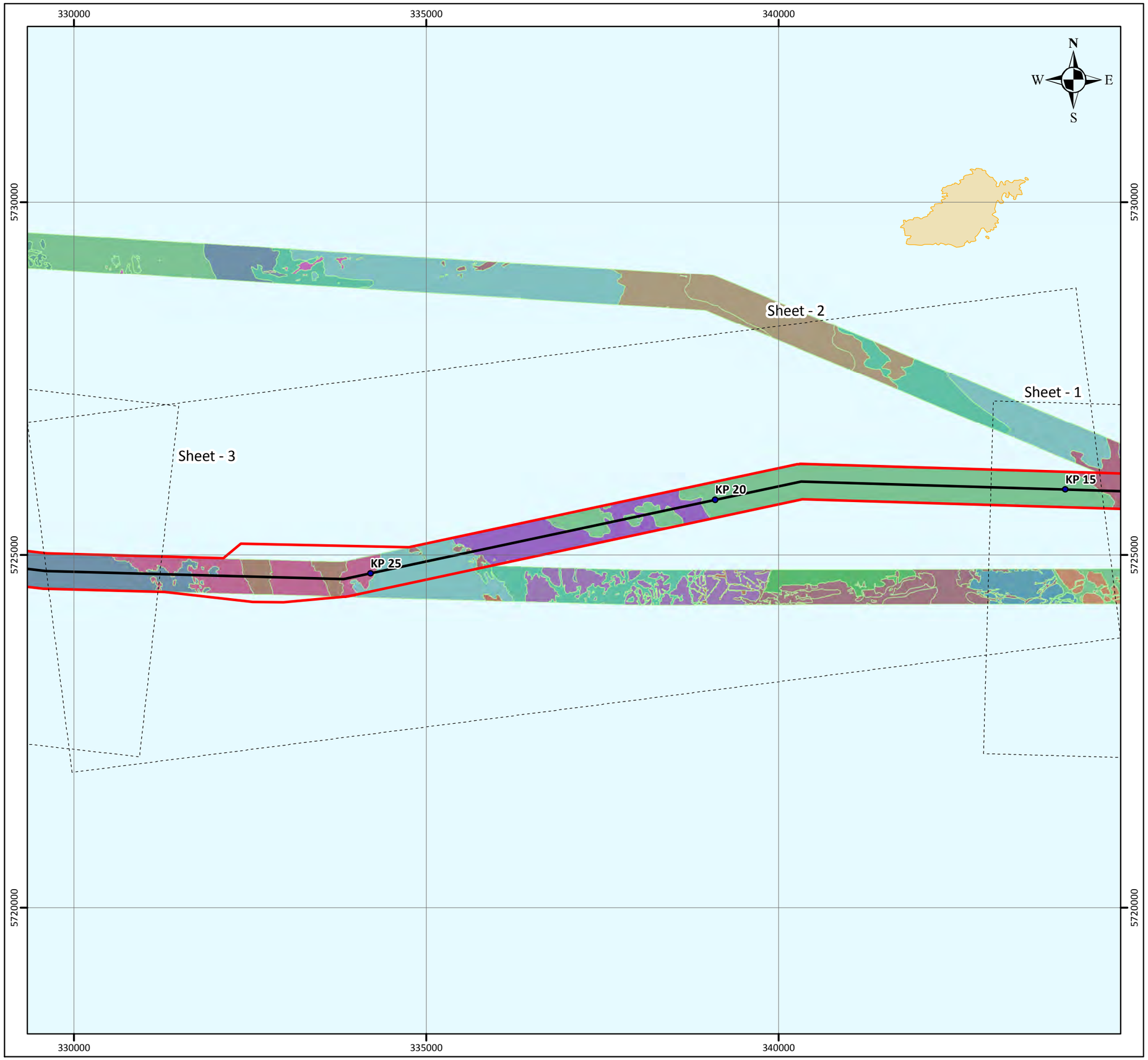
Date	Monday, April 8, 2019 12:40:35
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; OSOD; OSI; MMT; Greenlink
File Reference	J:\P1975\Mxd\06_HAB\ P1975-HAB-003.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Greenlink

Co-financed by the European Union
Connecting Europe Facility

intertek

0 0.5 1 1.5 2 km



GREENLINK INTERCONNECTOR

BENTHIC HABITATS
Survey Data - Sheet 2

Drawing No: P1975-HAB-003	A

Legend

- Greenlink Route Centreline (Indicative)
- Proposed Development

MMT Survey

EUNIS Classification

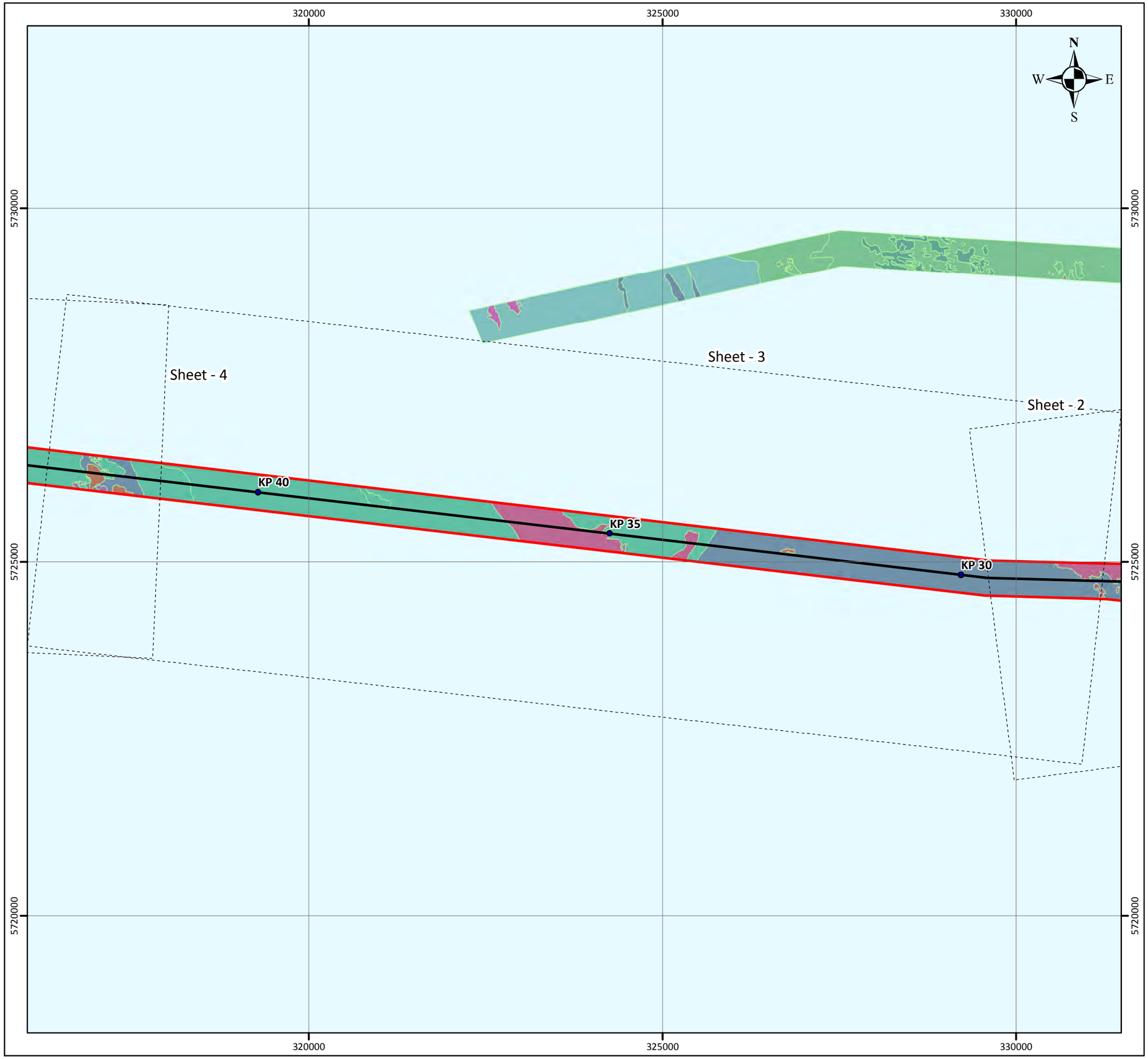
- A4.13
- A4.1312
- A4.132
- A4.21
- A4.213
- A4.213/ A4.241
- A4.2212
- A4.241
- A5.14
- A5.141
- A5.142
- A5.15
- A5.251
- A5.27
- A5.45
- A5.451
- A5.611

NOTE: Not to be used for Navigation

Date	Monday, April 8, 2019 12:40:35
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; OSOD; OSI; MMT; Greenlink
File Reference	J:\P1975\Mxd\06_HAB\ P1975-HAB-003.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Co-financed by the European Union
Connecting Europe Facility

0 0.5 1 1.5 2 km



GREENLINK INTERCONNECTOR

BENTHIC HABITATS
Survey Data - Sheet 3

Drawing No: P1975-HAB-003	A

Legend

- Greenlink Route Centreline (Indicative)
- Proposed Development

MMT Survey

EUNIS Classification

- A4.13
- A4.1312
- A4.221
- A4.2212
- A5.141
- A5.142
- A5.15
- A5.27
- A5.45
- A5.611

NOTE: Not to be used for Navigation

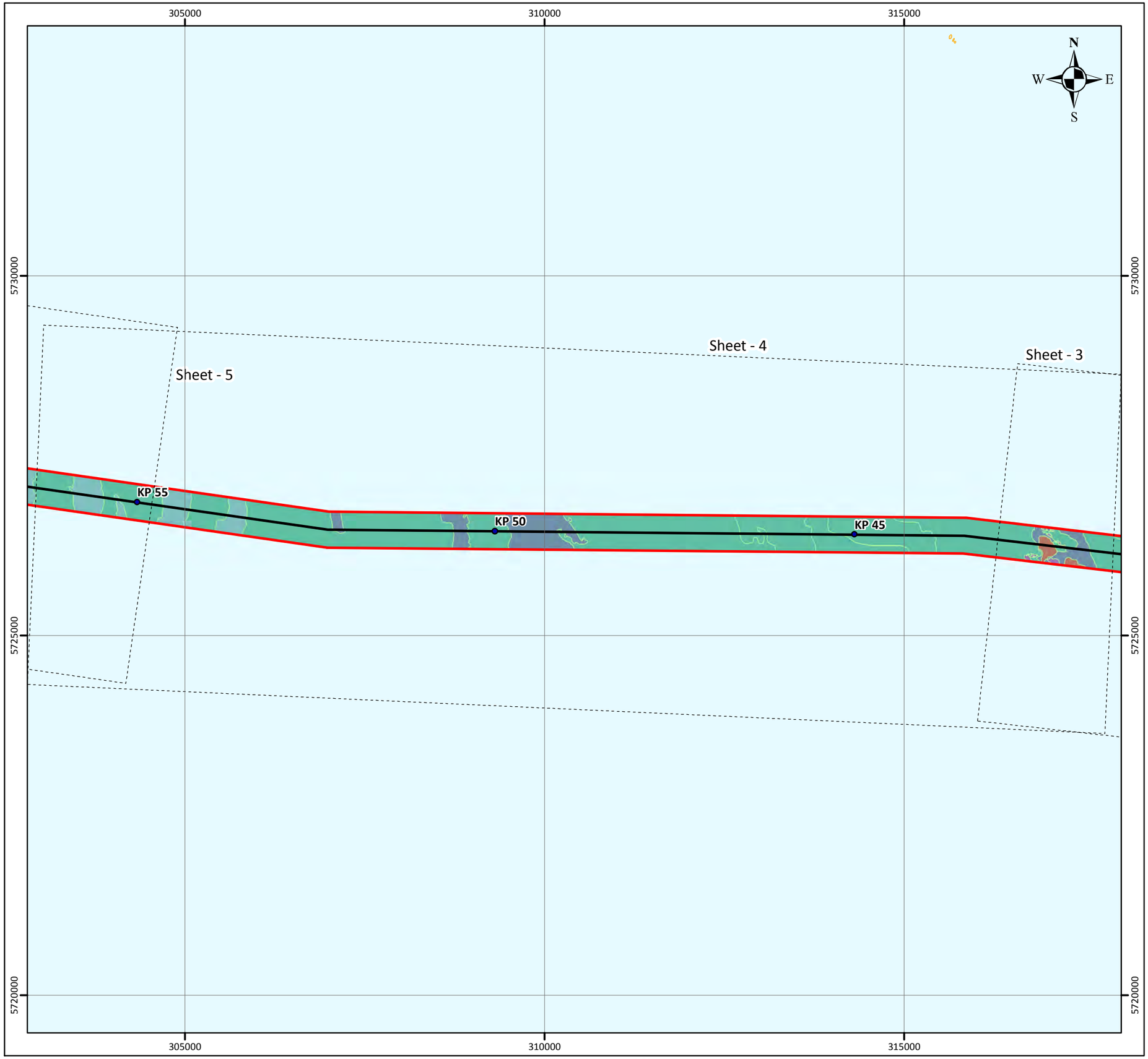
Date	Monday, April 8, 2019 12:40:35
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; OSOD; OSI; MMT; Greenlink
File Reference	J:\P1975\Mxd\06_HAB\ P1975-HAB-003.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Greenlink

Co-financed by the European Union
Connecting Europe Facility

intertek

0 0.5 1 1.5 2 km



GREENLINK INTERCONNECTOR

BENTHIC HABITATS

Survey Data - Sheet 4

Drawing No: P1975-HAB-003	A

Legend

- Greenlink Route Centreline (Indicative)
- Proposed Development

MMT Survey

EUNIS Classification

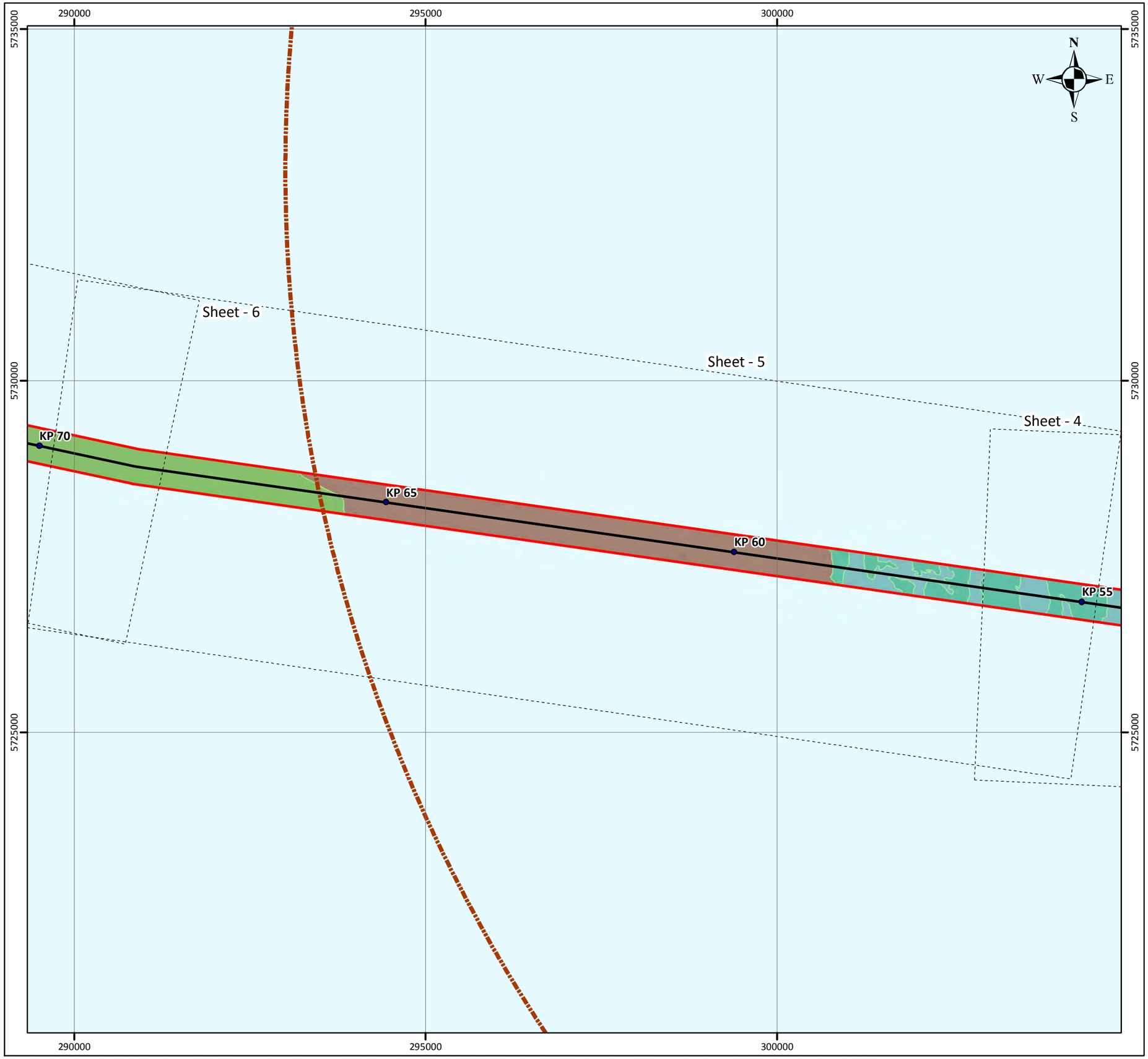
- A4.221
- A4.2212
- A5.15
- A5.27
- A5.45
- A5.611

NOTE: Not to be used for Navigation

Date	Monday, April 8, 2019 12:40:35
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; OSOD; OSI; MMT; Greenlink
File Reference	J:\P1975\Mxd\06_HAB\ P1975-HAB-003.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Co-financed by the European Union Connecting Europe Facility

0 0.5 1 1.5 2 km



GREENLINK INTERCONNECTOR

BENTHIC HABITATS
Survey Data - Sheet 5

Drawing No: P1975-HAB-003	A

Legend

- Greenlink Route Centreline (Indicative)
- Proposed Development
- UK 12nm Territorial Sea Limit

MMT Survey

EUNIS Classification

- A5.15
- A5.251
- A5.272
- A5.611

NOTE: Not to be used for Navigation

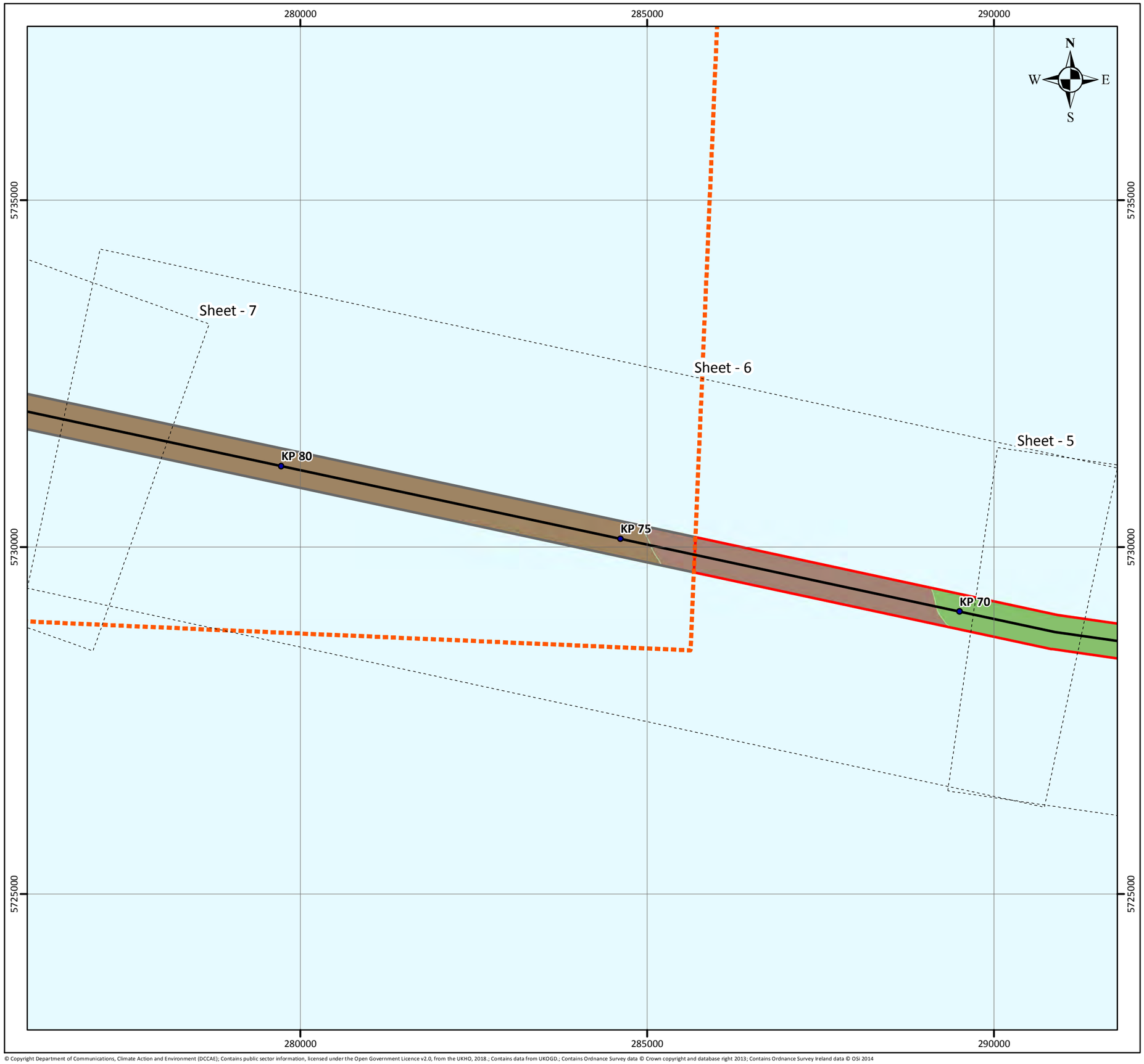
Date	Monday, April 8, 2019 12:40:35
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; OSOD; OSI; MMT; Greenlink
File Reference	J:\P1975\Mxd\06_HAB\ P1975-HAB-003.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Greenlink

Co-financed by the European Union Connecting Europe Facility

intertek

0 0.5 1 1.5 2 km



GREENLINK INTERCONNECTOR

BENTHIC HABITATS

Survey Data - Sheet 6

Drawing No: P1975-HAB-003	A

Legend

- Greenlink Route Centreline (Indicative)
- Proposed Development
- Irish Offshore
- Median Line

MMT Survey

EUNIS Classification

- A5.251
- A5.252
- A5.272

NOTE: Not to be used for Navigation

Date	Monday, April 8, 2019 12:40:35
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; OSOD; OSI; MMT; Greenlink
File Reference	J:\P1975\Mxd\06_HAB\ P1975-HAB-003.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Greenlink

Co-financed by the European Union Connecting Europe Facility

intertek

0 0.5 1 1.5 2 km

7.3.4 Protected habitats and species of conservation importance

Three EC Habitats Directive Annex I listed habitats were identified in the Proposed Development:

- 1140 - Mudflats and sandflats not covered by seawater at low tide;
- 1110 - Sandbanks which are slightly covered by seawater all the time; and
- 1170 - Reef

7.3.4.1 EC Habitats Directive Annex I – 1140 Mudflats and sandflats not covered by seawater at low tide

The sandy shore biotopes, A2.111 - Barren littoral shingle, A2.211 - Talitrids on the upper shore and strandline, A2.223 - Amphipods and *Scolelepis spp.* in littoral medium-fine sand, and A2.23 - Polychaete/amphipod-dominated fine sand shores, identified in the intertidal area at Freshwater West, are representative of the Annex I habitat 'mudflats and sandflats not covered by seawater at low tide'. This habitat qualifies as a feature of the Pembrokeshire Marine / Sir Benfro Forol SAC but is not a primary reason for the selection of the SAC.

The extent of the habitat within the Proposed Development is approximately 0.18km^2. The reportage coverage of Habitat 1140 within the SAC is 17.807km^2 (1780.7 hectares) (JNCC 2016).

7.3.4.2 EC Habitats Directive Annex I – 1110 Sandbanks which are slightly covered by seawater all the time

From approximately KP5 to KP10 the Proposed Development crosses the northern extent of the Turbot Bank (Figure 7-10, Drawing P1975-HAB-004 Sheet 1). The sandbank is a qualifying feature of the Pembrokeshire Marine / Sir Benfro Forol SAC but is not a primary reason for the selection of the SAC.

Turbot Bank is a sink for glacial till and land-derived sediments from the Cleddau Ddu and Milford Haven Estuary which is being reworked by the strong tidal currents into megaripples and sandwaves across the seabed. These features migrate and move from east to west, with rate of travel in the order of 10s of metres per year. They are aligned with the back of the sandwave to the predominant tidal flow and the steeper face towards the direction of travel. Further details are provided in Chapter 6.

The habitats identified between KP5 and KP10 were identified as A5.25 - Circalittoral fine sand. Sediments comprise of between 95% to 100% sand. The habitat was sampled by grab station S32 which showed the infauna was characterised by the molluscs *Goodallia triangularis*, *Asbjornsenia pygmaea*, and the polychaete *Nephtys cirrosa*. Grab station S31, on the western flank of the bank showed higher diversity and abundance in comparison to S32. Here the infauna was characterised by the molluscs *A. prismatica*, *T. ovata*, *Kurtiella bidentata*, the

polychaetes *O. borealis, Lumbrineris cingulate, Glycinde nordmanni* and different amphipods (MMT 2019).

The extent of habitat 1110 within the SAC is reported as 414.12km^2 (41411.55 hectares) (JNCC 2016). Of this area, the Turbot Bank covers approximately 19.10km^2. The Proposed Development covers approximately 3.05km^2 of this extent; equivalent to 15.97% of the Turbot Bank; and 0.74% of the wider habitat in the SAC.

7.3.4.3 EC Habitats Directive Annex I – 1170 Reefs

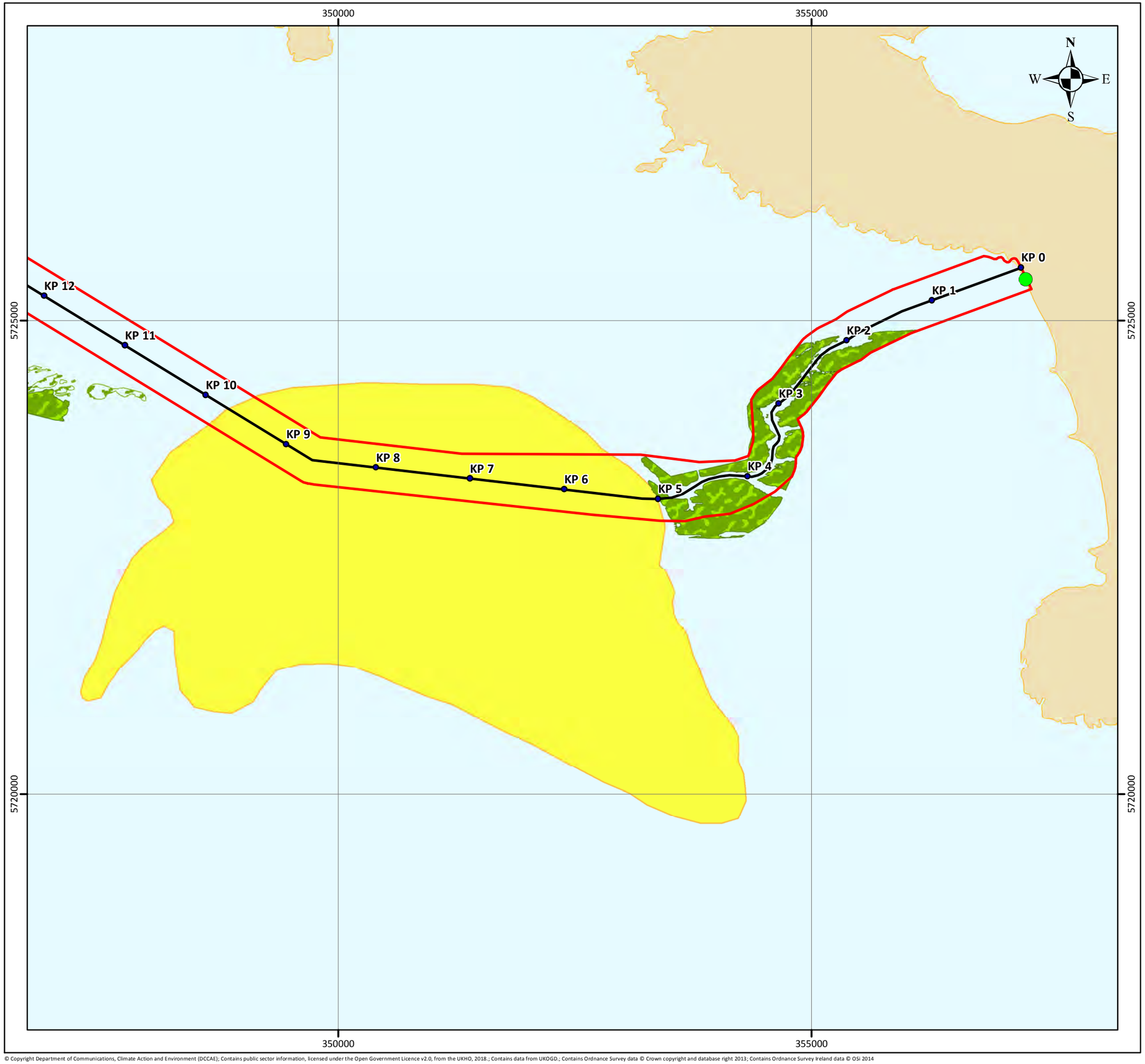
'Reef' is a primary reason for the selection of the Pembrokeshire Marine / Sir Benfro Forol SAC. All three sub-types of Annex I Reef habitat was identified by the cable route survey within the Proposed Development; bedrock reef, stony reef, and biogenic reef. The location of the habitat is displayed in Figures 7-10 to 7-13, (Drawings P1975-HAB-005, P1975-HAB-004 Sheet 2, P1975-HAB-006, and P1975HAB-004 Sheet 5).

The extent of habitat 1170 within the SAC is reported as 409.97km^2 (40997.43 hectares) (JNCC 2016). Maps showing the extent of 'Reef' habitat are available from the JNCC, which classifies the area according to confidence in the presence of the habitat. The JNCC maps indicate a slightly higher estimate of reef in the SAC although confidence in some areas is given as low. The habitat maps indicate Bedrock reef covers an area of 377km^2, whilst stony reef covers 70km^2. In addition, the reef extends outside of the SAC boundaries.

Intertidal

The littoral rock habitat (A1) encountered during the phase 1 intertidal survey at the Freshwater West landfall is representative of Annex I bedrock reef habitat. The habitat lies close to the base of the cliffs at the northern end of Freshwater West. Post-survey the boundary for the Proposed Development was refined to exclude this area.

The cliffs are also a designating feature of the adjacent Limestone Coast of South West Wales / Arfordir Calch faen de Orllewin Cymru SAC and the Broomhill Burrows Site of Special Scientific Interest (SSSI), and Angle Peninsula Coast / Arfordir Penrhyn Angle SSSI.



GREENLINK INTERCONNECTOR

ANNEX I HABITATS

Survey Data - KP 0 to KP 12

Drawing No: P1975-HAB-005	A

Legend

- Freshwater West
- Greenlink Route Centreline (Indicative)
- Proposed Development

Annex I Habitat Classification

- Bedrock Reef
- Potential Bedrock Reef

Protected Sandbank Slightly Covered by Seawater

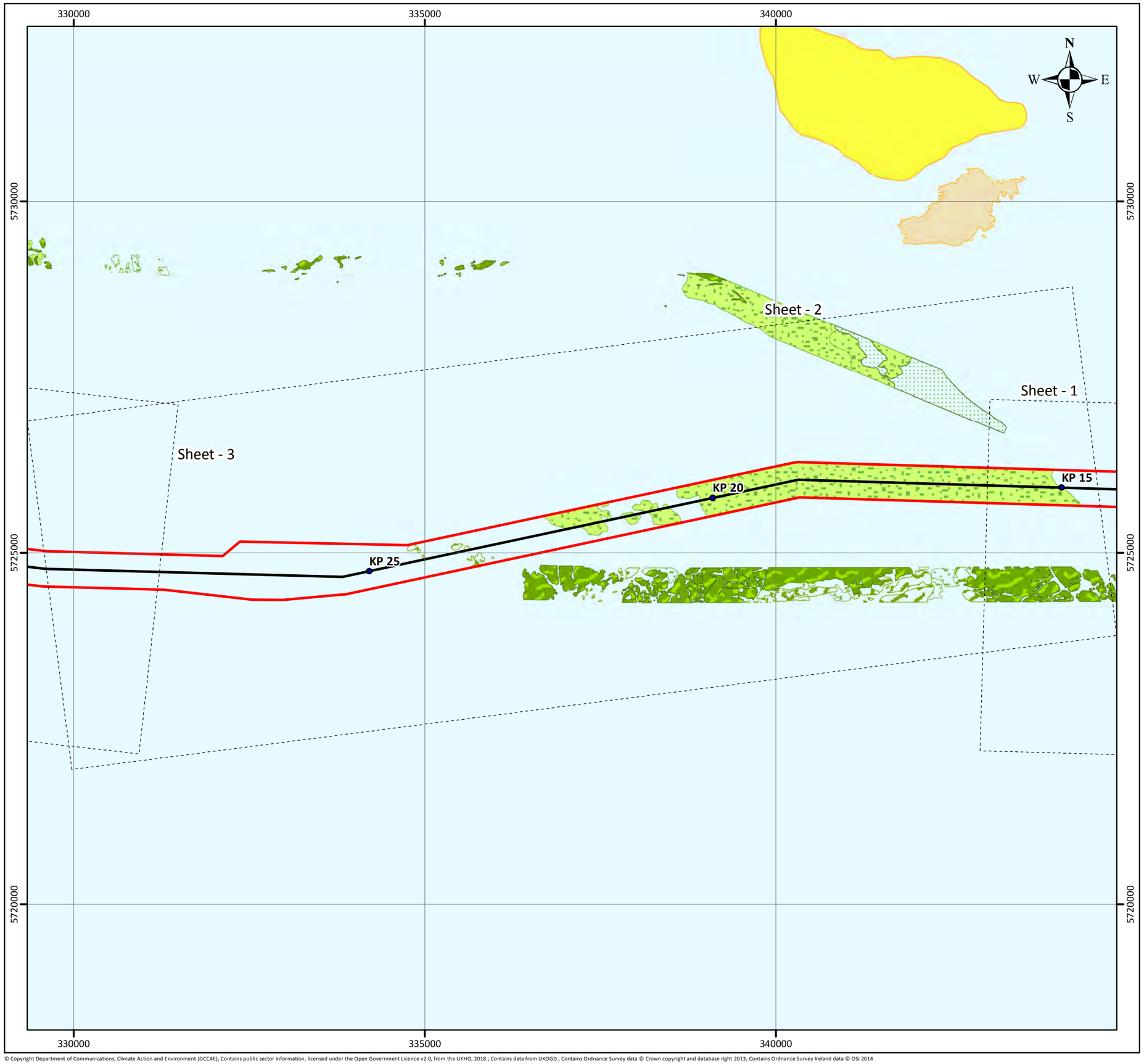
- Sandbank Area (High Confidence)

NOTE: Not to be used for Navigation

Date	Thursday, April 25, 2019 15:09:36
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; OSOD; OSI; MMT; Greenlink
File Reference	J:\P1975\Mxd\06_HAB\ P1975-HAB-005.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Co-financed by the European Union Connecting Europe Facility

0 0.5 1 1.5 2 km



GREENLINK INTERCONNECTOR

ANNEX I HABITATS
Survey Data - Sheet 2

Drawing No: P1975-HAB-004	A

Legend

- Greenlink Route Centreline (Indicative)
- Proposed Development

Annex I Habitat Classification

- Bedrock Reef
- Low/Medium Grade Stony Reef
- Potential Bedrock Reef
- Potential Biogenic Reef
- Potential Stony Reef

Protected Sandbank Slightly Covered by Seawater

- Sandbank Area (High Confidence)

NOTE: Not to be used for Navigation

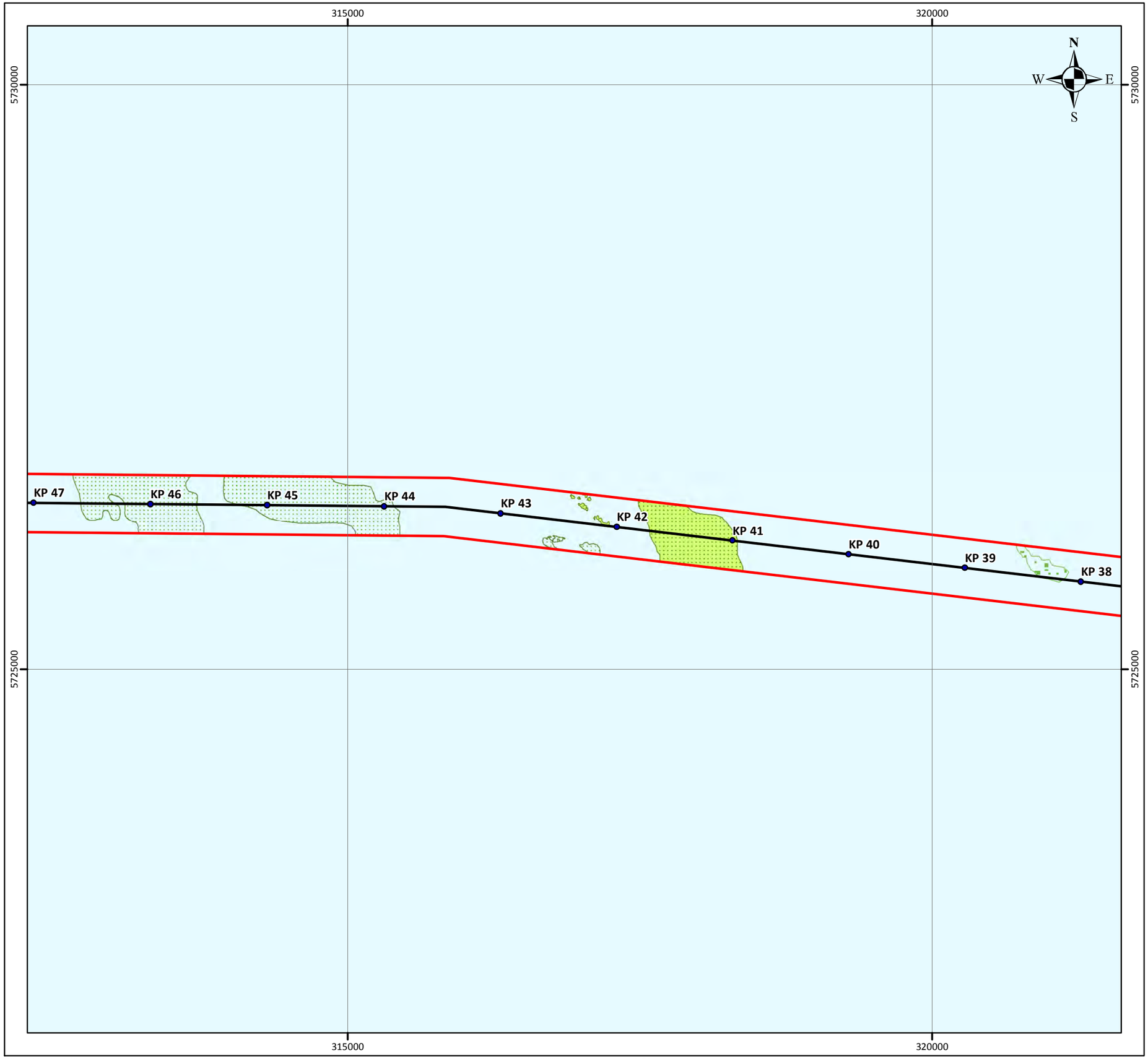
Date	Monday, April 8, 2019 12:43:10
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; OSOD; OSI; MMT; Greenlink
File Reference	J:\P1975\Mxd\06_HAB\ P1975-HAB-004.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Greenlink

Co-financed by the European Union
Connecting Europe Facility

intertek

0 0.5 1 1.5 2 km



GREENLINK INTERCONNECTOR

ANNEX I HABITATS

Survey Data - KP 38 to KP 47

Drawing No: P1975-HAB-006	A

Legend

- Greenlink Route Centreline (Indicative)
- Proposed Development

Annex I Habitat Classification

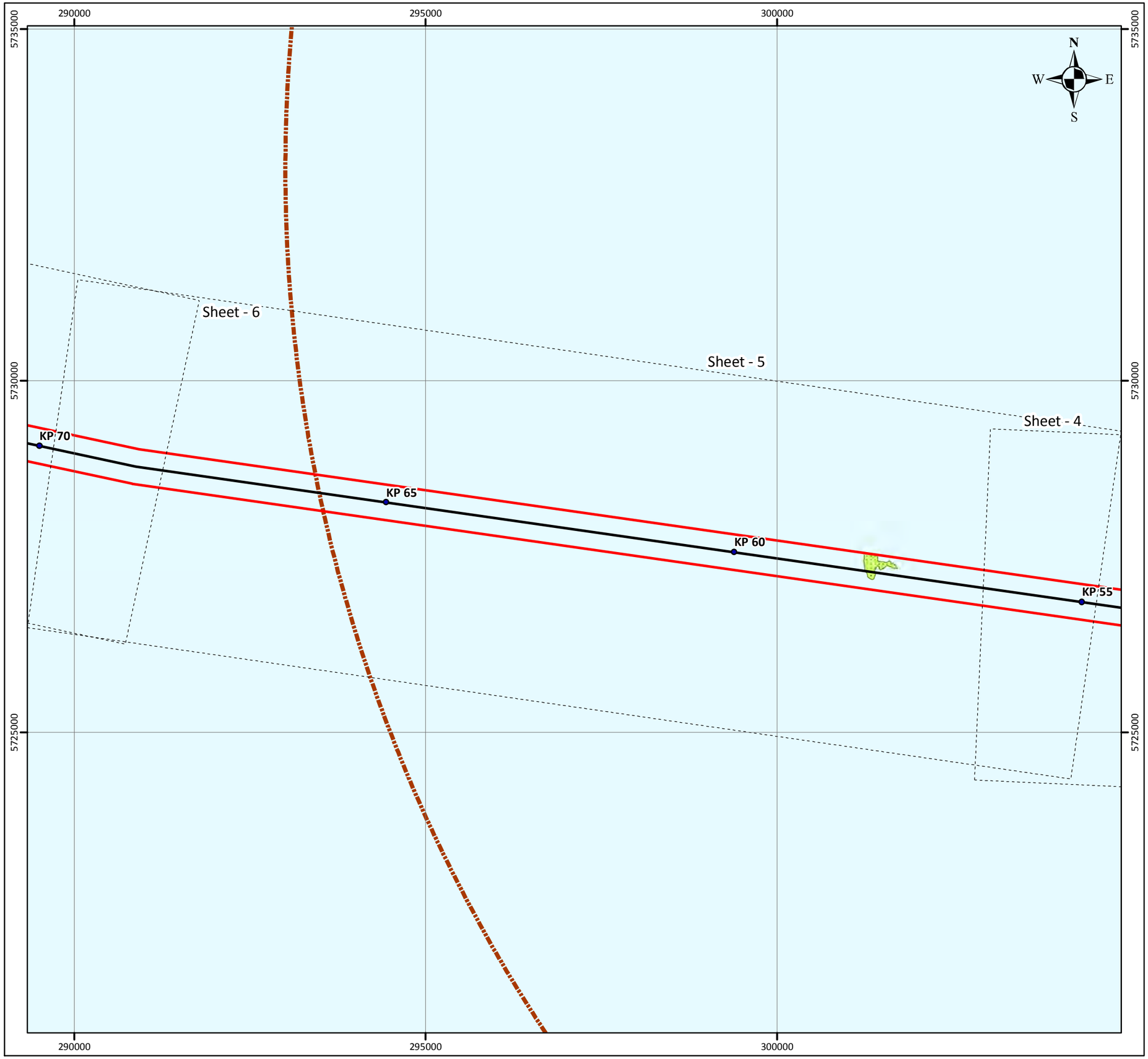
- Low/Medium Grade Biogenic Reef
- Potential Biogenic Reef
- Potential Stony Reef

NOTE: Not to be used for Navigation

Date	Thursday, April 25, 2019 15:19:02
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; OSOD; OSI; MMT; Greenlink
File Reference	J:\P1975\Mxd\06_HAB\ P1975-HAB-006.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Co-financed by the European Union Connecting Europe Facility

0 0.5 1 1.5 2 km



GREENLINK INTERCONNECTOR

ANNEX I HABITATS
Survey Data - Sheet 5

Drawing No: P1975-HAB-004	A

Legend

- Greenlink Route Centreline (Indicative)
- Proposed Development
- UK 12nm Territorial Sea Limit

Annex I Habitat Classification

- Low/Medium Grade Biogenic Reef

NOTE: Not to be used for Navigation

Date	Monday, April 8, 2019 12:43:10
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; OSOD; OSI; MMT; Greenlink
File Reference	J:\P1975\Mxd\06_HAB\ P1975-HAB-004.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Co-financed by the European Union Connecting Europe Facility

0 0.5 1 1.5 2 km

Subtidal

Bedrock Reef

Within the Proposed Development bedrock reef (as defined using the Irving 2009 criteria) is present from approximately KP1.5 to KP5.2. As illustrated in Figure 7-10 (Drawing P1975-HAB-005), the cable centreline has been routed through a channel of finer sediments in the bedrock reef between KP2.027 to KP4.998.

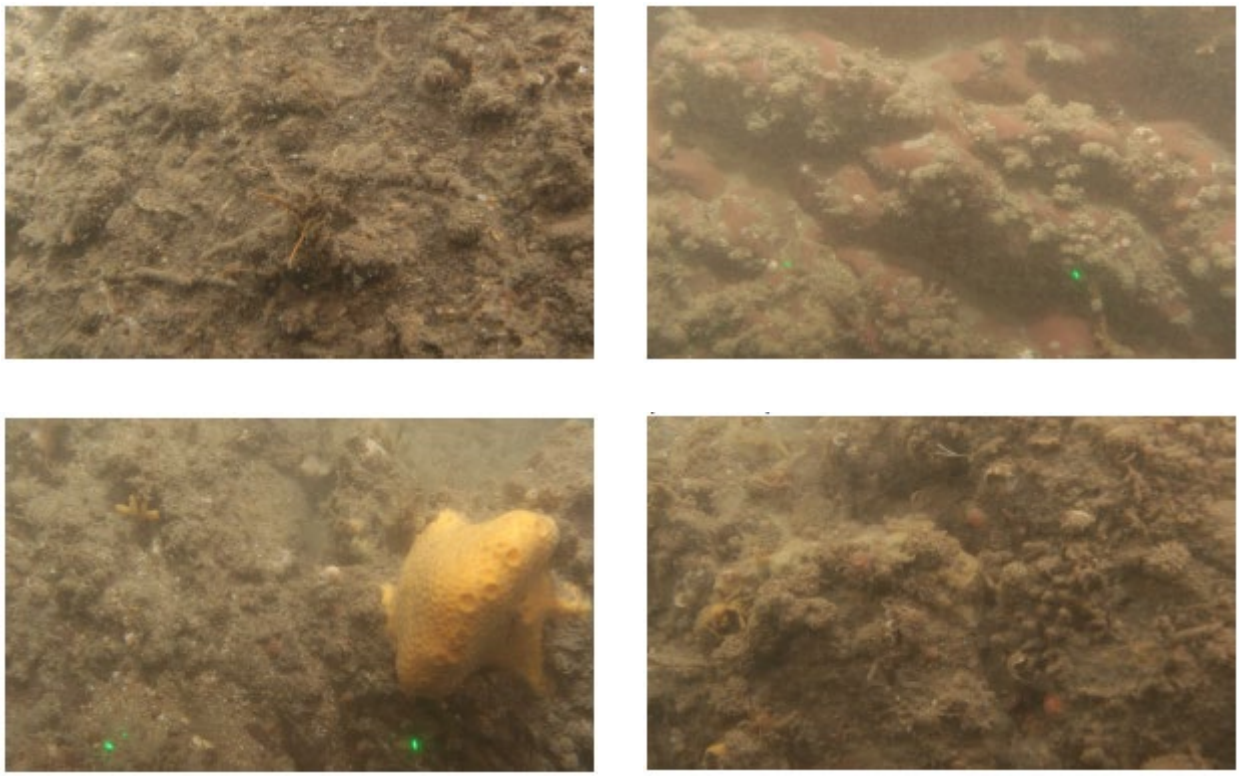
The sedimentary bedrock, surrounding the channel, is classified as A4.138 - *Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock (Figure 7-14) and is dominated by ascidians and hydrozoans. Image analysis from transects (Transects DDV_T06 to DDV_T09) showed similar composition with high diversity and colonisation by ascidians *Dendrodoa grossularia*, *Polycarpa sp.* and *M. manhattensis*. Other taxa identified include poriferans, *Tubularia sp.*, *Caryophyllia smithii* with hydrozoans and bryozoans (Figure 7-15 a-d).

Figure 7-14Image T06_014 of Annex (1170) - Bedrock reefs

Habitat A4.138 – *Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock

Figure 7-15 Bedrock reef communities for from Transects DDV_T06 to DDV_T09

Transects DDV_T06 to DDV_T09 show high diversity and colonisation by ascidians *Dendrodoa grossularia*, *Polycarpa sp.* and sand covered ascidians interpreted to be *M. manhattensis*. Other taxa identified present were poriferans, *Tubularia sp.*, *Caryophyllia smithii* with a hydrozoans and bryozoans.



The EUNIS habitat classification describes the biotope as typically found on slightly sand-scoured, tide-swept, moderately exposed circalittoral bedrock and cobbles. It is commonly recorded around 5m to 15m below chart datum and occurs mostly in very turbid waters. The physical characteristics are usually silted bedrock reefs and cobble, interspersed with patches of clean sand, causing a scour effect on the rock. Dense aggregations of the ascidian *Molgula manhattensis* form a silty mat on the rock and there is a sparse hydroid and bryozoan turf. Hydroid turfs usually consist of *Nemertesia antennina*, *Halecium beanii*, *Hydrallmania falcata*, *Sertularella gaudichaudi*, *Tubularia indivisa* and *Alcyonium digitatum*, in varying abundances, mostly occur on top of boulders and ridges. Bryozoan turfs are also present, but not usually dense and includes *Flustra foliacea*, *Alcyonidium diaphanum*, *Electra pilosa* and the crust-forming bryozoan Conopeum reticulum. The polychaete *Lanice conchilega* thrives in the sandy patches which often occur between the rock ridges. The scour effect tends to reduce the diversity of sponges present with only *Halichondria panicea* occasionally present. Isolated clumps of the polychaete *Sabellaria spinulosa* may be present but they do not occur in dense aggregations (EEA 2019a).

The extent of the habitat within the Proposed Development has been calculated as 1.12km^2. However, it is evident from a combination of the Greenlink and SECAMs bathymetry data that exposed bedrock covers a greater extent. The Joint Nature Conservation Committee (JNCC) data for potential Annex I reefs show the area for the feature covers 7.10km^2; although confidence in the overall extent is given as very poor. This aligns with findings from the Greenlink reconnaissance survey which identified areas of bedrock reef outside of the extent given in the JNCC GIS layer, but also confirmed that reef was not present in certain areas.

Small areas of outcropping bedrock reef have been identified in the sand channel between KP2.38 and KP2.41. Although micro-routeing around these features may be feasible, approximately 30m of the indicative Greenlink centreline will cross the habitat. There are no still photographs of this specific area.

The indicative Greenlink centreline also crosses the Bedrock reef habitat at approximately KP5 for 140m. However in this area, bathymetry data and transect T06 identify a narrow (approximately 20m wide) channel through which installation is feasible. It is possible that this may be a thin veneer of sediment over the bedrock but Figure 7-16 (Drawing P1975-SURV-008) shows that the Bedrock Reef habitat is not present in this channel. Sediments are sandy and similar to those identified on Turbot Bank, directly to the west.

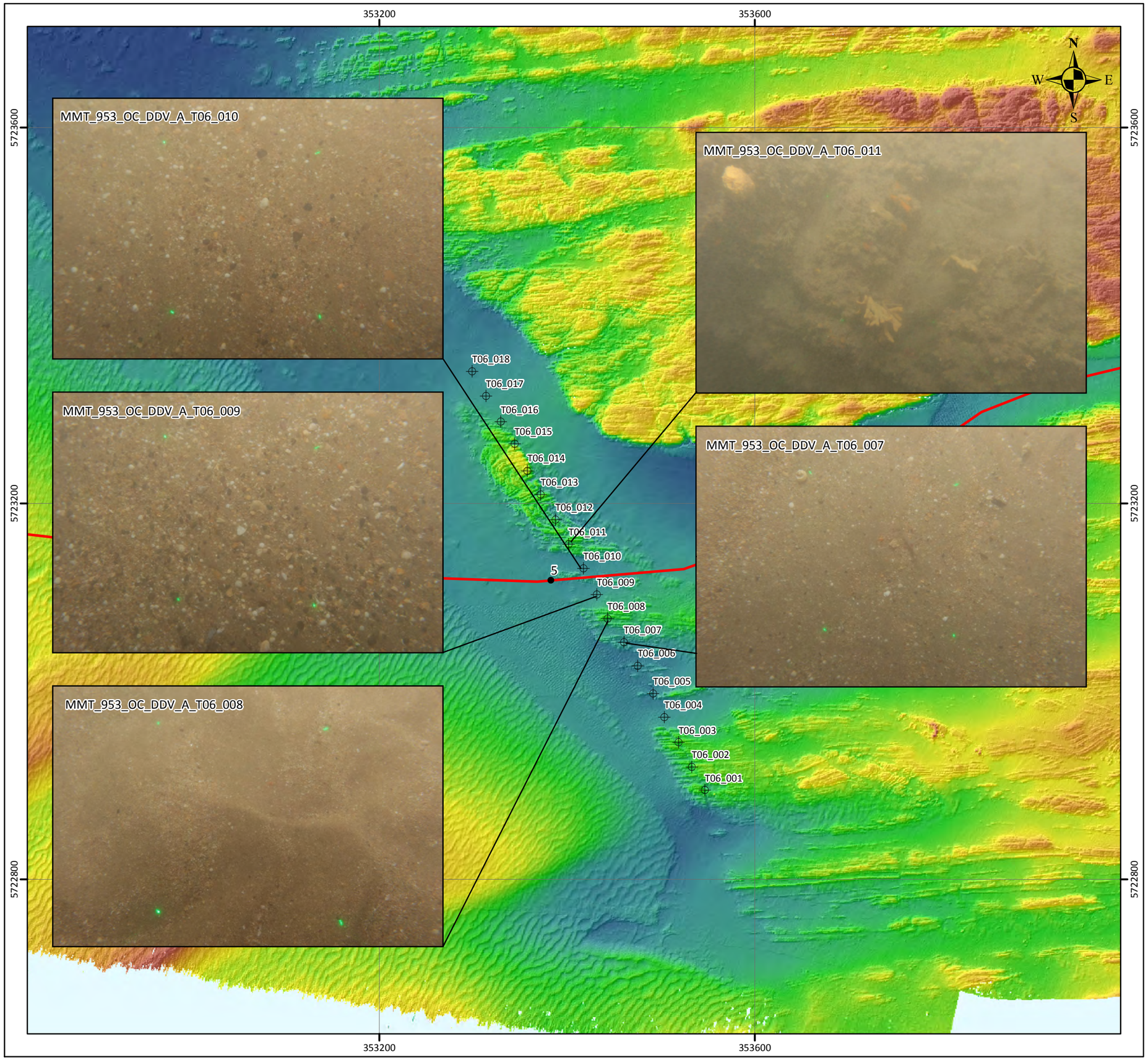
Potential Bedrock Reef

Potential bedrock reef habitats were patchy and identified within the Proposed Development ranging from KP23.5 to KP24.5 (Figure 7-11, Drawing P1975-HAB-004 Sheet 2).

Transect RR_T06 crossed the smaller areas of bedrock that was identified in the geophysical data. The bedrock was largely covered by sediment, with only small outcropping patches. The outcropping bedrock had a sparse epifauna consisting of mainly anemones and hydrozoans, with the biotope classified as A4.213 – *Urticina feline* and sand-tolerant fauna on sand-scoured or covered circalittoral rock. Due to the lack of conspicuous bedrock reef formations, the bedrock was classified as Annex I (1170) – Potential Bedrock Reef.

The EUNIS habitat classification describes the biotope as typically found on tide-swept circalittoral bedrock, and cobbles on gravel and sand. It is characterised by scour-tolerant robust species. The dominant species is the anemone *Urticina feline* which can tolerate the high levels of abrasion associated with the interface between sand and rock. The sponge *Ciocalypta penicillus* is also very characteristic of shifting sand-covered rock. The number of other species found tends to be limited due to the high levels of scour associated with the physical conditions in which the biotope is found (EEA 2019b).

Post-survey the indicative Greenlink centreline has been adjusted to avoid crossing this habitat.



GREENLINK INTERCONNECTOR

SURVEY DATA

Environmental Transect 06

Drawing No: P1975-SURV-008	A

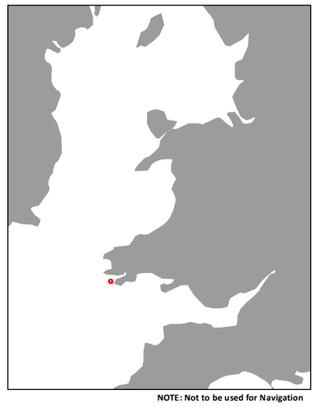
Legend

- KP
- Transect Photo Position
- Post Survey Route

Survey Bathymetry Below LAT (m)

High : 36.13

Low : 26.25



NOTE: Not to be used for Navigation

Date	Tuesday, April 2, 2019 15:10:59
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	ESRI; OSOD; MMT; Greenlink
File Reference	J:\P1975\Mxd\02_SURV\ P1975-SURV-008.mxd
Created By	Chris Carroll
Reviewed By	Chris Goode
Approved By	Anna Farley

Co-financed by the European Union Connecting Europe Facility

0 50 100 150 m

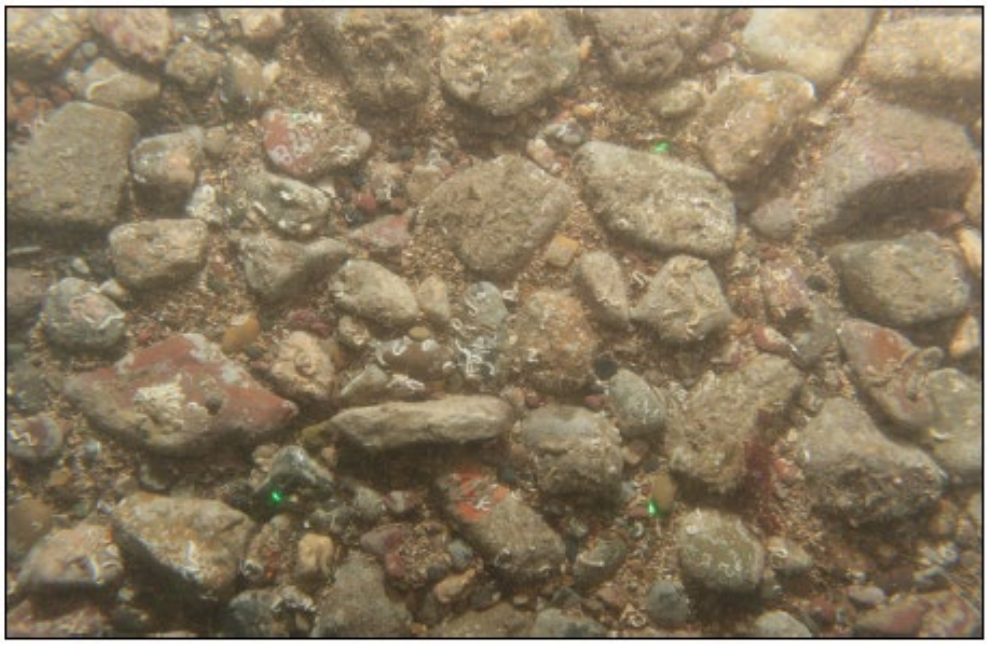
Stony Reef

Medium Grade Stony Reef was identified across the extent of the Proposed Development from KP15.0 to KP20.2, and then in wide patches from KP20.6 to KP22.1 (Figure 7-11, Drawing P1975-HAB-004 Sheet 2). It mainly consisted of cobbles and boulders which harboured a rich epifaunal community. The habitat was classified as A5.141 - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles (Figure 7-18).

The EUNIS habitat classification describes the biotope as characterised by a few abundant robust and or fast growing short-lived species which are able to colonise pebbles and unstable cobbles which are regularly moved by wave and tidal action. The main cover organisms tend to be restricted to calcareous tube worms such as *Pomatoceros triqueter* (or *P. lamarcki*), small barnacles including *Balanus crenatus* and *Balanus balanus*, and a few bryozoan and coralline algal crusts. Scour action from the mobile substratum prevents colonisation by more delicate species. Occasionally in tide-swept conditions tufts of hydroids such *as Sertularia argentea* and *Hydrallmania falcata* are present (EEA 2019c).

Imaged by transects RR_T01, RR_T02, RR_T03, RR_T04 and RR_T05, the seabed was covered by cobbles greater than 0.064m in diameter for 50% to 80% of the area. The maximum elevation was 0.2m, and combined with an extent greater than 25m^2 in each transect this led the reef assessment (using Irving 2009 criteria) to conclude that the seabed in the area meets the criteria for a Medium Grade Stony Reef.

Figure 7-17 Image T03_001 of Annex I (1170) – Medium Grade Stony Reef with the habitat A5.141 – *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles.



The extent of the habitat within the Proposed Development has been estimated as 3.04km^2. It overlaps two areas identified on the JNCC data for potential Annex I reefs with poor confidence.

A further area of potential stony reef habitat has been identified within the Proposed Development between KP38.15 to KP38.36. The habitat has been classified as A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment. This was interpreted as potential stony reef due to the density of cobbles and boulders interpreted from the geophysical data. The extent of this area is 0.05km^2. It lies within the potential stony reef habitat identified in the JNCC data for potential Annex I reefs.

There is the sufficient area to the south of this habitat for the cable route to avoid the habitat.

Biogenic reef

A number of areas of potential, low-grade and medium grade biogenic reef were identified within the Proposed Development as shown in Figure 7-12 (Drawing P1975-HAB-006), Figure 7-13 (Drawing P1975-HAB-004 Sheet 5) and outlined in Table 7-4. The JNCC Annex I reef habitat map has not identified reef in this area; nor did it identify biogenic reef as potentially occurring within the SAC.

Table 7-4 Areas of biogenic reef

KP Start	KP end	Classification	EUNIS habitat	Extent (km^2)	Can the habitat be avoided
KP43.9	KP45.23	Potential	A5.611	0.515	No – extends across width of Proposed Development
KP45.6	KP46.6	Potential	A5.611	0.426	No – extends across width of Proposed Development
KP42.0	KP42.6	Potential	A5.611	4 small discrete patches = 0.0106	Yes – small area in south of Proposed Development
KP40.9	KP41.7	Low-grade	A5.611	0.352	No – extends across width of Proposed Development
KP57.98	KP58.11	Low-grade	A5.15	0.075	Yes – centreline could be routed to the south
KP42.0	KP42.6	Medium-grade	A5.611	7 small discrete patches = 0.0084	Yes - centreline could be routed to the south

The majority of biogenic reef habitats were identified to be A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment, with the exception of one area of low-grade biogenic reef in habitat A5.15 – Deep circalittoral coarse sediment.

The EUNIS habitat classification for A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment describes the biotope as having high abundances of the

tube-building polychaete *S.spinulosa*. *S.spinulosa* typically forms loose agglomerations of tubes forming a low-lying matrix of sand, gravel, mud and tubes on the seabed. The infauna comprises typical sublittoral polychaete species such as *Protodorvillea kefersteini*, *Pholoe synophthalmica*, *Harmothoe*spp, *Scoloplos armiger*, *Mediomastus fragilis*, *Lanice conchilega* and cirratulids, together with the bivalve *Abra alba*, and tube building amphipods such as *Ampelisca spp*. The epifauna comprise a variety of bryozoans including *Flustra foliacea*, *Alcyonidium diaphanum* and *Cellepora pumicosa*, in addition to calcareous tubeworms, pycnogonids, hermit crabs and amphipods. The reefs formed by *S.spinulosa* consolidate the sediment and allow the settlement of other species not found in adjacent habitats leading to a diverse community of epifaunal and infauna species (EEA 2019d).

S.spinulosa was identified in grab samples S20 through to S27, S29 and S30. The average number of individuals per m^2 ranged from 5 at S22 and S29 to a maximum of 1720 at S20. Average percentage coverage in site photos also ranged from no visible presence at S22, S24, S27 and S30 through to 24% at S20.

Figure 7-18 shows the seabed at grab station S25, located within the low grade biogenic reef identified between KP40.9 and KP41.7. Grab station S25 showed an average abundance of 1495 individuals per m^2. Species coverage ranged between 7% and 17%, with an average coverage of 12%, based on image analysis from the site. The elevation of the tube aggregations was assessed to vary between flat seabed and 5 cm.

Figure 7-18 Annex I (1170) – Low Grade Biogenic reef with the habitat A5.611 – Sabellaria spinulosa on stable circalittoral mixed sediment (Image S25_003).

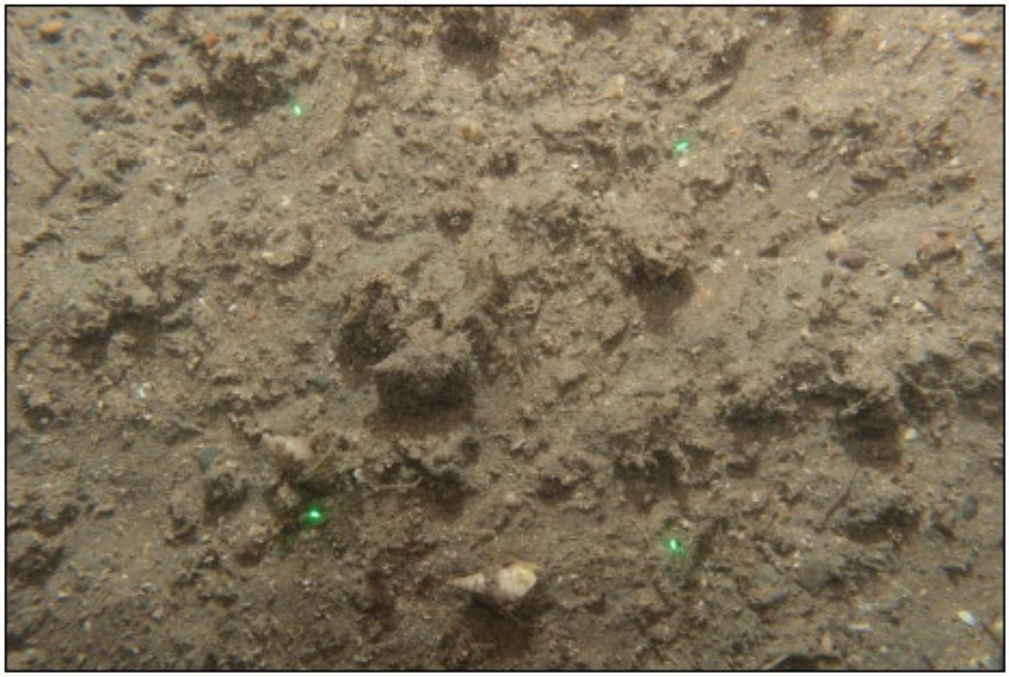
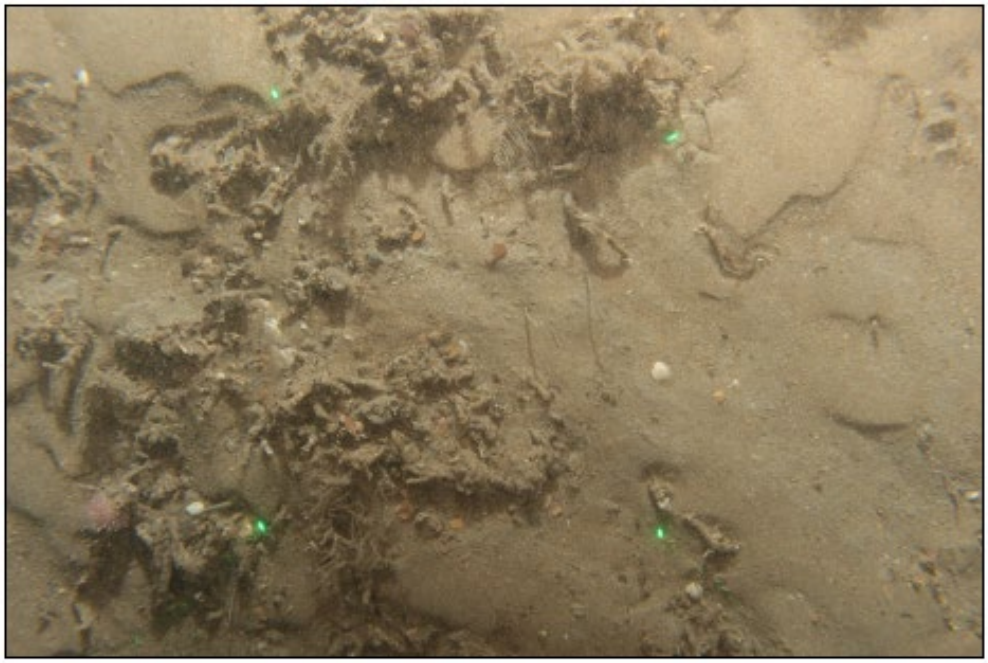


Figure 7-19 shows the seabed at grab station S20, located within the low grade biogenic reef identified between KP57.98 and KP58.11. Grab station S20 showed an average abundance of 1720 specimens per m^2. Imaging analysis of the *S.spinulosa* aggregations revealed a species coverage between 12% and 35%, with an average coverage of 25%. The elevation of the tube aggregations was assessed to vary between flat seabed and 5 cm. Although the patchiness matched a medium grade *S.spinulosa* reef, the generally low elevation of the aggregations resulted in the area being classified as low grade biogenic reef.

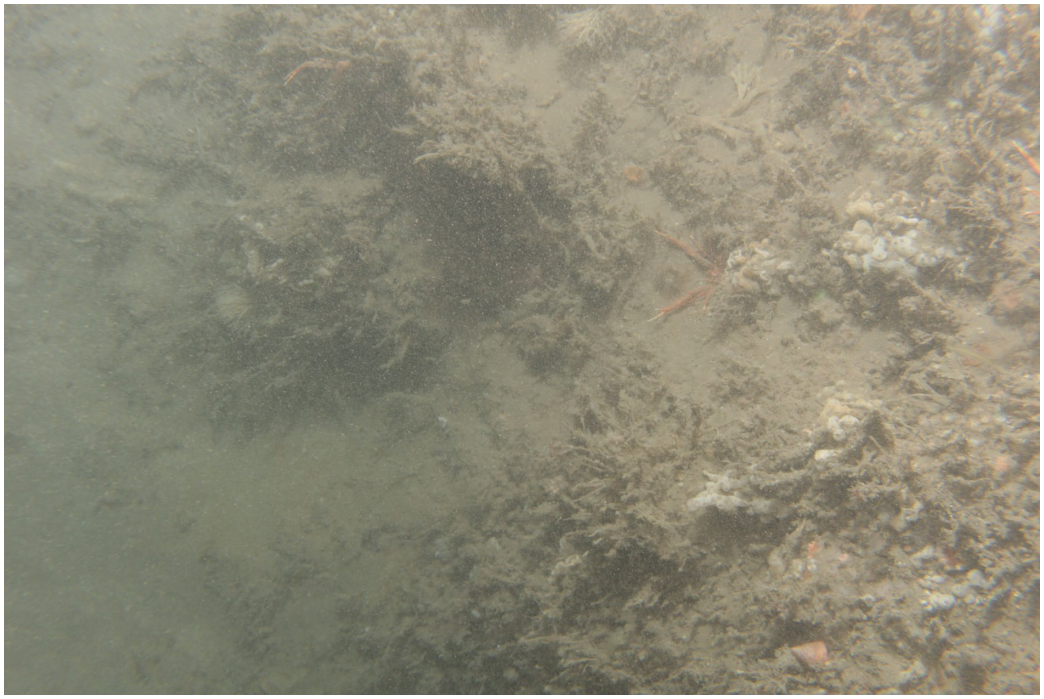
Figure 7-19 Annex I (1170) – Low Grade Biogenic reef with the habitat A5.611 – Sabellaria spinulosa on stable circalittoral mixed sediment (Image S20_005).



Several patchy areas of medium grade biogenic reef were located within the Proposed Development to the north of the indicative Greenlink centreline between KP42.0 and KP 42.60. The cable can be routed to avoid these areas.

S.spinulosa was identified on the bedrock during video transect T05 at KP42.055. The transect was planned to ground-truth bedrock identified in the geophysical data. It was difficult to assess to what extent the outcropping bedrock under the S.spinulosa aggregations added to the extent as no bedrock was visible through the dense aggregations of *S.spinulosa*. As the bedrock was not the prevailing reef forming substrate in the area, the S.spinulosa was considered to represent a reef. Due to the elevation (tube building height) being up to 10cm, the 10,000m^2 extent and the % cover ranging between 20%-30% the area was classified as a Medium grade reef (using Gubbay 2007). Figure 7-20 provides a representative photograph of the habitat.

Figure 7-20 Annex I (1170) – Medium Graded Biogenic Reef on the habitat A4.2212 – Sabellaria spinulosa didemnid and small ascidians on tide-swept moderately wave-exposed circalittoral rock (image T05_013)



7.3.4.4 Environment (Wales) Act 2016 – Section 7 Priority species and habitats

The following habitats found within the Proposed Development are listed on the interim Priority Habitats lists issued by the Welsh Government (Welsh Government 2016a):

- Fragile sponge & anthozoan communities on subtidal rocky habitats
- Subtidal sands and gravels
- Subtidal mixed muddy sediments
- Mud habitats in deep water

None of the macrofauna species listed in the Environment (Wales) Act interim Priority Species list (Welsh Government 2016b) were identified by the cable route survey within the Project Development.

7.3.1 Natural evolution of the baseline

The natural evolution of the baseline has been compiled using information from the Offshore Energy Strategic Environmental Assessment 3 (OESEA 3) (DECC 2016). Over the last 11,000 years seabed habitats around the UK have been subject to change associated with post-glacial trends in sea level, climate and sedimentation. In the shorter term, seasonal, inter-annual and decadal natural changes in benthic habitats, community structure and individual species population dynamics may

result from physical environmental influences (e.g. episodic storm events; hydroclimatic variability i.e. hot summers and cold winters; and sustained trends) and/or ecological influences such as reproductive cycles, larval settlement, predation, parasitism and disease.

As a result of climate change certain habitats around the UK are predicted to decline e.g. it is predicted that blue mussel beds will decline significantly in number by 2050 and are set to be lost completely by 2100. In addition, it expected that climate change will:

- Increase the number of invasive non-native species;
- Shift the distribution of habitats and species;
- Increase the risk of disease to species from new pathogens as their distributions shift; and
- Result in an increase in storms which could damage areas of high biodiversity.

Taken this information into consideration, it is expected that over the lifetime of the Proposed Development (40 years) habitats could be effected by shorter term seasonal events (i.e. storm events) but longer term effects as a result of climate change may also be observed.

7.4 Potential Pressure Identification and Zone of Influence

A scoping exercise undertaken to inform the content of the EIA has excluded the following pressures from further consideration in this topic Chapter. Explanation for the exclusion is provided in Chapter 5, Table 5-2:

- Hydrocarbon and PAH contamination; and
- Temperature changes – local.

The pressures listed in Table 7-5 will be assessed further. For each pressure the assessment considered the different aspects of the project during installation, operation (including repair & maintenance) and decommissioning. In order to evaluate the most significant effects, the largest zone of influence from these aspects was selected. The zones of influence are presented in Table 7-5.

Table 7-5 Pressure identification and zone of influence – benthic and intertidal ecology

Project Phase	Project Activity	Aspect	Potential Impact	Receptor	Zone of Influence
Installation	Cable burial	Pre-sweeping	Penetration and/or disturbance of the substrate below the surface of the seabed,	Sand habitats	20m x approximately 5.6km

Project Phase	Project Activity	Aspect	Potential Impact	Receptor	Zone of Influence
			including abrasion		
Installation	Cable burial	Seabed preparation. Cable trenching (ploughing and jet trenching) External cable protection	Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Subtidal habitats	15m
Operation	Cable repair and maintenance				
Decommissioning	Cable removal				
Installation	Cable burial	Pre-sweeping Seabed preparation. Cable trenching (ploughing and jet trenching) External cable protection	Siltation rate changes, including smothering (depth of vertical sediment overburden)	Subtidal habitats	100m*
Operation	Repair and maintenance operations				
Decommissioning	Cable removal				
Installation	Cable burial	External cable protection	Physical change (to another seabed type)	Subtidal habitats	10m x approximately 16.46km
Operation	Repair and maintenance operations				10m x 1km
Installation	Cable burial	Presence of project vessels Cable burial External cable protection	Introduction or spread of non-indigenous species	Subtidal habitats	15m
Operation	Repair and maintenance operations				
Decommissioning	Cable removal				

Project Phase	Project Activity	Aspect	Potential Impact	Receptor	Zone of Influence
		Cable removal			
Operation	Operation of cables	Emission of EMF	Electromagnetic Field effects	Subtidal species	2m (distance at which EMF attenuates to background levels)
* Chapter 6 concluded that whilst individual silt particles will remain in suspension for extended periods (up to 14 hours), sand particles suspended by installation activities will settle out of the water column quickly. Changes in sediment properties will not be detectable beyond 100m of the trench.					

7.5 Embedded Mitigation

The project description, Chapter 4, provides the current 'base case'. This includes mitigation measures which form part of the design and are therefore an inherent part of the Proposed Development and comprise embedded or primary mitigation. The embedded mitigation relevant to benthic and intertidal ecology is provided in Table 7-6 below. When undertaking the EIA it is assumed that these measures will be complied with; either as a matter of best practice or to ensure compliance with statute.

Table 7-6 Embedded mitigation

ID	Embedded mitigation measure
EM6	Ballast water discharges from Project vessels will be managed under the International Convention for the Control and Management of Ships' Ballast Water and Sediments standard.
EM8	The latest guidance from the GB non-native species secretariat (2015) will be followed and a Biosecurity Plan produced pre-installation.
EM13	HDD will be used for the cable landfalls to avoid disturbance of sensitive habitats (e.g. dune system) and disruption on beaches.
EM14	Route engineering was undertaken during the marine survey to avoid sensitive habitats where possible or to reduce the distance the submarine cable corridor crosses a sensitive feature.
EM15	Submarine cables will be bundled together, which reduces the seabed footprint of installation activities and the electromagnetic field generated during operation, thus minimising any potential compass deviation effects
EM18	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed.

ID	Embedded mitigation measure
EM26	Post-installation inspection surveys will be conducted along the length of the cables on a regular basis.
EM29	Rock and mattresses will only be deployed where adequate burial cannot be achieved. The footprint of the deposits will be the minimum required to ensure cable safety and rock berm stability.

7.6 Significance Assessment

7.6.1 Summary of Assessment

Table 7-7 presents the summary of the impact assessment conducted on the Proposed Development. Sections 7.6.2 to 7.6.6 provide the justification for the conclusions. Where the assessment concluded the effects are significant, Project Specific Mitigation has been proposed and is described in Section 7.7. Where there is still potential for residual effects this is discussed further in Section 7.8.

Table 7-7 Impact assessment summary – benthic and intertidal ecology

Determination of potential effect						Impact Assessment			Consideration of mitigation	Residual effect assessment		
Section	Project Phase	Aspect	Embedded mitigation (Table 7-6)	Pressure	Receptor	Magnitude	Sensitivity	Significance	Project Specific Mitigation (Table 7-11)	Magnitude	Sensitivity	Significance of Residual Effect
7.6.2	Installation	Cable burial	EM13, EM14, EM15, EM18, EM29	Penetration and/or disturbance including abrasion	Intertidal habitats	-	-	No effect	PS1	-	-	-
		Pre-sweeping Cable burial Cable removal			Sandy habitats (A5.142, A5.251. A5.272)	Low	Low	Negligible	-	-	-	-
	Installation Operation (Repair & Maintenance) Decommissioning	Pre-lay grapnel run Seabed preparation Cable burial Cable removal			Annex I Bedrock reef habitat	Low	Medium	Minor	PS2	Low	Medium	Minor
					Annex I Stony reef habitat	Low	Medium	Minor	PS6	Low	Medium	Minor
					Annex I Biogenic reef habitat	Low	Medium	Minor	-	Low	Medium	Minor
					Other subtidal habitats	Low	Medium	Minor	-	Low	Medium	Minor
7.6.3	Installation Operation (including repair & maintenance) Decommissioning	Pre-sweeping, Cable burial Cable removal	EM14, EM15	Changes in siltation rate, including smothering	Subtidal habitats	Negligible	Medium	Negligible	-	-	-	-
7.6.4	Installation Operation (including repair & maintenance)	Cable protection	EM14, EM15 EM29,	Physical change (to another seabed type	Bedrock & Stony Reef habitat	Low	Medium	Minor	PS2, PS6, PS7	Low	Medium	Minor
					Other subtidal habitats	Low	Medium	Minor	-	Low	Medium	Minor
7.6.5	Installation	Presence of project vessels Cable burial	EM6, EM8	Introduction or spread of non-indigenous	Subtidal habitats (A5.251, A5.252, A5.261 and A5.451)	Negligible	High	Negligible	PS7, PS8	-	-	-

Co-financed by the European Union
Connecting Europe Facility

Determination of potential effect						Impact Assessment			Consideration of mitigation	Residual effect assessment		
Section	Project Phase	Aspect	Embedded mitigation (Table 7-6)	Pressure	Receptor	Magnitude	Sensitivity	Significance	Project Specific Mitigation (Table 7-11)	Magnitude	Sensitivity	Significance of Residual Effect
	Operation (including repair & maintenance) Decommissioning	External cable protection Cable removal		species	Other subtidal habitats	Negligible	Low	Negligible	PS7, PS8	-	-	-
7.6.6	Operation	Operating cables	EM15	Electromagnetic changes	Benthic species	Low	Low	Negligible	-	-	-	-

7.6.2 Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion (change to seabed feature)

7.6.2.1 Installation

Intertidal habitats and species

The 'base case' being assessed is that horizontal directional drilling (HDD) will be used at Freshwater West; embedded mitigation EM13. Chapter 6 identified there is the potential for a significant effect if trenching across the intertidal area is required, and therefore Project Specific Mitigation (PS1) has been proposed. This commits GIL, to ensuring that the HDD exits below the low water mark. Compliance with PS1 will mean that there will be **No Effect** on intertidal habitats or species.

Subtidal habitats

This pressure is associated with activities that disturb the seabed but where there is limited or no loss of substrate from the system. Activities considered by the assessment that cause this pressure include cable route preparation e.g. boulder clearance, pre lay grapnel run, pre-sweeping; and cable burial e.g. jetting and plough trenching.

As the Proposed Development from KP0 to KP49.7 is within the Pembrokeshire Marine / Sir Benfro Forol SAC, the pressure has also been assessed within the Greenlink Marine HRA – Technical Appendix C. As the Proposed Development crosses areas of Annex I habitat, it concluded that there is the potential for likely significant effects and that an Appropriate Assessment is required.

The seabed within the direct zone of influence of the installation will be temporarily disturbed. The actual cable installation is a one-off event, but the seabed along the cable centreline could be disturbed on two to three discrete occasions within approximately a three month period. The first occasion will be for any seabed preparation works e.g. boulder clearance, pre-sweeping; the second occasion will be the pre-lay grapnel run; and the third occasion will be the cable lay and burial. These activities will be within the same zone of influence. When assessing the significance of the effect the assessment has considered the culmination of these activities.

It is likely that a high proportion of the benthic invertebrates within the width of the plough/trench footprint, will be susceptible to mortality, injury or displacement as a result of coming into contact with the route clearance grapnel, boulder clearance plough, dredging and/or cable installation machinery. This is more likely to affect sessile species such as *Sabellaria spinulosa*, bryozoans and hydroids and less mobile species such as echinoderms and polychaetes. Activities causing displacement and injury to infaunal species could also result in increased predation resulting from exposure of individuals.

The magnitude of the effect has been assessed as low for the following reasons:

- Disturbance will be brief and is equivalent to a one-off event which will not be repeated.
- The zone of influence is narrow in comparison to the wider extent of habitats in the Proposed Development and surrounds.
- Sediment will not be removed or altered leaving the underlying character of the habitat similar to that pre-development.

To determine the sensitivity of habitats within the Proposed Development an assessment has been carried out using information provided on the Marine Life Information Network (MarLIN). A wide range of habitats were identified in the Proposed Development of which Circalittoral fine sand (A5.25), polychaete-rich deep Venus community in offshore mixed sediments (A5.451), P*omatoceros triquieter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles (A5.141), Deep circalittoral sand (A5.27), *Sabellaria spinulosa* on stable circalittoral mixed sediment (A5.611) and *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (A5.251) represent the dominant habitats. Table 7-8 presents an assessment of the sensitivity of habitats to the pressures penetration and/or disturbance of the substratum below the surface and abrasion / disturbance of the substratum on the surface of the seabed.

Table 7-8 Sensitivity of habitats within the Proposed Development to the pressures penetration and abrasion

EUNIS habitat	Penetration and/or disturbance of the substratum below the surface				Abrasion/disturbance of the substratum on the surface of the seabed			
	Resistance	Resilience	Sensitivity	Confidence*	Resistance	Resilience	Sensitivity	Confidence*
A4.111 - *Balanus crenatus* and *Tubularia indivisa* on extremely tide-swept circalittoral rock	Not relevant				Medium	High	Low	High
A4.13 - Mixed faunal turf communities on circalittoral rock	Not relevant				Low	Medium	Medium	Medium-Low
A4.138 - *Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock	Not relevant				Medium	High	Low	High
A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Not relevant				Low	Medium	Low	Medium
A4.2212 - *Sabellaria spinulosa*, didemnid and small ascidians on tide-swept moderately wave-exposed circalittoral rock	None	Medium	Medium	Medium	Low	Medium	Medium	Low
A5.13 - Infralittoral coarse sediment	*Medium*	*High*	*Low*	*High*	*Medium*	*High*	*Low*	*Medium*
A5.14 - Circalittoral coarse sediment	*Medium*	*High*	*Low*	*Low*	*Low*	*High*	*Low*	*High*
A5.141 - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Low	High	Low	High	Low	High	Low	High
A5.142 - *Mediomastus fragilis, Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel	Medium	High	Low	High-Medium	Medium	High	Low	High-Low
A5.143 - *Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand	Medium	High	Low	High	Medium	High	Low	Low
A5.15 - Deep circalittoral coarse sediment	*Medium*	*High*	*Low*	*High*	*Medium*	*High*	*Low*	*Medium*
A5.24 - Infralittoral muddy sand	*Medium*	*High*	*Low*	*Medium*	*Low*	*Medium*	*Medium*	*High*
A5.25 - Circalittoral fine sand	*Medium*	*High*	*Low*	*High-medium*	*Medium*	*High*	*Low*	*Low*
A5.251 - *Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	Medium	High	Low	High - medium	Medium	High	Low	Low
A5.252 - *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	Medium	High	Low	High - medium	Medium	High	Low	Low
A5.261 - *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	Medium	High	Low	High - medium	Medium	High	Low	Low

EUNIS habitat	Penetration and/or disturbance of the substratum below the surface				Abrasion/disturbance of the substratum on the surface of the seabed			
	Resistance	Resilience	Sensitivity	Confidence*	Resistance	Resilience	Sensitivity	Confidence*
A5.27 - Deep circalittoral sand	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*	*Low*
A5.272 - *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	Low	Medium	Medium	Medium - high	Low	Medium	Medium	Medium-High
A5.44 - Circalittoral mixed sediments	*Low*	*Low*	*High*	*High - medium*	*Low*	*Low*	*High*	*High-Medium*
A5.45 - Deep circalittoral mixed sediments	Medium	None	Medium	Medium	Medium	Low	Medium	High
A5.451 - Polychaete-rich deep Venus community in offshore mixed sediments	Medium	High	Low	High-medium	Medium	High	Low	Medium
A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	None	Medium	Medium	Medium-High	Low	Medium	Medium	Low

Italics and grey = Assessment has been based on sublevel habitat assessments

* Confidence is specific to sensitivity. It is based on the quality of evidence, applicability of evidence and degree of concordance (agreement between studies).

The discussion below has been split into five categories as follows:

- Sand habitats within the zone of influence of pre-sweeping
- Annex I Bedrock Reef habitat
- Annex I Stony Reef habitat
- Annex I Biogenic Reef habitat
- Other subtidal habitats

Sand habitats within the zone of influence of pre-sweeping

The widest zone of influence is associated with pre-sweeping of sandwaves. This will be a localised activity that will potentially be required at two locations. The combined length of cable route that may require pre-sweeping is 5.6km. The width of seabed disturbed is estimated to be up to 100m. The indicative pre-sweeping locations identified by the cable burial risk assessment are between KP25.8 and KP26.4 (a distance of 600m) and between KP64 and KP69 (approximately 5km). They are not located on the Annex I protected sandbank feature - Turbot Bank.

The habitats at the two locations are A5.142 - *Mediomastus fragilis, Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel; and A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand and A5.272 - *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand. Of the three habitats, A5.272 is the most sensitive to disturbance, with a medium sensitivity. The key species in the biotope are shallower burrowers, found close to the sediment surface. Sampled by grab station S18, the infaunal composition was characterised by the brittlestar, *Amphiura filiformis* and the polychaetes *Lumbrineris cingulate and Owenia fusiformis* and Nemertea. *Owenia fusiformis* can form tubes up to 30cm deep, whilst brittlestar are epifaunal fragile species. As fragile, effectively sessile species, animals in the zone of influence will be killed. Higher densities are expected to occur in summer when animals spawn. As cable installation is likely to take place between April and October it will overlap with this period of higher density. Although the habitat will have little resistance to the activity, resilience is medium as recovery from effects will occur through migration of adults from the surrounding unaffected area and through recruitment of juveniles from planktonic larvae. Recruitment rates will depend on favourable hydrodynamic conditions but as the habitat has been widely identified within the Proposed Development (and EMODNet [2019] shows the broadscale habitat A5.27 covers extensive areas of the Celtic Sea) recovery is expected to occur within 2 years.

As effects are short-term and the habitats identified are not Annex I listed the sensitivity of the effect has been assessed as low (using the criteria established in Chapter 5).

The overall sensitivity of the predominantly sandy subtidal habitats to pre-sweeping and cable installation has been assessed as **Negligible** and is **Not Significant**.

Annex I Bedrock Reef habitat

The extent of Annex I Bedrock Reef habitat within the Proposed Development has been calculated as 1.12km^2. This represents approximately 15.8% of the known bedrock reef habitat within the Pembrokeshire Marine / Sir Benfro Forol SAC; acknowledging that confidence in the extent within the SAC is very poor.

The Annex I Bedrock Reef habitat has been classified as A4.138 - *Molgula manhattensis with* a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock. Table 7-8 identifies that this habitat has low sensitivity to abrasion. The characterising species, *Molgula manhattenis* is a small solitary ascidian (sea squirt) which can form dense aggregations. It is short-lived with a life-span of less than 1 year and reproduces several times during this period. Recruitment is generally from existing individuals no more than a few kilometres away, but the fast growth rates means recolonization, and a dense cover can be established within about two months of disturbance (Stamp 2016).

Bedrock reef is a qualifying feature of the Pembrokeshire Marine / Sir Benfro Forol SAC and is of high environmental value as it supports a diverse range of algae, invertebrates and fish species. The EIA has therefore concluded that the sensitivity of the habitat should be increased from low to medium in recognition that the habitat is a key contributor to the overall biodiversity of the SAC.

The conservation objectives for the site state that to achieve favourable status:

- The overall distribution and extent of the habitat feature within the site and each of the main component parts is stable or increasing.
- The physical, biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded; and
- The presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded.

The presence and location of the Annex I habitat offshore was taken into consideration during the design (routeing) of the Proposed Development. SECAMS bathymetry data and JNCC habitat maps were used to identify a suitable cable route through the SAC that avoids or minimises the crossing of the known and potential features (embedded mitigation EM14). Route engineering and additional survey was undertaken during the cable route survey to visualise a sand channel through the bedrock reef, to further avoid crossing Bedrock reef features. The 'base case' development being assessed is therefore an installation corridor that avoids crossing Annex I Bedrock reef habitat offshore.

However, a small area of outcropping Bedrock reef has been identified within the sand channel that it may not be feasible to avoid. The extent of disturbance would be approximately 30m long x 15m wide (450m^2; between KP2.38 and KP2.41). If jetting or plough trenching is used in this area (it may require external cable protection), the seabed will experience temporary disturbance but the underlying character and composition will not change. There is sufficient habitat in the

surrounding Proposed Development (within 100m) that will be undisturbed to allow recruitment and recolonisation.

The indicative Greenlink centreline crosses a second area classified as Bedrock Reef at KP5. However, analysis of video transect 06 photographs (Figure 7-16 Drawing P1975-SURV-008) shows that there is a small sand covered channel through the habitat and that habitat A4.138 is not present. Therefore, it is concluded that there will be no effect on Annex I Bedrock Reef in this area.

The EIA concluded that the effect will be temporary (habitat recovery will occur within a year), the area disturbed will be very small (450m^2, approximately 0.006% of the Bedrock Reef in the SAC) and the Proposed Development will not affect, other than temporarily the structure or function of the Annex I Bedrock Reef. The significance of the effect has been assessed as **Minor** and is **Not Significant**.

It is acknowledged that should the base case being assessed change, the significance of the effect could become more significant. Therefore, to ensure that the Annex I Bedrock Reef remains protected within the Proposed Development, Project Specific Mitigation (PS2) has been proposed, in the form of exclusion zones around the identified Annex I Bedrock Reef habitat.

Annex I Stony Reef habitat

Annex I Stony Reef classified as medium grade, was identified across the extent of the Proposed Development from KP15.0 to KP20.2, and then in wide patches from KP20.6 to KP22.1 (Figure 7-11, Drawing P1975-HAB-004 Sheet 2). It mainly consists of cobbles and boulders which harbour a rich epifaunal community. The habitat has been identified as A5.141 - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles (Figure 7-18).

Habitat A5.141 has a low sensitivity to penetration and abrasion. The fauna associated with this habitat are typically fast-growing epifauna, that are opportunistic as the habitat experiences seasonal and sporadic cycles of severe scour. The pebbles and cobbles are likely to be moved by the tidal streams in the region, which will be more severe during winter storms.

Studies off Chesil Beach, Dorset (cited in Tillin and Tyler-Walters 2016) showed that the epifaunal community coverage decreased in October, scoured away by winter storms, but was recolonised in May to June. As the Greenlink cable route survey was undertaken during winter months it is possible that the survey may therefore have under-represented the abundance of epifaunal communities that will be present during cable installation. However, Tillin and Tyler-Walters (2016) state that the habitat is characterised by short-lived species, that mature rapidly. There is a relatively extended reproductive season and pelagic larvae. As the habitat covers an extensive area within the Proposed Development, in comparison to the zone of influence, there will be a good larval supply to support colonisation of the disturbed area. Recolonization is expected to occur rapidly post-disturbance; within 1 year.

Stony Reef contributes to the Reef qualifying feature of the Pembrokeshire Marine / Sir Benfro Forol SAC. Overall the Reef habitat within the SAC has high environmental value as it supports a diverse range of algae, invertebrates and fish species. The EIA has therefore concluded that the sensitivity of the habitat should be increased from low to medium in recognition that the habitat is a key contributor to the overall biodiversity of the SAC.

If jetting or plough trenching is used in this area (it may require external cable protection), the seabed will experience temporary disturbance but the underlying character and composition will not change. The cobbles will not be removed from the Proposed Development, and will be used to cover the cable returning the seabed to a similar state as pre-installation. The area of habitat disturbed by cable installation will be approximately 7km x 15m (0.105km^2); approximately 3.5% of the habitat identified within the Proposed Development, and 0.15% of the wider extent of stony reef within the SAC. It should be noted that JNCC habitat maps show Stoney reef extends outside the boundary of the SAC as well.

The EIA concluded that as the effect will be temporary (recovery within 1 year) and the area disturbed small in the context of the wider habitat the Proposed Development will not affect, other than temporarily the structure or function of the Annex I medium grade Stony Reef. The significance of the effect has been assessed as **Minor** and is **Not Significant**.

Annex I Biogenic Reef habitat

Annex I Biogenic Reef classified as potential through to medium grade has been identified within the Proposed Development. There is sufficient room within the Proposed Development for the indicative Greenlink centreline to avoid areas classed as medium grade.

The areas of biogenic reef were mainly classified as habitat A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment, with the exception of one area of low-grade biogenic reef in habitat A5.15 – Deep circalittoral coarse sediment. A5.611 has a higher sensitivity to the pressure penetration than A5.15, and has been classed as medium.

Tillin et al. (2018) provides evidence from various studies (e.g. Gibb et al. 2014, Tillin et al. 2015, Vorberg 2000, Cunningham et al. 1984, and Holt et al. 1998) to assess the likely recovery rate of *S.spinulosa* reefs from effects. It reports data is limited with significant information gaps. Recovery rates are likely to be determined by a range of factors such as the degree of effect, the season of effect, larval supply and local environmental factors including hydrodynamics. There is evidence from studies on *S.alveolata* reefs which suggest that areas of limited damage on a reef (small impact) could be repaired rapidly (within weeks) through tube-building activities of adults, whereas following a medium effect recovery would be likely to occur within two years. Some thin crusts of *S.spinulosa* are relatively ephemeral and disappear following natural disturbance such as storms but

recover the following year, suggesting that recovery is high (within two years) even where reefs are removed.

Approximately 3.13km of the cable route will cross potential or low grade Biogenic reef. The area of habitat disturbed by cable installation will be approximately 0.05km^2; approximately 3.6% of the habitat identified within the Proposed Development. JNCC habitat maps do not show biogenic reef as occurring within the Pembrokeshire Marine / Sir Benfro Forol SAC.

Cable installation will temporarily disturb the seabed, but the underlying composition and character will not change. Given the wider area of habitat compared to the zone of influence of installation, recovery via recruitment from the surrounding area is likely to occur in the short-term (within two years). The significance of the effect has been assessed as **Minor** and is **Not Significant**.

Other subtidal habitats

Generally, the other subtidal habitats identified in the Proposed Development have low to medium sensitivity to the pressure. The exception is for A5.44 Circalittoral mixed sediments.

The assessment for A5.44 is based on the EUNIS sub-level habitat A5.442 - Sparse *Modiolus modiolus*, dense *Cerianthus lloydii* and burrowing holothurians on sheltered circalittoral stones and mixed sediment, as this is the only EUNIS sub-level habitat that has been assessed by MarLIN. The two featured species of the habitat are particularly sensitive to activities which cause abrasion and disturbance; *Cerianthus lloydii* is a tube-dwelling anemone, whilst *Modiolus modiolus* (blue mussel) are large, sessile and shallowly buried individuals unable to escape from activities which penetrate the seabed. The habitat A5.44 was identified on the Turbot Bank (Annex I sandbank feature), interpreted from sidescan sonar data. It was not sampled by any grabs.

The Turbot Bank is exposed to wave action, suggesting that epifauna and infauna present will be characteristic of moderately strong tidal currents, and given the dominance of sand and coarse sediments, can be viewed as adaptable to physical disturbance. Many infaunal species may live at depths where they will be protected from surface disturbance and in areas where direct loss occurs, it is likely that adjacent areas will act to replenish communities rapidly as most infaunal species are mobile and the zone of influence is narrow. The EIA therefore concluded that the sensitivity category of high presented in Table 7-8 is over conservative for the habitat and has reduced the sensitivity to medium.

The overall significance of the effect on the other subtidal habitats in the Proposed Development has been assessed as **Minor** and is **Not Significant**.

7.6.2.2 Operation (including maintenance and repair)

No disturbance or habitat loss will occur from the operating cables. Effects during any unforeseen repair and maintenance works will be of smaller magnitude when compared to cable installation. The assessment considered five discrete cable

repairs during operation and concluded that, given the sensitivity of habitats within the Proposed Development to penetration and abrasion, the significance of the effect remains **Minor** and is **Not Significant**.

7.6.2.3 Decommissioning

Two options will be considered at decommissioning; leaving the cables in-situ and removing them. If the cables are left in-situ there will be no effect on intertidal benthic and estuarine habitats and species during decommissioning. However, if the option to remove the cables (and any associated protection) is selected, this process would essentially be the same as installation activities but in reverse. Therefore, any effects that could arise due to the decommissioning phase of the Proposed Development will be of a comparable magnitude to those assessed above for cable installation and so the effect has been assessed **Minor** and is **Not Significant**.

7.6.3 Siltation rate changes, including smothering (depth of vertical sediment overburden)

7.6.3.1 Installation

The area surrounding the cable trench is likely to be affected by the suspension and subsequent deposition of sediments as a result of installation activities. Pre-sweeping and jet trenching will cause a greater level of sediment suspension compared to the use of ploughing equipment.

Although modern equipment and installation techniques have reduced the re-suspension of sediment during cable trenching activities, remaining suspended sediment dispersed into the water column has the potential to affect sessile filter feeders and, once settled out, could potentially smother organisms within the deposition area. Suspended sediments can obstruct the filtration mechanisms of some benthic and pelagic species. For example, some types of worm and brittlestars can be affected through the clogging of gills or damage to feeding structures. Suspended sediments can also attach to fish eggs causing abnormalities or death. It can also affect the growth of the macrobenthos and may have a lethal effect on some species.

Chapter 6 concluded that the change in suspended sediments (water clarity) as a consequence of cable installation is Negligible and is Not significant for the following reasons:

- Increases in SPM concentrations will be brief (restricted to the immediate period when cable burial is taking place)
- Sand and gravel disturbed during the cable burial operations will settle back to the seabed very rapidly (within 3 minutes) and the footprint is unlikely to extend any great distance from the cable route (median settling distance is 27m for sand).
- Silts, clay and chalk particles will remain in suspension for a greater period of time (up to 14 hours) and will be dispersed over a much greater distance,

depending upon the strength of the tidal currents. However, the depth of deposition over such a large area is likely to be unnoticeable.

- It is predicted that the change is suspended sediment concentrations will be within the normal environmental variation experienced after storm conditions in the region.

This has led to the magnitude of the effect of siltation rate changes on subtidal habitats being assessed as negligible. Some subtidal habitats within the Proposed Development will be exposed to more than one occasion of siltation changes e.g. from seabed preparation and subsequent cable lay. The activities will be separated temporally. No activities within the Proposed Development will accumulate in a manner that causes the magnitude of the effect to increase.

To determine the sensitivity of habitats within the Proposed Development an assessment has been carried out using information provided on the Marine Life Information Network (MarLIN). Table 7-9 identifies that the subtidal habitats identified within the Proposed Development generally have low to medium sensitivity to the pressure smothering and heavy siltation rate changes.

Table 7-9 Sensitivity of habitats within the Proposed Development to the pressure smothering and siltation rate changes (heavy)

EUNIS habitat	Resistance	Resilience	Sensitivity	Confidence*
A4.111 - *Balanus crenatus* and *Tubularia indivisa* on extremely tide-swept circalittoral rock	Medium	High	Low	Low
A4.13 - Mixed faunal turf communities on circalittoral rock	*Low*	*Medium*	*Medium*	*Low*
A4.138 - *Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock	Medium	High	Low	Low
A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Low	High	Low	Low
A4.2212 - *Sabellaria spinulosa*, didemnid and small ascidians on tide-swept moderately wave-exposed circalittoral rock	None	Medium	Medium	Low
A5.13 - Infralittoral coarse sediment	*Low*	*Medium*	*Medium*	*Low*
A5.14 - Circalittoral coarse sediment	*Medium*	*Medium*	*Medium*	*Low-High*
A5.141 - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Medium	High	Low	Medium
A5.142 - *Mediomastus fragilis, Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel	Medium	Medium	Medium	Low-High
A5.143 - *Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand	No Evidence	No Evidence	No Evidence	Not Relevant
A5.15 - Deep circalittoral coarse sediment	*Medium*	*Medium*	*Medium*	*Low-High*
A5.24 - Infralittoral muddy sand	*Low*	*Medium*	*Medium*	*Low-High*
A5.25 - Circalittoral fine sand	*Medium*	*High*	*Low*	*Medium*
A5.251 - *Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	Low	Medium	Medium	Low-High

EUNIS habitat	Resistance	Resilience	Sensitivity	Confidence*
A5.252 - *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	Low	Medium	Medium	Low-High
A5.261 - *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	Low	Medium	Medium	Low-High
A5.27 - Deep circalittoral sand	*Low*	*Medium*	*Medium*	*Medium-High*
A5.272 - *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	Low	Medium	Medium	Medium-High
A5.44 - Circalittoral mixed sediments	*Low*	*Low*	*High*	*Medium-High*
A5.45 - Deep circalittoral mixed sediments	*Medium*	*Medium*	*Medium*	*Low-High*
A5.451 - Polychaete-rich deep Venus community in offshore mixed sediments	Medium	Medium	Medium	Low-High
A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	None	Medium	Medium	Low
Italics and grey = Assessment has been based on sublevel habitat assessments * Confidence is specific to sensitivity. It is based on the quality of evidence, applicability of evidence and degree of concordance (agreement between studies).				

The sensitivity of subtidal habitats has been assessed as medium, recognising the differing sensitivities (identified in Table 7-8) within the Proposed Development. The overall significance of the effect has been assessed as **Negligible** and is **Not Significant.**

The potential effect of this pressure on the Pembrokeshire Marine / Sir Benfro Forol SAC has also been assessed within the Greenlink Marine HRA – Technical Appendix C. The HRA concluded no potential for significant effects and that an Appropriate Assessment is not required for this pressure.

7.6.3.2 Operation (including maintenance and repair)

No seabed disturbance or siltation rate changes will occur from the operating cables. Effects during any unforeseen repair and maintenance works will be of smaller magnitude when compared to cable installation. The assessment considered five discrete cable repairs during operation and concluded that as the sensitivity of habitats within the Proposed Development remains the same as for installation, the overall significance of the effect remains **Negligible** and is **Not Significant**.

7.6.3.3 Decommissioning

Two options will be considered at decommissioning; leaving the cables in-situ and removing them. If the cables are left in-situ there will be no effect on intertidal benthic and estuarine habitats and species during decommissioning. However, if the option to remove the cables (and any associated protection) is selected, this process would essentially be the same as installation activities but in reverse. Therefore, any effects that could arise due to the decommissioning phase of the Proposed Development will be of a comparable magnitude to those assessed above for cable installation and so the effect has been assessed **Negligible** and is **Not Significant**.

7.6.4 Physical change (to another seabed type)

7.6.4.1 Installation

External cable protection (i.e. concrete mattresses / rock berm) will be installed where the Proposed Development crosses a third-party telecommunications cable, and where ground conditions are unsuitable for cable burial. It is possible that up to 16.46km of the Proposed Development will require external cable protection. The footprint has been reduced by embedded mitigation EM15 and EM29. However, where it is used the seabed habitat within the footprint of the external cable protection will be lost and replaced with, in places, a harder substrate, changing the seabed type.

The crossing location lies outside of the Pembrokeshire Marine / Sir Benfro Forol SAC, but other indicative areas for external cable placement are within the site. Table 7-10 summarises the habitats within which external cable protection could be installed and the estimated length of protection required. The total loss of habitat within the SAC as a result of external cable protection has been calculated as 0.164km^2. Of this value 0.0017km^2 will be within Annex I Bedrock Reef habitat and 0.08km^2 will be within Annex I Stony Reef – medium grade habitat. These values represent less than 0.001% of the area of Bedrock Reef, and 0.11% of the Stony Reef in the Pembrokeshire Marine / Sir Benfro Forol SAC .

Table 7-10 Habitats within which external cable protection could be installed

EUNIS habitat	Distance crossed	Presence of Annex I habitat
A5.251- *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	120m	No
A4.138 - *Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock.	30m (+140m*)	Yes - Bedrock Reef
A5.143 - *Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand. A5.25 - Circalittoral fine sand	200m	No
A5.451 - Polychaete-rich deep Venus community in offshore mixed sediments A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	3000m	No
A5.141 - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles A5.14 – Circalittoral coarse sediment	8000m	Medium grade stony reef
A5.27 – Deep circalittoral sand	3000m	No
A5.611 - Sabellaria spinulosa on stable circalittoral mixed sediment A5.45 – Deep circalittoral mixed sediments	2000m	Yes – potential biogenic reef
*Between KP2.7 and KP2.9 the cable route crosses Bedrock reef, but video transect shows narrow sand channel which is feasible for installation which is not classed as A4.138; Section 7.3.4.3		

It is likely that a high proportion of the benthic invertebrates within the width of the footprint, will be susceptible to mortality, injury or displacement as a result of the activities. The habitat beneath the external cable protection will be completely removed. Where external cable protection is installed, the underlying Reef habitat

will be lost, but it will be replaced by a suitable hard, stable habitat for colonising communities. The external cable protection might be a slightly less complex habitat than that which occurs naturally, which might result in a comparative reduction in the diversity of species. However, there is sufficient habitat in the surrounding area to allow recruitment and colonisation of the protection material.

MarLIN (2019) identifies that the habitats identified in Table 7-9 have a high sensitivity to the pressure, because a permanent change in substrate type would lead to the biotope being re-classified.

Material used for rock berms is typically coarse gravel, cobbles and boulders. Chapter 4 indicates that rock sizes will likely be in the range of 2-22cm. Langhamer (2012) comment that "in comparison to boulders, gravel protection will result in low diversity and abundance of organisms due to a more unstable environment".

In areas where there is stony or bedrock reef, the surrounding substrate is stable cobbles, boulders and bedrock and the dominant epifaunal species are rapid colonisers, capable of early reproduction and rapid growth. Therefore, it is expected that epifauna will be able to colonise the new substrate.

The external protection in sandy habitats will inevitably support the settlement of non-local hard bottom fauna that may not be representative of the surrounding benthos. Evidence (in discussion below) suggests that effects on the local fauna in soft sediment areas will in most cases be very localised but long-term.

The above conclusions are supported by evidence from post-construction monitoring of offshore windfarms. The examples provided below are from the introduction of a hard substrate into a predominantly sandy environment. This however can be used to infer that colonisation of external protection in areas, where there is already rock habitat, will likely be quicker i.e. as colonisation of external protection on sand habitats is dependent on the passive transport of adult organisms or the availability of larvae from the surrounding region.

Case Studies on the Offshore Windfarm Egmond aan Zee, Prinses Amalia Wind Farm and Horns Rev Wind Farm found that the density of species on scour protection material were high and the number of species observed increased with time. In addition, in many cases the number of rare species had also increased (Waardenburg et al 2017). Studies (Lindeboom et al 2011) at OWEZ identified 11-17 hard substratum benthos species on the rock material, noting the surrounding habitat was sandy. At the Horns Rev windfarm the scour protection has been colonised by sea anemones and the soft coral *Alcyonium digitatum* (Langhamer 2012). Monitoring of the Nord Stream pipeline in Swedish waters showed that over a period of four years a general increase in epifauna was seen on the introduced hard substrate (pipeline and rock berms) (Nord Stream 2014).

The external cable protection could be viewed as an artificial reef. The OSPAR Commission (2009) defines an artificial reef, as a 'submerged structure placed on the seabed deliberately, to mimic some characteristics of a natural reef. It could be partly exposed at some stages of the tide'. This places the external cable

protection material outside the formal definition on the basis of purpose. However, almost all man-made structures placed on the seabed are rapidly and quickly colonised by marine organisms (Linley et al 2007). The effects of artificial reefs are ambiguous with Linley et al (2007) citing studies such as Ambrose and Anderson (1990) which have shown that some species of infauna were enhanced whilst others were depressed. It is therefore acknowledged that whilst the external cable protection could enhance the productivity and biodiversity of the habitat, it will also represent a variation on the habitat that was previously there.

Although evidence above suggests that the introduction of external cable protection in sandy areas could increase the biodiversity of the area, it will result in a long-term change in habitat. Taking this into account and given that sand habitat is widespread and external cable protection on sandy sediments is not within a protected site, the sensitivity of the habitat has been assessed as medium. External cable protection will be very localised and will not change the character and composition of the habitat as a whole, therefore the magnitude has been assessed as low. The overall significance of the effect has been assessed as **Minor** and is **Not Significant for subtidal sand habitats**.

Where external cable protection is deposited in areas of Annex I Reef habitat, the seabed height will become elevated in comparison to the surrounds. Large boulders, up to 2m high, have been observed in the area and therefore structures of this height are not uncommon in the area. Camera drops on these boulders were undertaken during the cable route survey. Imagery indicates the presence of habitat A4.111 - *Balanus crenatus* and *Tubularia indivisa* on extremely tide-swept circalittoral rock. This biotope is characterised by a few species that are capable of maintaining a strong foothold in strong tides, either by forming a flat adherent crust, or by having strong attachment points. Species typically associated with the biotope include hydroids, sponges and anemones, as well as mobile species such as starfish, crab and whelk (Tillin 2016). The species associated with the biotope grow rapidly, are short-lived, and generally thought of as early colonisers of bare surfaces. Tillin (2016) cite evidence of *Balanus crenatus* colonising artificial reef structures and sublittoral rock surfaces within months. For example, the ship, HMS Scylla was colonised by *Balanus crenatus* four weeks after sinking in March; the timing of the sinking would have ensured a good larval supply. This suggests that the height of the external cable protection will not detrimentally effect the function of the reef habitat but will provide alternative areas for colonisation by species in the surrounds.

The potential effect of this pressure on the Pembrokeshire Marine / Sir Benfro Forol SAC has also been assessed within the Greenlink Marine HRA – Technical Appendix C. The HRA concluded potential for likely significant effects and that an Appropriate Assessment is required for this pressure. Further assessment, in Stage 2 (Information to Inform the AA), concluded that given species from the surrounds will colonise the cable protection, the distribution, extent, structure and function and the condition and diversity of the habitat will not be degraded in the long-term. The HRA therefore concluded that the integrity of the Pembrokeshire Marine / Sir

Benfro Forol SAC would not be adversely affected by the Proposed Development. In line with this conclusion, the sensitivity of the reef habitat has been assessed as medium, recognising that although the habitat is a designating feature of an SAC the distribution and extent, structure and function and quality and diversity of the habitat will not be altered in the long-term. The magnitude of the effect has been assessed as low given the small, localised footprint of the pressure, the potential for colonisation of the external cable protection, and the wider extent of the habitat within the region. The overall significance of the effect has been assessed as **Minor** and is **Not Significant.**

7.6.4.2 Operation (including maintenance and repair)

Effects during any unforeseen repair and maintenance works will be of a smaller magnitude when compared to cable installation. The assessment considered five discrete cable repairs during operation and concluded that as the sensitivity of habitats within the Proposed Development remains the same as for installation, the overall significance of the effect remains **Moderate** and is **Significant.**

7.6.5 Introduction or spread of non-indigenous species

7.6.5.1 Installation, Operation (including maintenance and repair) and decommissioning

MarLIN (2019) identifies that the majority of habitats within the Proposed Development are not sensitive (e.g. A4.111, A4.213, A4.2212 and A5.611) to the pressure. The exception is habitats A5.251, A5.252, A5.261 and A5.451 which have been assessed as having a high sensitivity. There is concern that the slipper limpet *Crepidula fornicata* may settle on stones in substrates and hard surfaces such as bivalve shells in these habitats. The species has a high dispersal potential with pelagic larvae. Temporary disturbance of the seabed i.e. through cable installation, could therefore allow juveniles to settle in a new area.

Slipper limpet are well established in the Milford Haven Waterway (and Pembrokeshire Marine / Sir Benfro Forol SAC) having first been recorded in 1953. However, Bohn (2014) indicates that it currently appears to be absent in subtidal habitats. Slipper limpet were not identified by the cable route survey (MMT 2019) within the Proposed Development.

The introduction of invasive non-native species (e.g. through discharge of ballast water from project vessels) will be managed under the International Convention for the Control and Management of Ship's Ballast Water and Sediments (embedded mitigation EM6). The latest guidance from the GB non-native species secretariat (2015) will be followed and a Biosecurity Plan produced pre-installation (embedded mitigation EM8). This would include factors such as origins of the vessels and ensuring that relevant equipment is cleaned before use. Taking the embedded mitigation into consideration, the magnitude of the effect has been assessed as negligible.

The overall significance of the effect has been assessed as **Negligible** and is **Not Significant**.

As Best Practice, Project Specific Mitigation (PS8) has been proposed.

7.6.6 Electromagnetic changes

7.6.6.1 Operation

The Greenlink cables will be installed in direct contact with each other (bundled configuration, embedded mitigation EM15), with currents flowing in opposite directions. Magnetic (B) fields will emanate into the surrounding environment; although they will attenuate with distance (both horizontally and vertically). Movement through the B fields i.e. water currents or organisms swimming through, creates an induced electric (iE) field. The effect will be present along the Proposed Development.

The background geomagnetic field for the Celtic Sea is approximately 48.7 µT (Natural Resources Canada 2019), with the background iE field calculated as between 34.09 µV/m and 48.7 µV/m in Irish waters.

It has been calculated that the Greenlink cables will generate B fields of 21µT directly over the cables reducing to natural background levels within 2m. The iE fields are estimated to be between 48.79 and 69.7 µV/m at 1m from the cables. No detectable change above background geomagnetic fields will be noticeable at 2m from the cables.

The effect of EMF on benthic species is largely unknown. There is little and contradicting evidence of interactions with anthropogenic sources of magnetic fields. As benthic communities are typified by sessile or low-mobility species, which are unlikely to navigate using magnetic fields and anomalies, these species, are less likely to be affected than more mobile species such as teleost fish or elasmobranchs, which are assessed in Chapter 8. The exception could be crustaceans, such as edible crabs (*Cancer pagurus*), lobster (*Homarus gammarus*) and prawns (e.g. *Nephrops norvegicus)*. The brown shrimp (*Crangon crangon*) has been recorded as being attracted to AC magnetic fields of the magnitude expected from submarine power cabling (ICES 2003). However, Bochert and Zettler (2004) found no effects of exposure to static B fields upon the same species, nor upon the round crab (*Rhithropanopeus harrisii*), an isopod (*Saduria entomon*) or the mussel (*Mytilus edulis*). Demonstrations of B fields ranging between 1-100µT delaying embryonic development in sea urchins (Zimmerman et al. 1990), and of high frequency AC EMF causing cell damage to barnacle larvae and interfering with their settlement (Leya et al. 1999), contrasts with anecdotal evidence of benthic invertebrates living directly upon DC electrodes (Nielson 1986) with no apparent effects (Swedpower 2003). The sensitivity of the receptor to EMF has been assessed as low.

A number of marine invertebrate species that inhabit the Proposed Development are magnetically sensitive, including important commercially targeted taxa such as lobster, crabs, shrimps, and molluscs. As discussed above, B and iE fields generated

by the Proposed Development will attenuate to below background geomagnetic field levels within 2m of the cables.

Potential effects will largely be negated by cable burial; burial to a depth of at least 0.6m will prevent most invertebrates (except deep borrowing species such as certain Crustacea and bivalve molluscs) encountering the strongest fields present on the cable surfaces. In addition, embedded mitigation EM15, bundling of the cables, also significantly reduces the magnitude of the effect. The magnitude of the effect has been assessed as low, as although it will be a long-term change, the alteration will be extremely localised, and the underlying character of the baseline will be similar to the pre-development situation.

The overall significance of the effect has been assessed as **Negligible** and is **Not Significant.**

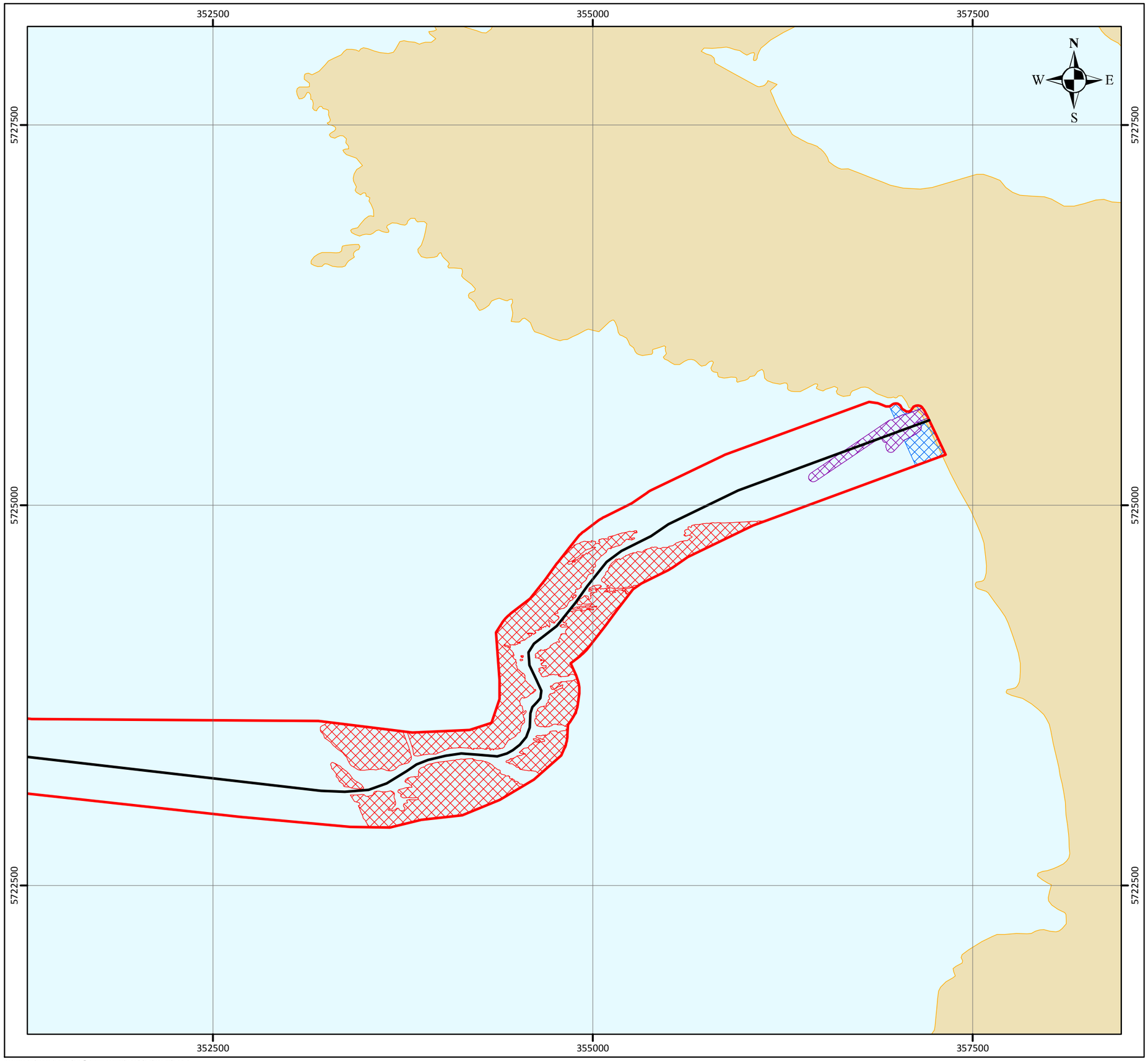
7.7 Project Specific Mitigation

In addition to the embedded mitigation outlined in Table 7-6, Table 7-11 presents measures that GIL is committed to adopting.

Table 7-11 Project specific mitigation – benthic and intertidal Ecology

ID	Project Specific Mitigation
PS1	No intrusive works will be undertaken at Freshwater West between mean high water springs and mean low water springs.
PS2	Exclusion zones have been established around Annex I bedrock reef features; shown on Figure 7-21, Drawing P1976-INST-009. No intrusive works (e.g. cable installation, deposit of external cable protection material) will be undertaken within these exclusion zones.
PS4	The preference is to bury the HDD duct exit and all cables in sediment to the required depth of lowering. No external cable protection should be deposited at the HDD exit point.
PS6	A burial assessment study will be carried out by the Installation Contractor that defines the feasibility of achieving the required depth of burial. When determining the installation technique for the cable route between KP15 and KP23 the preference shall be to bury the cable in sediment. If ground conditions do not allow this then cutting should be investigate as the next alternative. External cable protection shall only be consider as the final option, and if necessary, the Installation Contractor shall seek to minimise the footprint (length and width) of external cable protection required between KP15 and KP23 (Annex I stony reef).
PS7	Where external cable protection is used between KP15 and KP23 (Annex I Stony Reef) an environmental monitoring plan will be established to monitor colonisation of the external cable protection to demonstrate that the structure and function of the Reef feature has not been adversely affected in the long-term. The monitoring programme will be developed in consultation with NRW. It is proposed that one or more of transects MMT (2019) RR_T02, RR_T03 and RR_T04 are re-surveyed as a control, with additional video transects taken along the external cable protection to

ID	Project Specific Mitigation
	record epifauna. Monitoring would be planned to coincide with the first two routine cable inspection surveys. It is expected that the first inspection survey will be undertaken within the first three years of installation, with a second survey undertaken within three years of the first survey. All footage will also be reviewed for the presence of non-indigenous species. The objectives of monitoring colonisation of the external cable protection will be to establish an evidence base to inform future development within the Pembrokeshire Marine / Sir Benfro Forol SAC e.g. renewable energy generation. It will also confirm (or otherwise) the conclusion that the deposition of the external protection material adds to the Reef habitat within the SAC; albeit artificially.
PS8	A tool box talk will be given ahead of all works. It will provide key identifying features for slipper limpet. Any slipper limpet found during installation will be kept & destroyed.



Contains Ordnance Survey data © Crown copyright and database right 2013

GREENLINK INTERCONNECTOR

INSTALLATION

Annex I Habitat Exclusion Zones - UK Route

Drawing No: P1975-INST-009	A

Legend

- Indicative Greenlink Route Centreline
- Proposed Development
- Annex I Habitat Exclusion Zone
- Decommissioned MOD Cable Avoidance Zone
- Trenching Exclusion Zone

NOTE: Not to be used for Navigation

Date	Monday, April 29, 2019 08:37:30
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	OS; MMT; ESRI; Greenlink
File Reference	J:\P1975\Mxd\15_INST\ P1975-INST-009.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Co-financed by the European Union
Connecting Europe Facility

0 250 500 750 1,000 m

7.8 Residual Effect

The assessment presented in Section 7.6 identified two potential pressures could have significant effects on the receptor. The significance of these pressures was re-assessed taking into consideration the Project Specific Mitigation outlined in Section 7.7 to determine if a significant residual effect remains.

7.8.1 Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion

The assessment identified that subtidal habitats within the Proposed Development have a medium sensitivity to the pressure penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion. Extensive route development was undertaken during design (routeing) to identify an alternative route through the Pembrokeshire Marine / Sir Benfro Forol SAC that avoided Annex I habitat features. The Proposed Development represents the best alternative and has been optimised to avoid crossing Annex I habitat where possible, embedded mitigation EM14. The cables will also be bundled into the same trench to reduce the footprint of the Proposed Development (embedded mitigation EM15). In addition, Project Specific Mitigation in the form of exclusion zones (PS2, Figure 7-21, Drawing P1975-INST-009) have been established around the Annex I reef habitat within the Proposed Development. GIL will ensure that the Installation Contractor adheres to these exclusions. No further Project Specific Mitigation can be proposed that reduces the footprint, magnitude or sensitivity of the effect and therefore the significance of the residual effect remains **Minor** and is **Not Significant**.

7.8.2 Physical change (to another seabed type)

The assessment identified that the Proposed Development will have an effect of Minor significance on subtidal habitats. The preference is to bury the cables in sediment as this is the most cost-effective method of protection. External cable protection will only be deployed where adequate burial cannot be achieved. The footprint of the deposits will be the minimum required to ensure cable safety and rock berm stability (embedded mitigation EM29).

The alternative routes identified through the Pembrokeshire Marine / Sir Benfro Forol SAC also crossed extensive areas of Annex I reef habitat; and longer sections of external cable protection would have been required on these route options. The route developed, through consultation with NRW, is seen to be the best alternative. External cable protection in the area of Stony Reef is expected to be colonised by the surrounding epifauna rapidly.

The EIA concluded that burial in sediment and external cable protection, if required across the Stony Reef would have an effect of Minor significance. Project Specific Mitigation (PS6) has been proposed which outlines the environmental recommendations for cable protection between KP15 and KP23. A burial assessment study will be carried out by the Installation Contractor that defines the feasibility

of achieving the required depth of burial. When determining the installation technique for the cable route between KP15 and KP23, GIL will indicate that the preference shall be to bury the cable in sediment. If ground conditions do not allow this then cutting should be investigate as the next alternative. External cable protection shall only be considered as the final option, if necessary. The Installation Contractor shall seek to minimise the footprint (length and width) of external cable protection required between KP15 and KP23 (Annex I stony reef).

Project Specific Mitigation in the form of exclusion zones (PS2, Figure 7-21, Drawing P1975-INST-009 overleaf) have also been established around the majority of Annex I Bedrock Reef habitat within the Proposed Development. Micro-routeing will also be used to avoid Annex I habitat where possible. However, in certain areas the features cover the entire width of the Proposed Development and cannot be avoided. GIL will ensure that the Installation Contractor adheres to these exclusions.

No further Project Specific Mitigation can be proposed that reduces the footprint, magnitude or sensitivity of the effect. Where external cable protection is used monitoring has been recommended (PS7). Although monitoring will not reduce the effect, the objective is to validate the conclusion of short-term effects. It is thought monitoring would be beneficial for the management of the Pembrokeshire Marine SAC given that a number of renewable energy projects are proposed for testing and development within the SAC. Validating the conclusions of the Greenlink Marine HRA will support the decision making for future applications.

Taking the Project Specific Mitigation into consideration, the significance of the residual effect remains **Minor** and **Not Significant** in areas of Annex Bedrock and Stony reef and **Minor** and is **Not Significant** in all other subtidal habitats.

REFERENCES

1 Ambrose, R.F. and Anderson, T.W. (1990). Influence of an artificial reef on the surrounding infaunal community. Marine Biology, 107, 41-52

2 Bochert, R. and Zettler, M.L. (2004). Long-term exposure of several marine benthic animals to static magnetic fields. Bioelectromagnetics 25: 498-502.

3 Bohn, K. (2014) The distribution and potential northwards spread of the invasive slipper limpet *Crepidula fornicate* in Wales, UK. Natural Resources Wales Report No. 40. August 2014.

4 Countryside Council for Wales (CCW) (2005). Pembrokeshire Marine European Site. Advice provided by the Countryside Council for Wales in fulfilment of Regulation 33 of the Conservation (Natural Habitats, &c.) Regulations 1994.

5 Davies, J., Baxter, J., Bradley, M., Connor, D., Khan, J., Murray, E., Sanderson, W., Tumbull, C. and Vincent, M., 2001. *Marine Monitoring Handbook*. Joint Nature Conservation Committee.

6 DECC, 2016. Offshore Energy SEA 3: Appendix 1 Environmental Baseline: Benthos [Online]. URL https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/504527/OESEA3_A1a2_Benthos.pdf (accessed 6.4.19).

7 DTI (2005). Synthesis of information on the benthos of area SEA 6.

8 EEA (2019a). *Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock [online] Available at: https://eunis.eea.europa.eu/habitats/2130 (Accessed March 2019).

9 EEA (2019b). *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock. [online] Available at: https://eunis.eea.europa.eu/habitats/2120 (Accessed April 2019)

10 EEA (2019c). *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles [online] Available at: https://eunis.eea.europa.eu/habitats/2097 (Accessed April 2019)

11 EEA (2019d) *Sabellaria spinulosa* on stable circalittoral mixed sediment [online] Available at: https://eunis.eea.europa.eu/habitats/1693 (Accessed April 2019)

12 EMODNet (2019). EMODnet broad-scale seabed habitat map for Europe (EUSeaMap) [online] Available at: https://www.emodnet-seabedhabitats.eu/access-data/launch-map-viewer/ (Accessed April 2019)

13 GB Non-native species secretariat (2015). http://www.nonnativespecies.org/index.cfm?sectionid=53 (Accessed March 2019).

14 Gubbay, S. (2007). Defining and managing Sabellaria spinulosa reefs: Report of an inter-agency workshop 1-2 May, 2007. JNCC Report No. 405.

15 Intertek EWCS (2019). Greenlink Marine Habitats Regulation Assessment.

16 Irving, R. (2009). *The identification of the main characteristics of stony reef habitats under the Habitats Directive.*

Peterborough, UK: Joint Nature Conservation Committee.JNCC (2016). Natura 2000 Standard Data Form, Site UK0013116. Pembrokeshire Marine / Sir Benfro Forol [online] Available at: http://jncc.defra.gov.uk/ProtectedSites/SACselection/n2kforms/UK0013116.pdf (Accessed April 2019)

17 JNCC (2019). Pembrokeshire Marine / Sir Benfro Forol. [online] Available at: http://jncc.defra.gov.uk/ProtectedSites/SACselection/sac.asp?EUcode=UK0013116 (Accessed April 2019)

18 Langhamer, O (2012). Artificial reef effect in relation to offshore renewable energy conversion. State of the art. Scientific word journal.

19 Lindeboom, H.J., Kouwenhoven, H.J., Bergman, M.J.N., Bouma, S., Brasseur, S., Daan, R., Fijn, R.C., de Haan, D., Dirksen, S., van Hal, R., Hille Ris Lambers, R., ter Hofstede, R., Krijgsveld, K.L., Leopold, M. and Scheidat. (2011) Short term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation. Environmental Research Letters, 6.

20 Linley E.A.S., Wilding T.A., Black K., Hawkins A.J.S. and Mangi S. (2007) Review of the reef effects of offshore wind farm structures and their potential for enhancement and mitigation. Report from PML Applications Ltd and the Scottish Association for Marine Science to the Department for Business, Enterprise and Regulatory Reform Contract No: RFCA/005/0029P (BERR).

21

22 MarineSpace (2018). Greenlink Interconnector Cable Landfall Locations (Wales and Ireland) - Intertidal Walkover Survey Report 2018.

23 MarLIN. (2019). The Marine Life Information Network. [online] Available at: www.marlin.ac.uk (Accessed April 2019).Natural Resources Canada (2019). [Online] Available at: https://www.nrcan.gc.ca/home (Accessed March 2019)

24 Nord Stream (2014) Results of Environmental and Socio-Economic Monitoring 2014. August 2015 [Online] Available at: https://www.nord-stream.com/press-info/library/?pk=250 (Accessed April 2019)

25 OSPAR Commission (2009) Assessment of construction or placement of artificial reefs. Biodiversity Series Publication 438/2009.

26 Parry, M.E.V. (2015). Guidance on Assigning Benthic Biotopes using EUNIS or the Marine Habitat Classification of Britain and Ireland.

27 Pidduck, E., Jones, R., Daglish, P., Farley, A., Morley, N., Page, A. and Soubies, H. (2017). Identifying the possible impacts of rock dump from oil and gas decommissioning on Annex I mobile sandbanks – JNCC Report No: 603. [online] Available at: http://jncc.defra.gov.uk/pdf/Report_603_web.pdf (Accessed April 2019)

28 Stamp, T.E. (2016). Molgula manhattensis with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [online]. Plymouth: Marine Biological Association of the United Kingdom. Available at: https://www.marlin.ac.uk/habitat/detail/1063 (Accessed April 2019)

29 Swedpower (2003). Electrotechnical studies and effects on the marine ecosystem for BritNed Interconnector.

30 Tillin, H.M. 2016. [Balanus crenatus] and [Tubularia indivisa] on extremely tide-swept circalittoral rock. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 16-05-2019]. Available from: https://www.marlin.ac.uk/habitat/detail/349

31 Tillin, H.M. and Tyler-Walters, H. (2016). Spirobranchus triqueter with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [online]. Plymouth: Marine Biological Association of the United Kingdom. Available at: https://www.marlin.ac.uk/habitat/detail/177 (Accessed April 2019)

32 Tillin, H.M., Marshall, C. and Gibb, N. (2018). Sabellaria spinulosa on stable circalittoral mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [online]. Plymouth: Marine Biological Association of the United Kingdom. Available at: https://www.marlin.ac.uk/habitat/detail/377 (Accessed April 2019)

33 Waardenburg, B., Lengkeek, W., Didderen, K., Teunis, M., Driessen, F., Coolen, J.W.P., Vergouwen, S.A., Raaijmakers, T.C., Vries de M.B AND Koningsveld van M (2017). Eco-friendly design of scour protection: potential enhancement of ecological functioning in offshore wind farms. [online] Available at: http://edepot.wur.nl/411374 (Accessed April 2019)

34 Welsh Government (2016a). Environmental (Wales) Act 2016. Section 7 - list of the habitats of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales. [Online] Available at: file:///C:/Users/matthias.thomsen/Downloads/masterss7habitatslistmay%202016.pdf (Accessed April 2019).

35 Welsh Government (2016b). Environment (Wales) Act 2016, Section 7 - list of the living organisms of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales. [Online] Available at: file:///C:/Users/matthias.thomsen/Downloads/master%20s7%20species%20list%20may%202016%20final.pdf (Accessed April 2019).

36 Wyn, G., Brazier, P., Birch, K., Bunker, A., Cooke, A., Jones, M., Lough, N., McMath, A. and Roberts, S., 2006. Handbook for Marine Intertidal Phase 1 Biotope Mapping Survey.

37 Zimmermann, S., Zimmermann, A.M., Winters, W.D. and Cameron, I.L. (1990). Influence of 60-Hz magnetic fields on sea urchin development, Bioelectromagnetics, 11: 37-45.