GREENLINK
MARINE ENVIRONMENTAL IMPACT ASSESSMENT REPORT- IRELAND

P1975_R4500_RevF2
July 2019

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

Greenlink
INTERCONNECTOR

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GLOSSARY

AA
Appropriate Assessment

AADT
Annual Average Daily Traffic

AC
Alternating Current

ADD
Acoustic deterrent device

AER
Annual Environmental Report

AEWA
African-Eurasian Migratory Waterbirds Agreement

AEP
Auditory Evoked Potential

AEZ
Archaeological Exclusion Zone

AIS
Automatic Identification Data

ALARP
As Low As Reasonably Practicable

AQS
Air Quality Standards

BEIS
Department for Business, Energy and Industrial Strategy

B field
Magnetic field

BGS
British Geological Survey

BIM
Bord Iascaigh Mhara (Irish Sea Fisheries Board)

Birds Directive
European Council Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds

BRE
British Research Establishment

Brief Effects
Effects lasting less than a day

BSA
Biologically Sensitive Area

BT
British Telecom

BTO
British Trust for Ornithology

BWD
Directive 2006/7/EC concerning the management of bathing water quality (Bathing Waters Directive)

CA
Crossing Agreement

Campile Estuary
Component of Greenlink where onshore cables cross under the River Campile

CBRA
Cable burial risk assessment

CCME
Canadian Council of Ministers of the Environment

CCW
Countryside Council for Wales

C&D
Construction and Demolition

CD
Chart Datum

CEA
Cumulative Effects Assessment

CEF
Connecting Europe Facility

Cefas
Centre for Environment, Fisheries and Aquaculture Science

CEMP
Construction Environmental Management Plan

CEP
Common Fisheries Policy

CIEEM
Chartered Institute of Ecology and Environmental Management

CIRIA
Construction Industry Research and Information Association

CITES
Convention on International Trade in Endangered Species

CLB
Cable Lay Barge

CLV
Cable Lay Vessel

CMS
Law from used by Greenlink Interconnector Limited

COLREGs
International Regulations for Preventing Collisions at Sea

COMAH
Control of Major Accident Hazards involving Dangerous Substances

CPP
Concept for Public Participation

CPT
Cone Penetration Testing

CRBI
Community Rescue Boats Ireland

CRU
The Commission for Regulation of Utilities

CSO
Central Statistics Office

Cumulative Effects
The combined effect of pressures present to which a specific receptor is sensitive. Cumulative effects result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project.

DAFM
Department of Agriculture, Food and Marine

DAHG
Department of Arts, Heritage and the Gaeltacht

DC
Direct Current

DCCAE
Department of Communications, Climate Action and Environment

DCHG
Department of Culture, Heritage and the Gaeltacht

DDV
Drop-Down Video

DECC
formerly the Department for Energy and Climate Change

DHPLG
Department of Housing, Planning and Local Government

DIO
Defence Infrastructure Organisation

DMRB
Design Manual for Roads and Bridges

DOC
Depth of closure

DP
Dynamic Positioning

EC
European Council

EEZ
Exclusive Economic Zone

Effects
The consequence of pressures, usually measurable. Effects only occur only when an pressure is present within an environment that is sensitive to it

E field
Electric field

EIA
Environmental Impact Assessment

EIAR
Environmental Impact Assessment Report

EIMA
Environmental Management and Assessment

EIS
Environmental Impact Statement

Embedded Mitigation
Refers to primary and tertiary mitigation that form the 'base case' project description assessed for Greenlink.

EMF
Electromagnetic Fields

EMODnet
European Marine Observation and Data Network

EMP
Environmental Management Plan

EPA
Environmental Protection Agency

EPS
European Protected Species – Species of animals or plants listed in Annex II and IV of the Habitats Directive

EQS
Environmental Quality Standards

ES
Environmental Statement

ESB
Electricity Supply Board

ETS
Emissions Trading Scheme

EU
European Union

EUNIS
European Nature Information

EUPCI
European Union Project of Common Interest

FSC
Field Studies Council

FLO
Fisheries Liaison Officer

Foreshore
Defined by the Irish Foreshore Act 1933 as meaning "the bed and shore, below the line of high water of ordinary or medium tides, of the sea and of every tidal river and tidal estuary and of every channel, creek, and bay of the sea or of any such river or estuary" extending out to the 12nm limit.

FOW
Floating offshore wind

GB
Great Britain

GES
Good Environmental Status

GIL
Greenlink Interconnector Limited (the developer of Greenlink)

GPS
Global Positioning Systems

Greenlink
The entire Greenlink Interconnector project, comprising Ireland Onshore, Ireland Offshore, Wales Offshore and Wales Onshore

GSI
Geological Society of Ireland

Habitats Directive
European Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora

HDD
Horizontal Directional Drilling

HRA
Habitats Regulation Assessment

HV
High Voltage

HVAC
High Voltage Alternating Current

HVDC
High Voltage Direct Current

IAQM
Institute of Air Quality Management

ICPC
International Cable Protection Committee

ICES
International Council for the Exploration of the Sea

iE
Induced Electric Fields

IEC
International Electro-technical Commission

IEMA
Institute of Environmental and Assessment

IHLS
International Herring Larvae Survey

IMO
International Marine Organisation

Impact
The consequence of the pressure; a predicted change in the baseline environment.

In-combination Effects
Similar to Cumulative Effects but it describes the effect of a pressures present from the plan or project acting with pressures from other plans or projects

Indirect Effects
Effects, which are not a direct result of the project, often produced away from or as a result of a complex pathway

INFOMAR
Integrated Mapping for the Sustainable Development of Ireland's Marine Resource

INSN
Irish National Seismic Network

Interaction
The link between a pressure and the receptor. There must be an interaction for an impact to occur.

Intertidal
The area between mean high-water springs and mean low water springs

IPA
Initial Project Assessment

INS
International Navigation System

IRCG
Irish Coast Guard

ISA
Irish Sailing Association

ISQG
Interim marine sediment quality guidelines

IS cables
In Service

IS&EFPO
Irish South and East Fish Producers Organisation

IS&WFPO
Irish South and West Fish Producers Organisation

IUCN
International Union for Conservation of Nature

IWDG
Irish Whale and Dolphin Group

IWDS
Irish Whale and Dolphin Society

I-WeBS
Irish Wetland Bird Survey

IWS
Irish Water Safety

JNCC
Joint Nature Conservation Committee

JUB
Jack-up barge

KIS-ORCA
The Kingfisher Information Service - Offshore Renewable & Cable Awareness project

KPs
Kilometre Points

LAT
Lowest Astronomical Tide

Long-term Effects
Effects lasting fifteen to sixty years

LSA
Land service ammunition

LWM
Low Water Mark

Marine Ireland
Component of Greenlink from mean high-water springs at Baginbun Beach to 12nm limit

Marine Wales
Component of Greenlink from mean high water springs at Freshwater West to UK/ Republic of Ireland median line.

MarLIN
Marine Life Information Network

MARPOL
International Convention for the Prevention of Pollution from Ships

MBES
multi-beam echo sounder

MCA
Maritime and Coastguard Agency

MCAA
Marine and Coastal Access Act

MCZ
Marine Conservation Zone

Median line
The boundary between two adjacent countries' Exclusive Economic Zones (offshore waters).

Medium-term Effects
Effects lasting seven to fifteen years

META
Marine Energy Testing Area

MFE
Mass Flow Excavation

MGN
Marine Guidance Notice

MHPA
Milford Haven Port Authority

MHWS
Mean High Water Springs

MI
Marine Institute

Mitigation
means primary (inherent design), secondary (foreseeable) and tertiary (inexorable) measures as defined by IEMA (2016)

MLWS
mean low water springs

MMO
Marine mammal observer

MNCR
Marine Nature Conservation Recorder

MoD
Ministry of Defence

Momentary Effects
Effects lasting from seconds to minutes

MPS
Marine Policy Statement

MSFD
Marine Strategy Framework Directive 2008/56/EC establishing a framework for community action in the field of marine environmental policy

MSL
Mean Sea Level

MSP
Marine Spatial Plan

MU
Management unit

MW
Megawatt

MWR
Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended)

NATO
North Atlantic Treaty Organisation

Natura 2000
The European network of nature conservation areas, including special areas of conservation, and special protection areas under the Birds Directive, provided for by Article 3(1) of the Habitats Directive

Nautical miles
International measurement equivalent to 1,852 metres

NAVAREA
The geographic areas in which various governments are responsible for navigation and weather warnings.

NAVTEX
Navigational Telex is an international automated medium frequency direct-printing service for delivery of navigational and meteorological warnings and forecasts, as well as urgent maritime safety information (MSI) to ships

NBDC
National Biodiversity Data Centre

NCA
National Competent Authority

Nearshore
The area between mean low water springs and the 10m depth contour

NFFO
National Federation of Fishermen's Organisations

NGET
National Grid Electricity Transmission plc

NHA
Natural Heritage Area

NIS
Natura Impact Statement

NMFS
American National Marine Fisheries Service

NMS
National Monuments Service

NNS
northern North Sea

NPWS
National Parks and Wildlife Service

NRA
Navigation Risk Assessment

NRW
Natural Resources Wales

NtM
Notice to Mariners

NTS
Non-Technical Summary

OD
Ordnance Datum

OESEA
Offshore Energy Strategic Environmental Assessment

Offshore Ireland
Component of Greenlink from 12nm limit to UK/Republic of Ireland median line

Offshore waters
The exclusive economic zone i.e. from the seaward limit of the territorial waters to the median line.

Ofgem
Office of Gas and Electricity Markets

OGA
Oil and Gas Authority

OMR
The Conservation of Offshore Marine Habitats and Species Regulations 2017

Onshore Ireland
Component of Greenlink from converter station at Great Island to mean high water springs at Baginbun Beach.

Onshore Wales
Component of Greenlink from converter station at Pembroke to mean high water springs at Freshwater West

OOS
Out Of Service

OPW
Office of Public Works

OREDP
Offshore Renewable Energy Development Plan

OSPAR
Convention for the Protection of the Marine Environment of the North-East Atlantic

OWEZ
Offshore Windpark Egmond aan Zee

PAD
Protocol for Archaeological Discoveries

PAH
Polycyclic aromatic hydrocarbons

PAM
Passive Acoustic Monitoring

PCB
Polychlorinated Biphenyl

PCE
Potential cumulative effects

PCI
Project of Common Interest

PLB
Post lay burial

PLGR
pre-lay grapnel run

PoWC
Port of Waterford Company

p-p
Peak-to-peak sound pressure

PPW
Planning Policy Wales

Pressure
the mechanism through which an activity has an effect on any part of an ecosystem. Pressures can be physical, chemical or biological, and can be created by different activities or drivers. The OSPAR Intercessional Correspondence Group on Cumulative Effects (ICG-C) prepared a list of marine pressures and their descriptions (OSPAR Commission 2011) which have been used in the preparation of the EIAR.

Primary Mitigation
Modifications to the location or design of the development made during the pre-application phase that are an inherent part of the project, and do not require additional action to be taken. Referred to as 'Embedded Mitigation' in the EIAR.

Project Specific Mitigation
Secondary mitigation identified as a consequence of the EIA process to reduce or avoid the significance or likelihood of adverse effects.

Proposed Development
The components of Greenlink that fall within the jurisdiction of a specific consenting or competent authority.

PS
Project Specific

PSA
Particle Size Analysis

PTS
Permanent threshold shift

PWA
Protection of Wrecks Act 1973

RAC
Royal Armoured Corps

RAG
Regulatory Advisory Group

Ramsar
Ramsar sites are wetlands of international importance designated under the Ramsar Convention

RBMP
River Basin Management Plans

RDP
Redox potential discontinuity

Receptor
Any ecological or other specific feature that is sensitive to or has the potential to be affected by a pressure (IEEM 2010)

Residual Effect
The degree of environmental change that will occur after the proposed mitigation measures have taken effect

Resilience
The ability of an ecosystem to return to its original state after being disturbed (from Makins, 1991) (cf. 'constancy', 'persistence', 'stability').

Resistance
The degree to which a variable is changed following perturbation (Pimm, 1984). The tendency to withstand being perturbed from the equilibrium (Connell & Sousa, 1983). (cf. 'Stability'; 'adjustment stability').

Reversible Effects
Effects that can be undone, for example through remediation or restoration

RIFF
Regional Inshore Fisheries Forum

rms
Root mean square

RNLI
Royal National Lifeboat Institution

Routeing
The selection of the preferred cable route, having regard to engineering, environmental and other constraints

ROI
Republic of Ireland

ROV
Remotely Operated Vehicle

RSG
Rural Steering Group

RSPB
Royal Society for the Protection of Birds

RYA
Royal Yachting Association

SAA
Small arms ammunition

SAC
Special Area of Conservation

SBP
Sub-bottom profiler

SCI
Site of Community Importance

SDA
Sea Danger Area

SEA
Strategic environmental assessment

SEACAMS
A collaborative project between Bangor, Swansea and Aberystwyth Universities

Secondary mitigation
Actions that will require further activity in order to achieve the anticipated outcome. These may be imposed as part of the planning consent, or through inclusion in the environmental reporting. They tend to operate in the middle of the mitigation hierarchy, focusing on reducing the significance or likelihood of adverse effects. They are referred to as Project Specific Mitigation in the EIAR.

SEL
Sound Exposure Levels

Sensitivity
An assessment of the intolerance of a species or habitat to damage from an external factor and the time taken for its subsequent recovery. For example, a very sensitive species or habitat is one that is very adversely affected by an external factor arising from human activities or natural events (killed/destroyed, 'high' intolerance) and is expected to recover over a very long period of time, i.e. >10 or up to 25 years ('low'; recoverability). Intolerance and hence sensitivity must be assessed relative to change in a specific factor.

SERIFF
South East Regional Inshore Fisheries Forum

SFWD
Directive 2006/113/EC on the quality required of shellfish waters (Shellfish Waters Directive)

SID
Strategic Infrastructure Development

Short-term Effects
Effects lasting one to seven years

SL
Source level

SLR
Sea level rise

SNH
Scotland Natural Heritage

SNS
Southern North Sea

SOLAS V
International Convention for the Safety of Life at Sea

SOPEPs
Shipboard oil pollution emergency plans

SPA
Special Protection Area

SPL
Sound Pressure Levels

SPM
Suspended particulate matter

SSB
Spawning stock biomass

SSS
Side Scan Sonar

SSSI
Site of Special Scientific Interest

STECF
Scientific, Technical & Economic Committee for Fisheries

TAC
Total Allowable Catches

TBT
Tributyltin

Temporary Effects
Effects lasting less than a year

TEN-E
Regulation (EU) No 347/2013 guidelines for Trans-European Network for Energy

Territorial waters
Waters within 12 nautical miles of the coastline

Tertiary mitigation (inexorable)
Actions that would occur with or without input from the EIA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effect. This can be identified at any point during the design and EIA process. They are referred to as 'Embedded Mitigation' in the EIAR.

TII
Transport Infrastructure Ireland

TJB
Transition Jointing Bay

TJP
Transition joint pit

Transboundary Effects
Effects from a project that cross an international boundary.

TSHD
Trailing suction hopper dredger

TSS
Traffic separation scheme

TTS
Temporary threshold shift

UAIA
Underwater archaeological impact assessment

UAU
Underwater Archaeology Unit

UAV
Unmanned autonomous vehicle

UKHO
UK Hydrographic Office

UXO
Unexploded Ordnance

UXBs
Unexploded Bombs

VC
Vibrocore

VMS
Vessel Monitoring Systems

VSC
Voltage Source Conversion

WCC
Wexford County Council

WeBS
Wetland Bird Survey

WFA
Welsh Fisherman's Association

WFD
Water Framework Directive 2000/60/EC establishing a framework for Community action in the field of water policy

WMFAG
Welsh Marine Fisheries advisory Group

WNMP
Welsh National Marine Plan

Wrapper document
A document which summarises all four components of the planning application (Welsh Onshore, Welsh Marine, Irish Marine, Irish Onshore), will be prepared and will be available online at www.greenlink.ie. to aid consultation and wider understanding of Greenlink

WSI
Written Scheme of Investigation

XLPE
Cross-linked polyethylene

ZOI
Zone Of Influence - The spatial extent over which an activity is predicted to have an impact on the receiving environment.

1. Introduction

This Environmental Impact Assessment Report (EIAR) documents the Environmental Impact Assessment (EIA) process and conclusions as carried out in support of an application for consent to install, operate, maintain and eventually decommission an electricity interconnector linking the existing electricity grids in Great Britain (GB) and Ireland.

1.1 The Proposed Development

Greenlink Interconnector Limited (**GIL**) is proposing to develop an electricity interconnector (**Greenlink**) linking the existing electricity grids in GB and Ireland (Figure 1-1). 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).

Greenlink 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 (CEF).

In Ireland, Greenlink's connection application is being progressed by EirGrid (the transmission network operator). Greenlink anticipates that EirGrid will issue a formal connection offer for a grid connection to the existing Great Island substation in summer 2019.

In Wales, a connection agreement has been signed with National Grid Electricity Transmission plc for a grid connection at the existing Pembroke substation.

This EIAR covers the Irish Marine components of Greenlink from mean high-water springs (MHWS) at the Irish landfall at Baginbun Beach, County Wexford out to the 12nm territorial limit, a distance of 35.65km with an average width of 500m. 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.

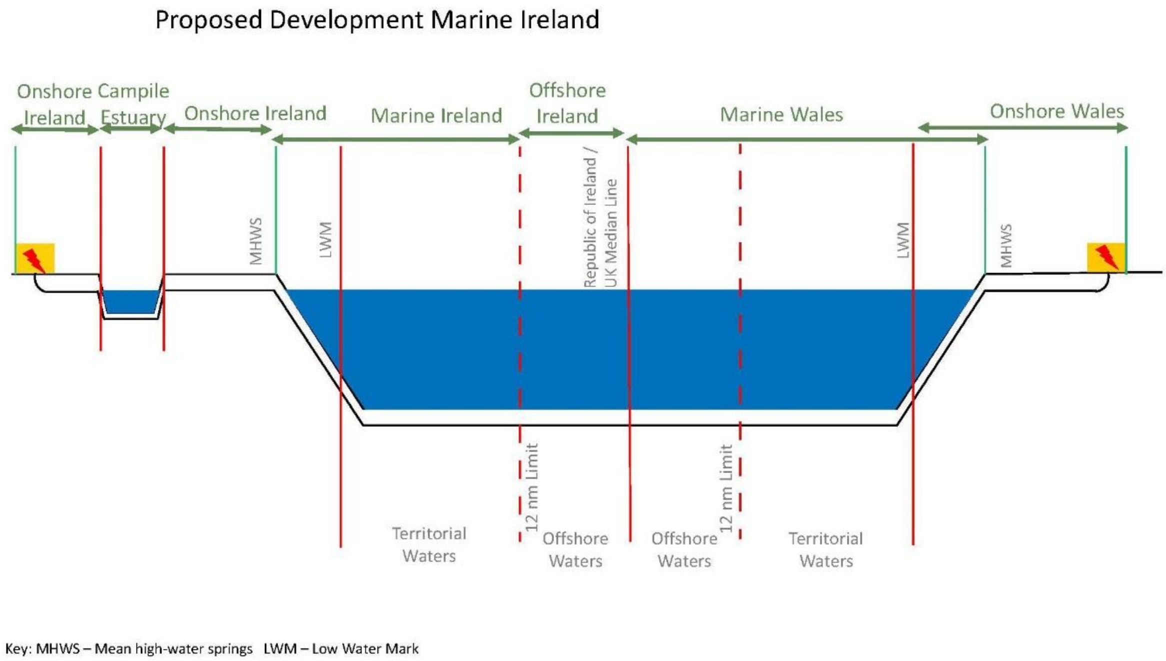
The location of Greenlink is illustrated in Figure 1-2 (Drawing P1975-LOC-001). The Proposed Development is illustrated in Figure 1-3 (Drawing P1975-CORR-002).

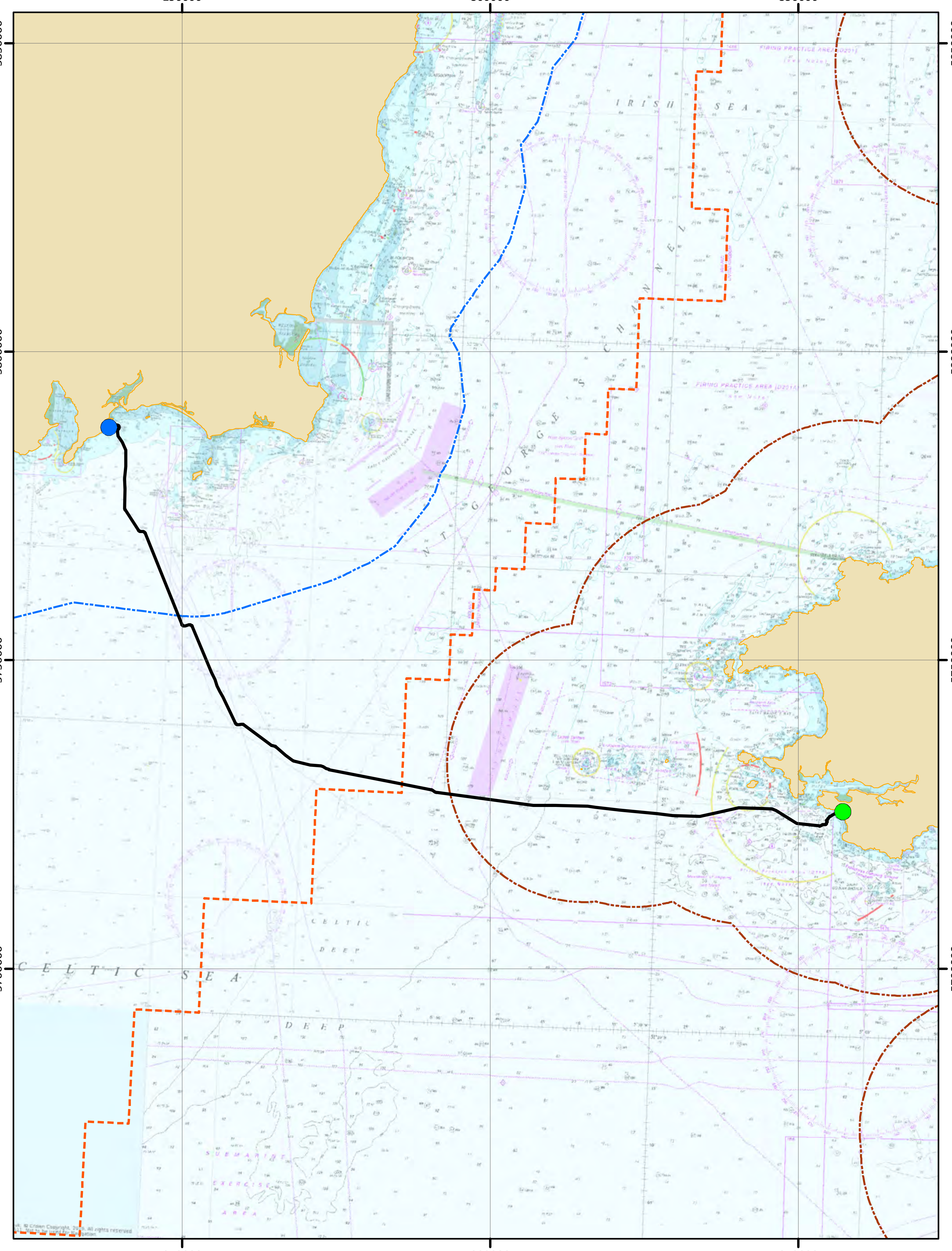
This EIAR also provides information on the Campile Estuary and Irish Offshore components of Greenlink from the 12nm territorial limit to the Ireland/UK median line.

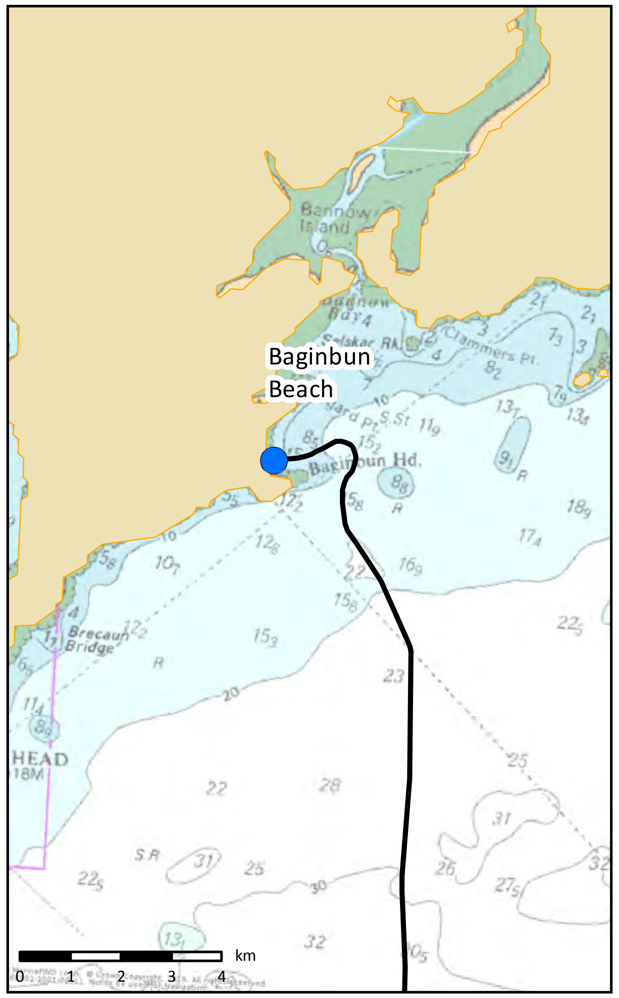
Separate EIARs will be prepared which cover individually the Welsh Onshore; the Irish Onshore; the Welsh Marine (the submarine route from the Ireland/UK median line to MHWS at the Welsh landfall at Freshwater West, Pembrokeshire); and the the Irish Marine (the submarine route from MHWS at the Irish landfall 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). These include a full cumulative effects assessment of all five components of the project. Chapter 16 of this EIAR includes the cumulative assessment for the Proposed Development and Campile Estuary. As the EIARs are submitted they will be available online at www.greenlink.ie. The boundaries of the individual components described above are shown in Figure 1-1.

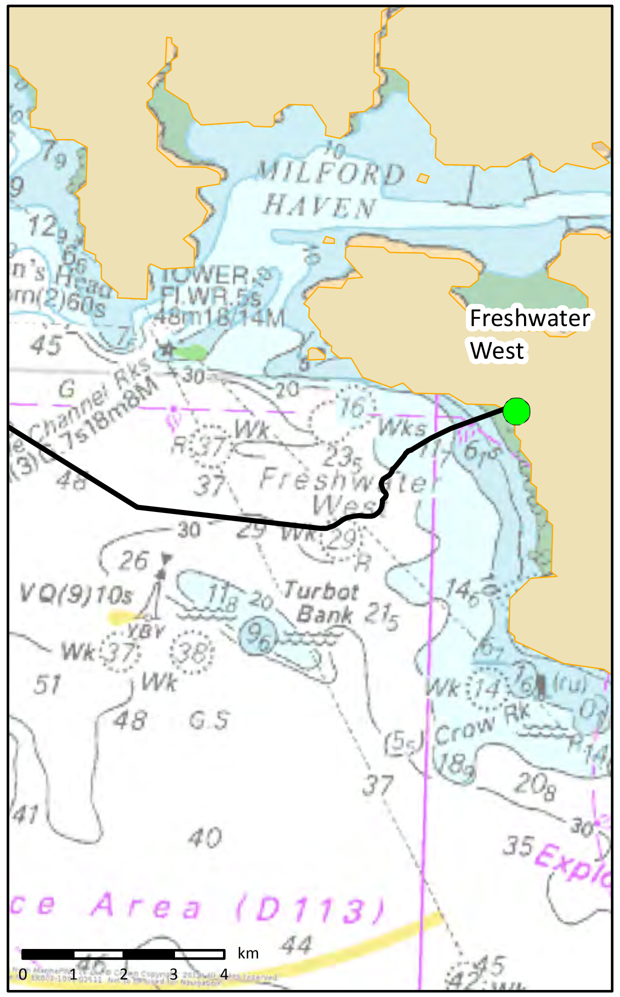
A wrapper document which summarises all components of the planning application (Welsh Onshore, Welsh Marine, Irish Offshore, Irish Marine, Irish Onshore), will be prepared and will be available online at www.greenlink.ie once all planning applications have been submitted.

Figure 1-1 Components of Greenlink









GREENLINK INTERCONNECTOR

ROUTE OVERVIEW

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

Legend

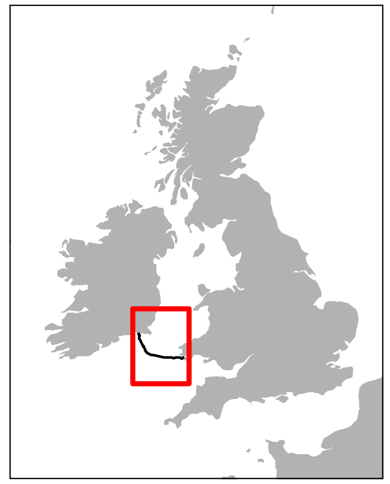
Landfall

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

Administrative Boundaries

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

N E S W



NOTE: Not to be used for Navigation

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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

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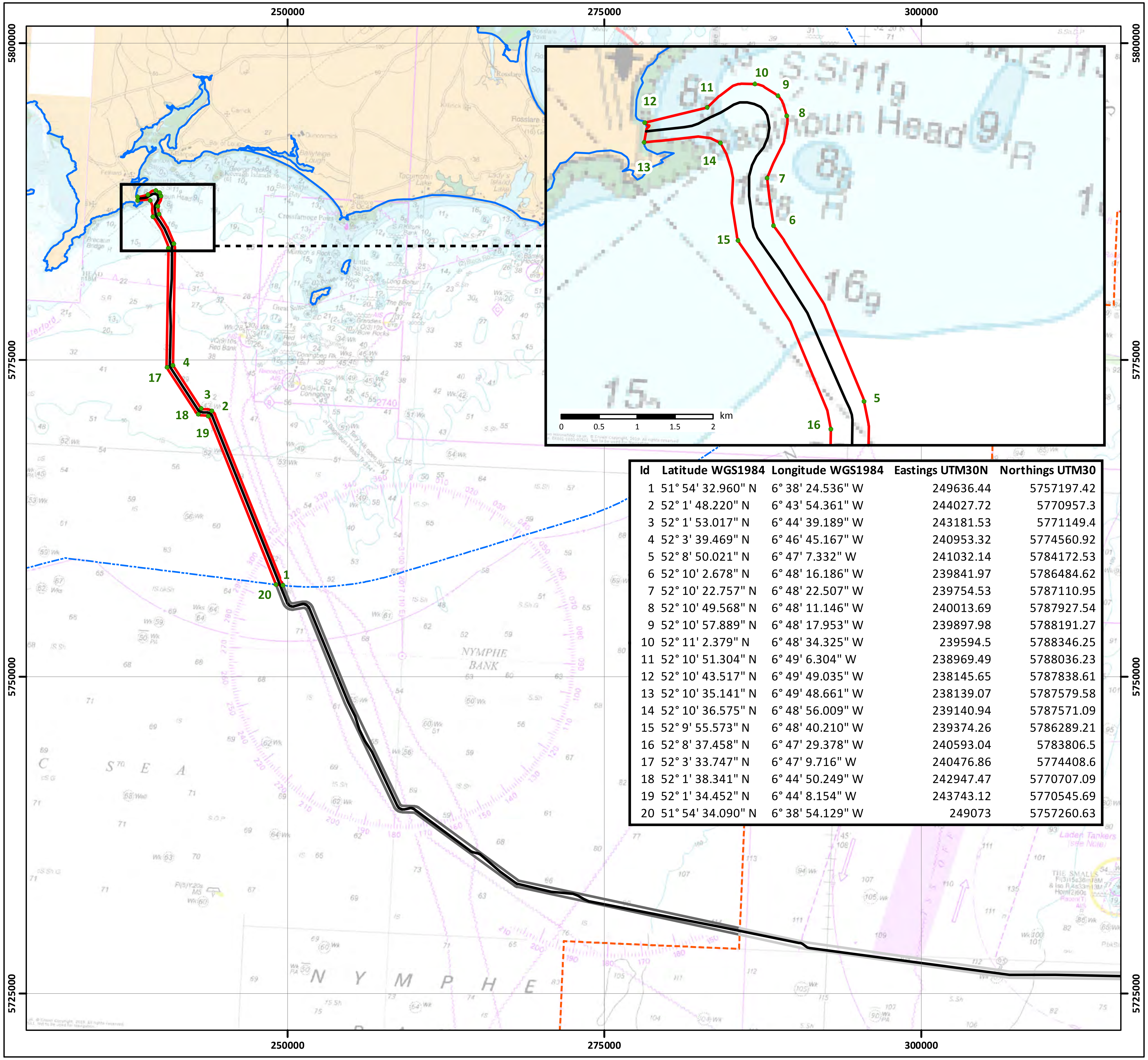
intertek

0 10 20 30 40 km



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2	52° 1' 48.220" N	6° 43' 54.361" W	244027.72	5770957.3
3	52° 1' 53.017" N	6° 44' 39.189" W	243181.53	5771149.4
4	52° 3' 39.469" N	6° 46' 45.167" W	240953.32	5774560.92
5	52° 8' 50.021" N	6° 47' 7.332" W	241032.14	5784172.53
6	52° 10' 2.678" N	6° 48' 16.186" W	239841.97	5786484.62
7	52° 10' 22.757" N	6° 48' 22.507" W	239754.53	5787110.95
8	52° 10' 49.568" N	6° 48' 11.146" W	240013.69	5787927.54
9	52° 10' 57.889" N	6° 48' 17.953" W	239897.98	5788191.27
10	52° 11' 2.379" N	6° 48' 34.325" W	239594.5	5788346.25
11	52° 10' 51.304" N	6° 49' 6.304" W	238969.49	5788036.23
12	52° 10' 43.517" N	6° 49' 49.035" W	238145.65	5787838.61
13	52° 10' 35.141" N	6° 49' 48.661" W	238139.07	5787579.58
14	52° 10' 36.575" N	6° 48' 56.009" W	239140.94	5787571.09
15	52° 9' 55.573" N	6° 48' 40.210" W	239374.26	5786289.21
16	52° 8' 37.458" N	6° 47' 29.378" W	240593.04	5783806.5
17	52° 3' 33.747" N	6° 47' 9.716" W	240476.86	5774408.6
18	52° 1' 38.341" N	6° 44' 50.249" W	242947.47	5770707.09
19	52° 1' 34.452" N	6° 44' 8.154" W	243743.12	5770545.69
20	51° 54' 34.090" N	6° 38' 54.129" W	249073	5757260.63

GREENLINK INTERCONNECTOR
PROPOSE DEVELOPMENT
ROI Waters

Drawing No: P1975-CORR-002 | A

Legend

- Application Area Points
- Greenlink Route Centreline (Indicative)
- Proposed Development
- Irish Offshore
- Wales Marine
- ROI Mean High Water
- ROI 12nm Territorial Sea Limit
- Median Line

N W E S

NOTE: Not to be used for Navigation

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Data Source	DCCAE; OSI; CDA; GEBCO; UKHO; MarineFind
File Reference	J:\P1975\Mxd\03_CORR\ P1975-CORR-002.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Greenlink

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intertek

0 3 6 9 12 km

1.2 The Aim of the Document

The aim of the EIAR is to present, in a logical and comprehensive fashion, the findings and outcomes of the EIA.

The EIA process follows a systematic approach to assess the potential pressures and subsequent effects of a project on the environment in a robust and transparent manner. There are three stages to the process: screening, scoping and assessment (described fully in Chapter 5).

The focus of the EIA and subsequent EIAR was developed during the Scoping phase of the process, in consultation with statutory and non-statutory stakeholders. The EIAR encompasses all aspects of the environment where it is considered there could be a potential effect but focuses in more detail on topics which were highlighted by stakeholders.

The Scoping Report (Intertek EWCS 2018) is available online at www.greenlink.ie. All scoping comments received from stakeholders throughout the EIA process up to submission of the EIAR are summarised at the start of each relevant topic chapter.

1.3 Statutory Consents and Permissions

The EIAR will be submitted to the Foreshore Unit in line the Irish Foreshore Acts 1933 – 2011 in support of an application for a Foreshore Licence.

Further details of the other consents that will be required, consenting process and legislation that GIL will comply with is provided in Chapter 2.

1.4 The Developer

The Greenlink project is being developed by Greenlink Interconnector Limited, which is owned jointly by Element Power Holdings, part of Hudson Sustainable Investment, and Partners Group on behalf of its clients. Hudson Sustainable Investment is an independent investment management firm with a strong track record and expertise in investing in and developing sustainable energy infrastructure projects in Ireland, the UK and internationally. Partners Group is a global private markets investment management firm with €73 billion in investment programs under management in private equity, private real estate, private infrastructure and private debt.

1.5 The Project Team

The GIL team is highly experienced in the project development and construction of electricity interconnectors. The team has been supported during the EIA process by a number of specialist contractors.

Intertek Energy & Water Consultancy Services (Intertek EWCS) is the lead EIA manager for the marine components of Greenlink assisting GIL with data collection, analysis and interpretation in support of route development, consenting and mitigation.

Intertek EWCS is part of the part of Intertek Group plc, a FTSE 100 listed company quoted on the London Stock Exchange. Previously Metoc, Intertek EWCS has been operating since 1983, providing specialist technical services in the marine, coastal and river environments. The company has considerable experience in undertaking interconnector route development and EIAs and managing supporting surveys, and has led the environmental assessment process on ten of the interconnectors that connect into the UK. In addition, the company has worked on all other interconnectors that are constructed or proposed connecting into Ireland (East-West Interconnector and Celtic Interconnector).

Specialist technical input has been provided by the following consultants:

- MMT – marine cable route survey
- Cotswold Archaeology – marine archaeology
- 1st Line Defence – unexploded ordnance
- MarineSpace Ltd – commercial fisheries
- Arup – onshore environmental consultants

A full list of technical experts who were involved in compiling the EIAR are provided in Technical Appendix B.

1.5.1 Structure of the Environmnetal Impact Assessment Report

The EIAR comprises 18 chapters, a stand-alone Non-Technical Summary (NTS) document and 12 Technical Appendices.

The EIAR is structured as outlined in Table 1-1. Topics are discussed in full within each chapter in a consistent and sequential manner i.e. each environmental receptor chapter describes the baseline, impact assessment, mitigation measures and conclusions for the receptor. For each topic receptor the baseline is described in sequence following the Proposed Development from the landfall to the median line.

Technical Appendix provides a full list of all technical experts who contributed to each chapter.

The Greenlink Marine Natura Impact Statement is provided as a separate document that accompanies the EIAR.

Table 1-1 Structure of the EIAR

Chapter	Title	Content
0	Non-Technical Summary	The aim of the NTS is to enable communication with those unfamiliar with the EIA process and terminology by summarising the key findings of the EIAR in simple terms.
1	Introduction	An introduction describing the developer, the content of the EIAR and summarising the Proposed Development.
2	Policy and Legislative Framework	A description of the legislative frameworks which govern the Proposed Development and the EIA process.

Chapter	Title	Content
3	Development of the Project and Alternatives	This chapter outlines the need for the interconnector, and why the Proposed Development is preferable to alternative options.
4	Project Description	A description of the Proposed Development in terms of the activities that will be undertaken and emissions to the environment during construction and operation of Greenlink. This chapter also presents embedded mitigation; measures which are an inherent part of the design of the Proposed Development (primary mitigation); and actions that will be undertaken to meet existing legislative requirements and are considered to be standard practice (tertiary mitigation).
5	Impact Assessment Methodology	A description of the process followed when conducting the EIA. This chapter also presents an overview of the results of the scoping consultation and summarises the technical studies and specific surveys that have been undertaken to inform the EIA.
6	Physical Conditions and Marine Processes	These chapters describe the physical, biological and human baseline environment in the Proposed Development including identification of key receptors and their sensitivity to possible effects. The findings of the EIA process are reported, which takes into consideration the nature, magnitude, duration of the potential effects in order to determine their significance. If necessary, secondary mitigation (Project Specific Mitigation) measures to avoid, reduce or remedy the effects identified are described. The chapters are informed by the relevant studies and surveys undertaken for the Proposed Development.
7	Benthic and Intertidal Ecology	
8	Fish and Shellfish	
9	Birds	
10	Marine Mammals and Reptiles	
11	Protected Sites	
12	Commercial Fisheries	
13	Shipping and Navigation	
14	Infrastructure and Other Users	
15	Marine Archaeology	
16	Cumulative and Transboundary Effects	Possible effects from Greenlink and the Proposed Development in combination with other power cable developments as well as other types of development in the vicinity have been assessed and are presented.
17	Schedule of Mitigation	This chapter outlines the embedded (primary and tertiary mitigation) and Project Specific Mitigation (secondary mitigation) measures proposed in the assessment.
18	Conclusions	This chapter provides overall conclusions on the significance of any effects, proposed mitigation and how measures will be implemented.
Appendix A	Meetings held with Irish stakeholders to inform Proposed Development and EIAR	
Appendix B	Competent Experts	
Appendix C	Noise Assessment	
Appendix D	Herring Spawning and Sandeel Assessment	
Appendix E	Commercial Fisheries Assessment	
Appendix F	Marine Archaeology Technical Report	
Appendix G	Geophysical Survey Report	
Appendix H	Environmental Survey Report	
Appendix I	Intertidal Habitat Survey Report	

Chapter	Title	Content
Appendix J	Marine Detailed UXO Risk Assessment	
Appendix K	Magnetic Fields and the Induced Voltages caused by the Greenlink HVDC Circuit	
Appendix L	Welsh and Irish Landfall Final Selection Report	

1.6 Sources of Data and Information

The information contained within this EIAR has been drawn from existing literature, project-specific data, personal communications with local experts and statutory bodies and site-specific studies and surveys commissioned for the Proposed Development. Every effort has been made to obtain data concerning the existing environment and to accurately predict the likely environmental effect of the Proposed Development. Assumptions adopted in the evaluation of the effects are reported in the relevant sections.

Key literature sources used in the EIA process are listed at the beginning of each section; and referenced throughout the topic chapters. Specialist studies and surveys have also been carried out to inform the EIA process. These are listed in Table 1-2.

The data collected throughout these assessments and surveys have been used to define the baseline conditions – against which effects have been measured and predicted, in turn helping to define the mitigation measures required. More information on these studies is provided in the relevant chapters of the EIAR.

Table 1-2 Specialist studies

Document	Author
Greenlink Marine Natura Impact Statement	Intertek EWCS
Greenlink Cable Route Survey: Geophysical & Geotechnical Report - Offshore	MMT
Greenlink Cable Route Survey: Geophysical & Geotechnical Report – Nearshore	MMT
Greenlink Cable Route Survey: Environmental Survey Report	MMT
Phase 1 Intertidal surveys: Freshwater West and Baginbun Beach	MarineSpace
Greenlink – Marine Archaeology Technical Report	Cotswold Archaeology
Greenlink Interconnector Commercial Fisheries Assessment	MarineSpace
Greenlink - Detailed Unexploded Ordnance (UXO) Risk Assessment	1st Line defence
Greenlink Cable Burial Risk Assessment	Intertek EWCS
Greenlink Welsh and Irish Landfall Final Selection Report	Intertek EWCS
Greenlink Route Development Report	Intertek EWCS
Greenlink Trenching Analysis	Intertek EWCS

Document	Author
Greenlink Landfall HDD Report	Arup
Greenlink Winter Bird Counts	Arup
Campile River Estuary Crossing and Baginbun Beach Ecology Survey Report	Dixon.Brosnan
Magnetic Fields and the Induced Voltages caused by the Greenlink HVDC Circuit	WSP

1.7 Consultation

GIL has taken a pro-active approach to consultation, recognising that it is a critical activity in the development or a comprehensive and balanced EIA.

GIL opened discussions in 2015 with the DHPLG Foreshore Unit, National Parks & Wildlife Service, local planning authorities, and other non-statutory stakeholder groups. In November 2018, GIL submitted a scoping report to consult with statutory consultees and other interested parties on the approach to, and scope of, a voluntary Environmental Impact Assessment of the proposed installation, operation and maintenance of the Greenlink Interconnector in Irish Waters.

In total, 11 stakeholders were asked for opinions on the proposed approach to, and scope of the EIA as outlined in a Scoping Report. The aim of the scoping process was to assist GIL in identifying the key environmental issues surrounding their proposal. It also provided stakeholders with an opportunity to comment on the Proposed Development, the scope of the EIA and raise any issues which they consider may be important to the EIA process. All comments and data received during the Scoping exercise has been used in the EIA process and has helped provide direction on the topics the EIA focuses on. Further details of the Scoping stage, including a list of stakeholders involved in the process is provided in Chapter 5.

As a promoter of a European PCI project GIL is also required to conduct public and stakeholder consultation meetings through a variety of means set out in Annex IV(5) - No 347/2013 Guidelines for Trans-European Energy Infrastructure (PCI Regulation). Wider public participation was achieved through:

- Regular updates to Project Website (www.greenlink.ie)
- Public consultation meetings
- Provision of public information brochure (TEN-E Regulation Information Brochure) – published before the start of formal public consultation and updated throughout the development process.

Comments received through the public meetings have also been considered in the preparation of this EIAR. Further details on the public consultation is provided in Chapter 5.

1.8 Availability of EIAR

The full EIAR, the NTS, Technical Appendices and Greenlink Marine Natura Impact Statement are available in electronic copy on request or are available for download from the Greenlink website.

To request a digital copy please contact GIL at:

Intertek EWCS, Exchange House, Station Road, Liphook, Hampshire, GU30 7DW, UK

Email: energy.water.bst@intertek.com

Website: www.greenlink.ie

REFERENCES

1 Intertek EWCS (2018). Greenlink Interconnector Environmental Scoping Report – Republic of Ireland Marine Route. P1975F_R4102_RevF1_20181108

2. Policy and Legislative Framework

This Chapter provides a description of the key European, National and Local Energy and Planning Policies which support the 'Need' for Greenlink (further described in Chapter 3) and the Proposed Development; and the marine planning policy in the Republic of Ireland. It also sets out the legislative framework and marine licensing and permitting requirements that apply to the installation, repair and maintenance, operation and decommissioning of Greenlink.

2.1 Energy Policy

This section summarises the planning policies that support the development of the Proposed Development. Greenlink has been awarded Project of Common Interest (PCI) status by the European Commission, making it one of Europe's most important energy infrastructure projects and granting it the "highest national significance" possible.

2.1.1 European policy

The 'Energy Union' launched by the European Commission in February 2015, and endorsed by Member States in October 2015, is driving a fundamental transition towards more innovative ways to produce, transport and consume energy, and to address different approaches to design, implement and, where needed, enforce energy policy. A range of actions will be required to make this happen, including improvements to the physical interconnectedness of energy grids (both gas and electricity) to meet a 10% interconnection target by 2020 and to possibly reach 15% by 2030. As of November 2017, 17 EU Member States have reached the 10% target, with a further 7, including Ireland, on the path to reach the target by 2020 (European Commission 2017).

An interconnected European energy grid is vital for Europe's energy security, for more competition in the internal market resulting in more competitive prices, and for better achieving the decarbonisation and climate policy targets, to which the European Union (EU) has committed. An interconnected grid will help to deliver the ultimate goal of the Energy Union i.e. to ensure affordable, secure and sustainable energy, as well as growth and jobs across Europe.

There is broad consensus that, in a post-Brexit world, the efficient cross-border trade in electricity between the UK and the EU should continue. The UK government has stated its commitment to mechanisms to achieve this (BEIS 2019).

This was confirmed by the Irish utility regulator (the Commission for Regulation of Utilities Water and Energy, CRU) when in October 2018 it determined, after a detailed consultation, that Greenlink is in the public interest, with "the potential to provide a net benefit to Irish consumers and Ireland as a whole."

The CRU's analysis included modelling of Brexit sensitivities and concluded that under Brexit "introducing a new interconnector may unlock more benefits to Irish consumers compared to a no Brexit scenario where no trading frictions are present." The CRU explained: "this is because the addition of Greenlink in a market with trading frictions provides an additional link to import/export route and hence consumers are better off than without the addition of a new interconnector." (CRU 2018)

Whether there is a 'hard' or 'soft' Brexit Greenlink will not only remain economically viable, but will continue to offer benefits to both Ireland and the UK in the shape of increased energy security, decarbonisation and downward pressure on consumer bills (CRU 2018).

Whatever the future holds, Greenlink will be an example of how the UK and Ireland can continue to work positively and profitably together to meet their energy and economic objectives.

2.1.1.1 PCI Regulation: Regulation (EU) No 347/2013

In 2013, the EU adopted Regulation (EU) No 347/2013 on Guidelines for Trans-European energy infrastructure (PCI Regulation). The PCI Regulations set out guidelines for streamlining the permitting processes for major energy infrastructure projects that contribute to European energy networks. These are referred to as Projects of Common Interest (PCIs).

The EU identified 248 energy infrastructure projects in the first PCI list. These PCI projects encompassed a range of network development, smart grids, energy storage and interconnector projects involving two or more EU Member states. To ensure effective and efficient implementation of the projects, the European Commission is focusing on improving regional cooperation between Member States as part of the implementation of the PCI Regulations.

Greenlink achieved PCI status in November 2017.

The PCI Regulation requires that each Member State assign a single co-ordinating authority, also known as the National Competent Authority (NCA), as being responsible for facilitating and coordinating the permit granting process for projects within that Member State, and to co-ordinate with other NCA's on PCI projects. In the Republic of Ireland, the NCA is An Bord Pleanála. The PCI Regulation requires that PCI projects are given to be 'priority status' at a national level to ensure rapid administrative treatment. To address this An Bord Pleanála will be required to issue a Schedule of Permit Granting Process for Greenlink which outlines the 'in principle' timeline for the permit granting process to be followed by competent authorities. An Bord Pleanála is responsible for ensuring that this schedule is complied with.

Article 10(4)(a) of the PCI Regulation requires the NCA to identify the scope of material and level of detail of information to be submitted by the project proponent, as part of the application for the comprehensive decision (i.e. the "decision or set of decisions taken by a Member State authority or authorities that determines whether or not a project promoter is to be granted authorisation to build the energy infrastructure to realise a project”), which includes for the Foreshore License.

Article 10(4)(c) of the PCI Regulation requires the project proponent to submit a “draft application file” to the NCA. The project proponent is also required to make the “draft application file” available to consultees and the public for comment. Following receipt of the file, the NCA are required to identify whether information is missing and inform the project proponent of omissions.

The Schedule of Permit Granting Process provides that the NCA (in this case, An Bord Pleanála) will confirm that the “final application file” can be submitted within 3 months of receipt of the “draft application file” or the submission of missing information.

GIL has been advised that the project categories listed in the EIA Directive must be understood by reference to a wide scope and broad purpose. GIL is therefore following the EIA process for all project components.

This Environmental Impact Assessment Report (EIAR) has been prepared to accompany a Foreshore License application (see Section 2.3.1 below) which will form part of the ‘Draft Application File’ and ‘Final Application file’.

Specific requirements of the PCI Regulation include guidelines for public participation. Annex IV(5) specifies that at the least the following should be undertaken:

- Publish an information leaflet, giving, in a clear and concise manner, an overview of the purpose and preliminary timetable of the project, the national grid development plan, alternative routes considered, expected impacts, including of cross-border nature, and possible mitigation measures, which shall be published prior to the start of the consultation.
- Establish a project website;
- Inform all stakeholders affected about the project through the project website;
- Invite relevant affected stakeholders to dedicated meetings, during which concerns shall be addressed; and
- Undertake at least one public consultation before submission of the “draft application file”.

GIL has complied with these requirements, details of which can be found on the project website: www.greenlink.ie.

2.1.2 Irish policy

On 6 July 2018 the Irish Department of Communications, Climate Action and Environment (DCCAE) published its National Policy on Electricity Interconnection in Ireland which sets out the strategic importance of interconnection to Ireland and the three pillars of its energy policy – sustainability, security of supply and competitiveness and recognises the benefits to the consumer 'including lower long-term costs of electricity' (DCCAE 2018).

Following public consultation in relation to the initial project assessment of Greenlink, the Irish utilities regulator, the Commission for Regulation of Utilities (CRU), determined that Greenlink passes the public interest test in Ireland (CRU 2018).

More recently, the Government of Ireland have published the Climate Action Plan 2019 "To Tackle Climate Breakdown" (GOI 2019). A key assumption of the plan, which is also set out in the draft National Energy and Climate Plan (Table 2, page 10, GOI 2018), is that additional interconnection will be added in 2025 and 2026 (Table 3.1, page 23, GOI 2019) i.e. the two planned interconnectors Celtic Interconnector to France and further interconnection to the UK (Greenlink) are delivered. This is necessary to support the objective of achieving 70% renewable electricity by 2030. Increased levels of storage and interconnection will be critical to absorbing high levels of renewable generation on to the system, as renewables require back-up which will have to be provided by quick response plant, storage or interconnection. There is therefore strong policy support for the development of Greenlink.

2.1.3 Welsh policy

Planning Policy Wales (PPW10 Edition 10) sets out the land use planning policies of the Welsh Government, supporting the UK's commitment to the EU Renewable Energy Directive and the UK target of 15% of energy from renewables by 2020 (Welsh Government 2018).

PPW10 Edition 10 states that the new PPW embeds the spirit of the Wellbeing of Future Generations Act, through moving us towards a low carbon, resilient society, of providing secure and well-paid jobs, and of building well-connected environments for everyone in Wales that improves our lives and health and enhances our well-being. It seeks to promote adequate and efficient infrastructure, highlighting services such as electricity and telecommunications, as crucial for the economic, social and environmental sustainability of all parts of Wales.

Greenlink aligns with the strategies and objectives described in PPW10 Edition 10 in developing Wales' access to a more diverse energy mix including energy from renewable and low carbon energy sources, promoting energy efficiency and enhancing security of supply.

2.2 Marine Planning

2.2.1 European framework

In 2014 the EU adopted Directive 2014/89/EU establishing a framework for Maritime Spatial Planning (MSP Directive).

Marine Spatial Planning (MSP) is a new approach to the management of our seas. The aim is to ensure a sustainable future for our coastal and offshore waters through managing and balancing the many activities, resources and assets in our marine environment. MSP seeks to adapt spatial planning concepts used on land and, taking into consideration the challenges in the marine environment, apply them to territorial and offshore waters. MSP has emerged as a means of resolving inter-sectoral and cross-border conflicts over marine space.

The directive sets out the framework under which Member States must establish a Marine Spatial Plan (MSP); and details the main goals (Article 5) and minimum requirements (Article 6). The plan must be in place by March 2021.

2.2.2 Irish Marine Plan

The Irish Government has chosen the Department of Housing, Planning and Local Government (DHPLG) as the competent authority to implement the MSP Directive in Ireland. There will be four broad stages in the development of the plan (DHPLG 2017a):

- Start-up or activation phase – During this phase Irish ministers published a roadmap, DHPLG (2017b), outlining their proposed approach to developing Ireland’s first marine spatial, and initial contact was made with stakeholders.
- Development stage – This stage commenced in the first quarter of 2018 and is expected to run until the end of the third quarter 2019. It includes the publication of an evidence and issues overview, development of a full draft plan and public consultation on the draft plan.
- Finalisation stage - A final plan will be prepared for submission to Government in 2020 with supporting environmental assessments (e.g. strategic environmental assessment [SEA] under the EU SEA Directive, appropriate assessment under the EU Birds and Habitats Directives) for approval. The final plan will be submitted to the European Commission ahead of the March 2021 deadline set out under the MSP Directive.
- Implementation – This will commence on publication of the final Marine Spatial Plan.

On 10 June 2019 the DHPLG issued a draft Marine Planning Policy Statement for public consultation. This outlines the vision for the future development of the marine planning system, and sets out the overarching policies and principals the Government expects marine planning bodies and other public bodies that engage with the marine planning system to observe. However, this will not affect Greenlink as consent for the works is granted under the Foreshore Acts 1933 -2011 (see section 2.3.1).

2.3 Irish Marine Licensing and Permits

GIL will be required to obtain licences and permits from different authorities to undertake the installation, repair and maintenance, operation and eventual decommissioning of Greenlink. Table 2-1 provides a list of the key permits that will be required for the Proposed Development in Ireland. This section describes the European and National Regulatory Framework within which these permits and licences are granted.

Table 2-1 List of key permits and licences needed for marine project elements

Permit Name	Licensing authority	Scope of permit
Foreshore Licence	DHLPG - Foreshore Unit	Mean high-water spring mark to 12nm in Irish territorial waters. Cable installation works and deposit of cable protection; removal and detonation of unexploded ordnance (UXO).
Archaeology Excavation Licence	National Monuments Service	Mean high-water spring mark to Irish median line. Intrusive seabed works e.g. cable installation.

2.3.1 Foreshore Licence

The Irish Foreshore Acts 1933 – 2011 require that before the commencement of any works or activities on State-owned foreshore a license or lease must be obtained from the Minster of Agriculture, Food and the Marine. The extent of the foreshore is from the high water mark out to 12 nm (i.e. territorial waters). The installation of the cable and deposition of cable protection material will therefore require a Foreshore Licence from the DHPLG – Foreshore Unit.

When assessing a Foreshore Licence application, the Foreshore Unit require that the applicant has met all legal requirements under relevant European Union Directives; and in particular:

- Directive 2014/52/EU (amending Directives 2011/92/EU and 85/337/EEC) on the assessment of the impacts of certain private and public projects on the environment (Environmental Impact Assessment [EIA] Directive) (Section 2.3.1.1);
- Directive 92/43/EC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive); and
- Directive 2009/147/EC on the conservation of wild birds (Birds Directive (Section 2.3.1.2).

The purpose, requirement, and how GIL will comply with these Directives are described in Sections 2.3.1.1 to 2.3.1.2 below.

As part of the assessment of the Foreshore Licence application the Foreshore Unit will seek advice from their primary advisors and consultees before making a decision on whether to issue the licence. The Foreshore Unit may consult any person or body it deems fit, in cases involving any matter in which that person or body has particular interest or expertise.

2.3.1.1 EIA Directive

On receipt of a Foreshore Licence application it is the responsibility of the Foreshore Unit to assess and understand the likely impacts of the proposed activities on the marine environment. The applicant must supply in support of the Foreshore Licence application sufficiently high-quality information to allow the Foreshore Unit to make a decision about the environmental impact of the Proposed Development.

EU Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment sets out the requirements in relation to Environmental Impact Assessment (EIA). EU Directive 2014/52/EU2 amends Directive 2011/92/EU (together the 'EIA Directive'). The EIA Directive requires a competent authority to carry out an assessment of the effects of a proposed project on the environment prior to a development consent, in this case a foreshore licence, being granted.

Article 5(2) of the EIA Directive outlines the information to be included in an EIAR:

Where an environmental impact assessment is required, the developer shall prepare and submit an EIAR. The information to be provided by the developer shall include at least:

(a) a description of the project comprising information on the site, design, size and other relevant features of the project;

(b) a description of the likely significant effects of the project on the environment;

(c) a description of the features of the project and/or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment;

(d) a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment;

(e) a non-technical summary of the information referred to in points (a) to (d); and

(f) any additional information specified in Annex IV relevant to the specific characteristics of a particular project or type of project and to the environmental features likely to be affected.

The proposed interconnector does not constitute a "project" listed within either Annex I or Annex II to the EIA Directive. Accordingly, an Environmental Impact Assessment (EIA) is not required in relation to the proposed interconnector.

GIL has been advised that the project categories listed in the EIA Directive must be understood by reference to a wide scope and broad purpose. GIL is therefore following the EIA process for all project components. An Environmental Impact Assessment Report / Environmental Statement will be submitted with all relevant applications for consent.

This EIAR, reports on the marine elements of the project in Irish waters. A separate EIAR for the Irish Onshore component, and separate Environmental Statements for the Wales Marine and Wales Onshore components of Greenlink will also be prepared and will be available online at www.greenlink.ie once all planning applications have been submitted.

2.3.1.2 Habitat Directive and Wild Birds Directive

European Commission (EC) Directive 92/43/EC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) and EC Council Directive 2009/147/EC on the conservation of wild birds (Birds Directive) enable European Union member states to work together within the same legislative framework to protect Europe's most valuable species and habitats, irrespective of political or administrative boundaries. At the heart of these Directives is the creation of a network of sites, known as the Natura 2000 network.

The aim of the Natura 2000 network is to ensure the long-term survival of European threatened species and habitats. 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. Sites which have been submitted to the European Union but which have not formally been adopted e.g. candidate SACs and proposed SPAs, also form part of the network and are treated as if fully designated.

A key requirement of the Habitats Directive is that the effects of any plan or project, alone, or in combination with other plans or projects, on the Natura 2000 site network, should be assessed before any decision is made to allow that plan or project to proceed. This process is known as Appropriate Assessment (AA) and is provided for under Articles 6(3) and 6(4) of the Habitats Directive and is transposed into Irish law through the European Communities (Birds and Natural Habitats) Regulations 2011 (as amended) (the "2011 Regulations").

European Communities (Birds and Natural Habitats) Regulations 2011 - Part 5 Appropriate Assessment

Under Article 6(3) of the Habitats Directive, all plans and projects must be assessed to determine whether the plan or project is likely to have any significant effects on any Natura 2000 site in light of the site's conservation objectives. This requirement is transposed into Part 5 of the 2011 Regulations. If the project is likely to have a significant effect on a Natura 2000 site, either alone or in combination with other plans or projects, it must undergo an AA by the competent authority (those with decision making powers).

The competent authority cannot consent the plan / project without first having ascertained that it will not have an adverse effect on the integrity of the Natura 2000 site concerned. If an adverse 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 impacts to a non-significant level so that the plan/project may be approved (European Commission 2018).

The AA procedure is based on a four-stage approach, where the outcome at each successive stage determines whether a further stage in the process is required. The first stage is to undertake AA screening which establishes whether, in relation to a particular plan or project, AA is required. The purpose of screening is to determine, on the basis of a preliminary assessment and objective criteria, whether a plan or project, alone and in combination with other plans or projects, could have significant effects on a Natura 2000 site in view of the site's conservation objectives.

If Appropriate Assessment Screening concludes that 'Significant effects are certain, likely or uncertain' the plan or project must proceed to Stage two. Stage two is the Natura Impact Assessment, the results of which are presented in a Natura Impact Statement (NIS). This is a more detailed ecological assessment of the proposed activities and considers, in greater detail, whether the plan or project could adversely affect the integrity of the Natura 2000 site.

At this stage mitigation measures are proposed to minimise and/or eliminate likely effects on the qualifying interest features and if appropriate, the monitoring and reporting to be undertaken.

The Greenlink Marine NIS accompanies the Greenlink Marine EIAR – Ireland and has been used to inform the assessment provided in Chapter 11.

European Communities (Birds and Natural Habitats) Regulations 2011 – Part 6 Protection of Flora and Fauna

Annex IV of the EC Habitats Directive lists species of Community Interest in need of strict protection. Referred to as European Protected Species (EPS), it is an offence to deliberately kill, injure or disturb animals listed in the Annex. This requirement is transposed into Irish statute in Section 51(2) of the European Communities (Birds and Natural Habitats) Regulations 2011 and refers to all flora listed in Schedule 1 of the Regulations.

Table 2-2 presents the marine species which are currently protected in Ireland under this legislation.

In addition, certain marine species are also protected under The Wildlife (Amendment) Act 1976-2005 (also listed in Table 2-2).

Table 2-2 Marine species protected by Irish statute

European Communities (Birds and Natural Habitats) Regulations 2011	Wildlife Act 1976 (as amended)
First Schedule (European Protected Species)	**Fifth Schedule**
Whales, Dolphins and Porpoises (all species) Loggerhead turtle Green turtle Kemp's Ridley turtle Hawksbill turtle Leatherback turtle Common Sturgeon Otter	Whales, Dolphins, Seal and Porpoises (all species) Otter

As part of the Foreshore License application, GIL must demonstrate that the proposed activities will not deliberately kill, injure or disturb animals of a European Protected Species. If there is the potential that an activity may result in action that could constitute an offence, then the Foreshore License would be granted subject to conditions. It is the license holder's responsibility to ensure compliance with these conditions. Failure to comply with conditions is an offence.

2.3.1.3 Other relevant EU Directives

Water and sediment quality are monitored and regulated in Ireland under EU Directives. The most relevant to the project are:

- Directive 2008/56/EC establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive, MSFD);
- Directive 2000/60/EC establishing a framework for Community action in the field of water policy (Water Framework Directive, WFD);
- Directive 2006/7/EC concerning the management of bathing water quality (Bathing Waters Directive, BWD); and
- Directive 2006/113/EC on the quality required of shellfish waters (Shellfish Waters Directive, SFWD).

The WFD sets out Environmental Quality Standards that are used to assess the risk of chemical pollutant impacts on water quality to the health of aquatic plants and animals. EQSs are set for freshwater, estuarine and coastal waters. The MSFD considers marine water beyond 1nm. Both the WFD and MSFD seek to ensure Good Environmental Status (GES) within designated water bodies. The WFD requires member states to ensure surface water and groundwater achieve "good chemical and ecological status" by 2015 by progressive reductions in pollution and restoration. Under the MSFD each marine region or sub-region needs to achieve GES by 2020 (Articles 1 and 3). Broadly GES for the marine environment means that marine waters are:

- Ecologically diverse;

- Clean, healthy and productive; and
- Used sustainably, so that the needs of current and future generations are safeguarded.

The BWD and the SFWD are only applicable at designated bathing waters and shellfisheries, respectively. Sediment quality within the marine environment is measured using the Marine Institute action levels, which were developed to consider dredged material contamination, however this still provides a guide to the levels contained within sediments for assessment purposes.

2.3.2 Other National legislation

A number of other national acts, under which Greenlink could require additional consents and permits have been identified. These are summarised below:

- The Foreshore and Dumping at Sea (Amendment) Act 2009 - Under this Act, any dredging or dumping activities will require a separate permit administered by the Environmental Protection Agency (EPA). Email correspondence with the EPA (Suzanna Wylde 2016, personal communication, 11 August) has confirmed that the deposit of the marine cables on the seabed for installation and the deposit of cable protection material e.g. concrete mattresses or rock will not require consent.
- Continental Shelf Act 1968 - The Department of Communications, Climate Action & Environment have confirmed via email (DCCAE 2019, personal communication, 12 June) that a license under the above Act is not required for the laying of marine cables or the deposition of cable protection material on the Irish continental shelf.
- Planning and Development (Strategic Infrastructure) Act 2006 - The proposed interconnector would be considered a Strategic Infrastructure Development (SID) and therefore requires approval from An Bord Pleanála (the Board) for the Irish Onshore components of Greenlink. The initial stage of the application process is mandatory consultation with the Board. During the pre-application stage the Board may provide advice to prospective applicants as to the application procedures to be followed, information to be provided, and consultation requirements. The Board also ultimately decides whether a proposed development is granted approval and, if so, what conditions should apply.

2.4 Marine Archaeology

Although primarily land based, in recent years the National Monuments Act 1930 (As amended) (NMA), makes provision for the protection and preservation of national monuments and for the preservation of archaeological objects. The Act provides for the scheduling of monuments which have been deemed to be of national importance.

National monuments are managed under the auspices of the National Monuments Service, which is currently part of the Department of Culture, Heritage and the Gaeltacht and are protected under the National Monuments Acts 1930-2004.

The assessment in Chapter 15, takes account of the following national legislative procedures and guidelines:

- National Monuments Acts (1930-2004);
- Heritage Act (Ireland, 1995); and
- Framework and Principles for the Protection of the Archaeological Heritage, Department of the Arts, Heritage, the Gaeltacht and the Islands (1999).

2.5 Crossing and Proximity Agreements

The Proposed Development will cross one third-party telecommunication cable. The Irish Offshore components of Greenlink will cross a further four third-party telecommunications cables. The crossing of third party infrastructure is made with prior agreement of the owners following a negotiated formal Crossing Agreement. The Crossing Agreement describes the rights and responsibilities of the parties and also the detailed physical design of the crossing. The design addresses the need to protect both the cables and the third-party infrastructure and other aspects such as crossing angle and vertical separation.

The exact physical design of the crossing will depend on both the negotiated Crossing Agreement and the Installation Contractor methodology and may vary from location to location. A worst case footprint has been assessed by the EIA process.

GIL is in the process of negotiating formal Crossing Agreements with existing telecommunication owners.

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3. Development of the Project and Alternatives

This Chapter summarises the development of Greenlink, including the alternatives which have been considered and the rationale for selection of the Proposed Development. It considers technology selection; summarises the processes that were undertaken to identify an Irish connection point; and sets out the alternative landfalls and marine route options which have been considered in developing Greenlink.

The evolution of the Onshore Wales, Onshore Ireland, Marine Wales aspects of Greenlink are presented separately in the respective Environmental Statements and Environmental Impact Assessment Reports.

3.1 'Do-Nothing Option

The 'do nothing' option dictates that generation of electricity needs to be based in the country where it is used and constrains export of electricity when generation exceeds demand. One of the key actions identified in the European Commission Priority Interconnection Plan and the TEN-E regulations is to increase the transmission capacity between countries and improve security of supply.

To meet its obligations under the United Nations Framework Convention on Climate Change and the 2016 Paris Agreement, the European Union's goal is an electricity system to which renewables will contribute around half of the generation in 2030 and that will be fully decarbonised by 2050. A well connected and integrated trans-European grid is indispensable for making the energy transition a success (EC 2017).

Greenlink has been awarded Project of Common Interest (PCI) status by the European Commission, making it one of Europe's most important energy infrastructure projects and granting it the "highest national significance" possible.

The 'do nothing' option would therefore not be supported by Irish government and EU policy and would not support the European Union and Ireland's commitment to combating climate change.

3.2 Selection of Technology

Greenlink will consist of a pair of high voltage direct current (HVDC) submarine and underground onshore cables connected to an AC/DC converter station in each country. The converter station in Ireland will be connected to the Great Island substation via high voltage alternating current (HVAC) underground cables. Electricity will be able to flow in either direction between Ireland and Great Britain (GB).

Irish and GB electricity transportation grids operate as HVAC systems, in which the direction of the current changes (and then changes back) on average fifty times a second. However, an HVAC interconnector between the Irish and GB grids is not technically and economically feasible as:

- The Irish and British grids are not “synchronized”, i.e. the current reversals are not happening at the same times – without this synchronization, power cannot be successfully transmitted between the grids with an HVAC interconnector; and
- The capacity of HVAC underground or subsea cables to transmit power reduces significantly with distance travelled such that an HVAC interconnector would not be an economic means to transmit power between Ireland and GB.

Therefore, a HVDC interconnector, including a converter station at each end to change the current to HVAC is the best current technology.

Transmission electricity losses emanate in the form of heat and are increased with the current flowing through the equipment. HVDC cable witness lower losses when compared to HVAC cables and therefore is a more efficient technology.

3.3 Connection Options

3.3.1 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.

3.3.2 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.

3.3.3 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.

3.3.4 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). Figure 3-1 and Table 3-1 presents a figure and table included in the Connections and Infrastructure Options Note that summarises route distances between Ireland and the four options.

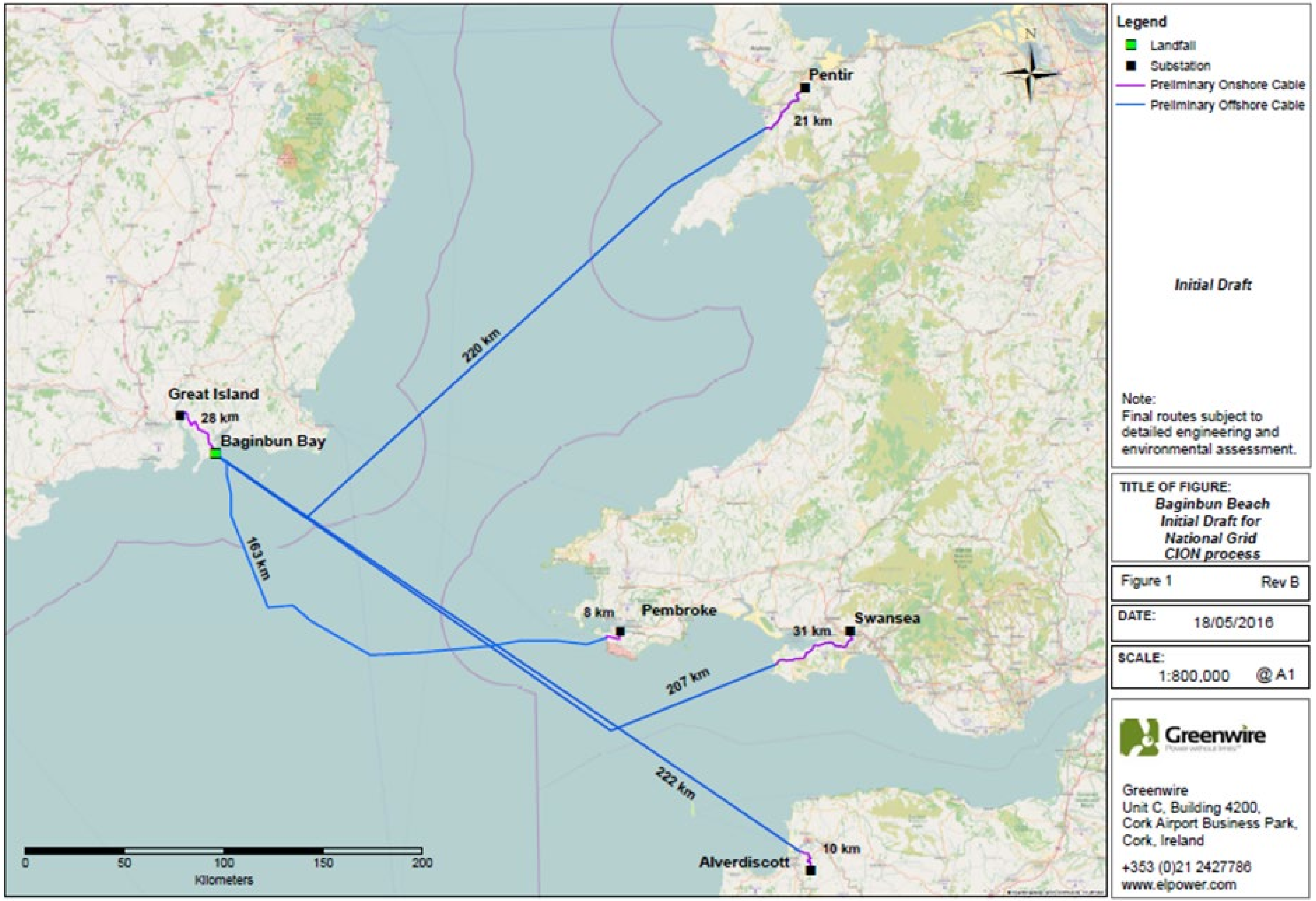
Table 3-1 Summary of project distances

	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.

Figure 3-1 Summary of project distances



3.4 Landfall Options

Following identification of Great Island substation as the connection point for Greenlink, an options appraisal study of the adjacent coastline was undertaken using a search area from approximately Brownstown Head, Co. Waterford to Bannow Beach, Co. Wexford. Ten potential landfall sites were selected based on their proximity to the Great Island substation.

The decision was taken early on to discount a route up the River Barrow estuary directly to Great Island for the following reasons:

- The River Barrow estuary adjacent to the Great Island substation forms part of the River Barrow and River Nore Special Area of Conservation (SAC). The site is important for the presence of a number of EU Habitats Directive Annex I listed habitats and well as Annex II listed species such as Freshwater Pearl Mussel, White-Clawed Crayfish, Salmon, Twaite shad, three lamprey species (sea, brook and river lamprey), the whorl snail *Vertigo moulinsiana* and otter. The River Barrow is the only site in the world for the hard water form of the Freshwater Pearl Mussel and one of only a few rivers in Ireland in which twaite shad spawn.
- Although there is a navigation channel through the estuary to the Port of Waterford in which water depths reach 10m, water depths across most of the estuary are typically 5m or less. Constraints in this area include:
    - Navigation channels, dredged channels and designated anchor zones are avoided where possible when routeing a cable due to the risk posed to the cable from dredging and accidental anchoring. Additionally, the sterilisation of a designated anchor zone and the disruption effects to commercial shipping that would be experienced during installation.
    - Long stretches of shallow water depths are technically difficult from a cable installation perspective, requiring very slow moving anchored barges. This can lead to increased levels of disruption, habitat disturbance and higher costs.

The options appraisal (desk-top study), undertaken by Intertek EWCS (2015), considered a range of environmental, technical and economic constraints to identify suitable landfall locations within the search area. It was undertaken in parallel with consideration of onshore locations for converter stations and underground and marine cable routes.

Ten potentially suitable landfall locations were identified, of which four were visited by Arup (Onshore Consultants) and eight were visited jointly by Arup and Intertek EWCS (Offshore Consultants) in 2015. This ensured all sites had been visited and assessed. Shown on Figure 3-1 (Drawing P1975-LOC-003), the ten sites were Rathmoylan Cove, Boyce's Bay, Sandeel Bay, Carnivan Bay, Baginbun Beach, Dollar Bay, Booley Bay, Newtown Beach, Bannow Beach and Cullenstown Beach.

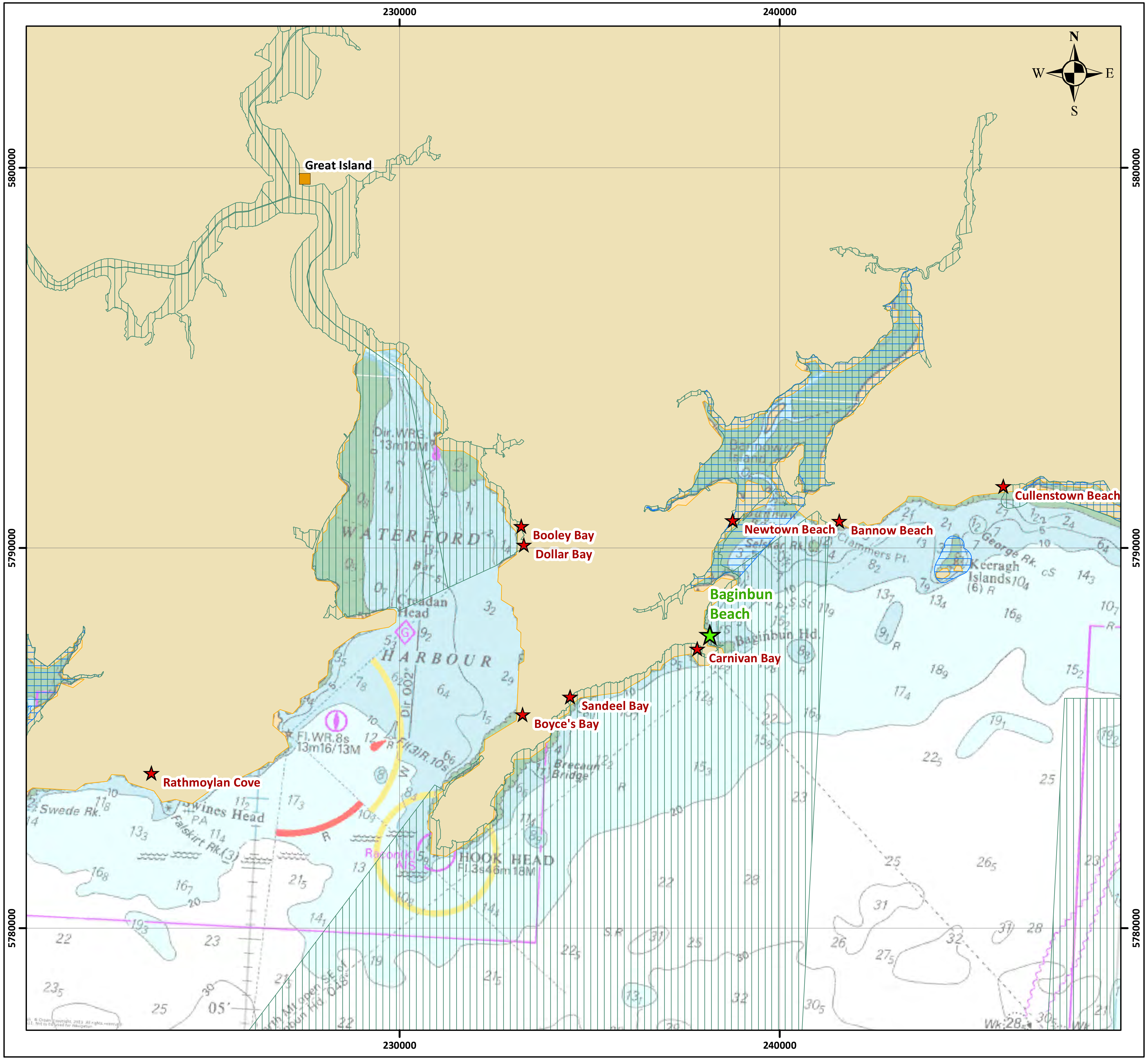
Each landfall site was scored based on technical and environmental criteria. Criteria assessed included vessel access, beach composition, amenity impact, environmental constraints (e.g. presence of protected sites), exposure, coastal erosion, access to beach, cable engineering and protection requirements, obstructions and existing infrastructure.

After site visits, four preferred options were identified:

1. Baginbun Beach;
2. Sandeel Bay;
3. Booley Bay; and
4. Boyce's Bay.

Of these sites, landfalls 1 and 2 are on the east coast of the Hook Head Peninsula, 3 and 4 are on the west coast of the Hook Head Peninsula.

Table 3-2 provides a summary of the four options and the reason for the selection of Baginbun Beach as the preferred landfall. A report outlining the route selection process and the environmental effects considered as part of this selection process in greater detail are included at Technical Appendix L.



GREENLINK INTERCONNECTOR

ROUTE OVERVIEW
ROI Landfall Options

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

Legend

- Power Station
- Landfall Selected
- Landfall Considered

Protected Sites

- SAC
- SPA

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Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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0 1 2 3 4 km

Table 3-2 Landfall options

Name	Description	Decision
Baginbun Beach	Baginbun Beach is located to the north of Carnivan Bay on the Baginbun peninsula. It lies within the Hook Head Special Area of Conservation (SAC) but the cable would have less distance in the SAC than at alternative sites such as Sandeel Bay. The beach faces north east, has excellent access for vessels and the eastward facing aspect would protect the site from prevailing wind conditions. The gradient of the beach was flat (1.7°) and the sediment was generally uniformly distributed coarse sand with occasional whole or partial shells. Notably, there was very little man-made debris. Offshore, lobster / crab pots were observed indicating fishing activity in the area. Surrounding the beach are heavily vegetated cliffs of moderate height (< 15 m) with only minor signs of erosion on the northern side of the beach. Height and apparent stability would suggest horizontal directional drilling would be possible but would require appropriate geological assessment and survey of ground conditions for confirmation. Consultation with the Foreshore Unit indicated that the beach has high amenity value especially during summer months. The beach has historical importance as the site of an Anglo-Norman invasion in May 1170.	**Landfall Selected as Preferred Option** Selection was based on the fact that it offered the shortest overall offshore cable route length and met the technical requirements other landfalls fell short on. Selection as the preferred option was however, dependent on the results of the cable route survey. The survey needed to demonstrate that the submarine cable route could be installed without significantly affecting the conservation objectives of the Hook head SAC. A sand channel with sufficient depth to achieve cable burial has been confirmed during the cable route survey, through the SAC to Baginbun Beach (see Section 3.5.5.)
Sandeel Bay	Sandeel Bay is located to the south of the Baginbun peninsula on the east of the Hook peninsula. Lying within the Hook Head SAC, it is close to Hookless Village / Sandeel Bay Cottages, a popular holiday resort. The cliffs surrounding the beach are approximately 10 - 15 m in height with small localised areas of erosion and landslip. There is a rock outcrop to the south of the bay. The beach gradient is shallow and demonstrates large amounts of seaweed and debris. There also appears to be sediment zonation indicative of sediment sorting associated with high-energy condition.	**Landfall Discounted** Initially, the landfall was not considered a 'preferred' option as the offshore environmental constraints were considered too significant. Following consultation with the National Parks & Wildlife Service (NPWS) (09 December 2015) it was concluded that installing a cable through a SAC could potentially be possible provided that works do not adversely affect the integrity of the protected site and its conservation objectives. In the interest of achieving the most direct offshore cable route, Sandeel Bay

Name	Description	Decision
	The site would not be suitable for open-cut trenching due to the volume of rock and the seawall approaching the path. HDD may be suitable but geotechnical data assessment would be required to confirm suitability.	was reinstated as a potential landfall location, despite the relatively low score in assessment. It was subsequently de-selected when analysis of INFOMAR bathymetric data identified likely extensive reef habitat offshore, confirming any route to the landfall would likely have significant effect on the conservation objectives of the SAC.
Boyce's Bay	This landfall location lies on the west coast of the Hook Peninsula, within the Port of Waterford harbour limits. The site is located outside the Hook Head SAC, but it falls within a proposed Natural Heritage Area (NHA). The beach faces the south west making it an exposed site, given the prevailing south-westerly weather conditions. Due to the shallow waters and location of the 5 and 10 m depth contours, the types of vessel that can reach the beach may be restricted, increasing the chances of requiring anchored barges. The beach extends further north along the coastline for approximately 2 km but a rock outcrop to the north of the site prevents vehicles from accessing the additional coastline and beach. The beach itself is gently sloping with evidence of a storm berm and seaweed debris on the upper reaches of the beach. The typical slope angle was 2.4° from the cliff to the water. The beach was approximately 200m wide, with approximately 157 m of rock to the south of the beach. Fossils were observed on rock outcrops on the side of the bay. The surrounding cliffs and headland are high with one large derelict property at the top, close to the dairy farm; this is possibly a heritage site and would require confirmation prior to establishing the location for an HDD point. The surrounding cliffs are densely vegetated with grasses and scrub but there are many indicators of instability and slope movement. Portions of the cliffs were identified as suitable for HDD up to the main track, pending further geotechnical assessments and ground investigation.	**Landfall reserved as Second Preferred Option pending survey of Baginbun Beach.** Selected as an alternative for investigation should the cable route survey identify substantial issues which could result in a route to Baginbun Beach not being feasible. The Port of Waterford has expressed concerns that the proposed route to Boyce's Bay enters the shipping channel passing Hook headland. They have not granted permission for the route to extend into the central channel where there are potentially deeper Holocene sediments. Instead, their preference is for the cable to be routed as close to the headland as possible. A compromise, whereby the route follows the edge of a mapped outcrop to the east of the channel centre, was proposed. However, this area may have only a veneer of sediment overlying rock which would likely result in external rock protection (e.g. rock berm) being required. The outcropping rock is likely to be Annex I Reef (Stony Reef) habitat and although not within the Hook Head SAC forms part of the wider habitat for which the site is designated. As well as increasing installation costs installation across the outcropping rock has the potential to significantly affect a sensitive habitat.

Name	Description	Decision
		The landfall was discounted in 2018 when the cable route survey confirmed a route into Baginbun Beach was feasible.
Booley Bay	Booley Bay is approximately 5 km north of Boyce's Bay, within the Port of Waterford harbour limits. Like Boyce's Bay, the landfall faces the west and is moderately exposed to the prevailing southwesterly wind conditions. The beach is approximately 205 m wide and 113 m from the cliff to the water's edge shortly before low water. The beach is predominately flat (0.2°) with fine, water saturated sand. A storm berm was observed at the upper reaches of the beach. The surrounding headland is dominated by vegetated cliffs to the north and south, both sides demonstrated low levels of coastal erosion with minor evidence of disruption by landslides. Adjacent to the access road and track was a freshwater riverine input, surrounded by unmanaged vegetation. The river water flows directly onto the beach where the water flow is diverted along the upper reach of the beach to the southern rock outcrop where it is forced towards the sea by rocks. Options for installation would include HDD and open-cut trenching. It is likely that the flow of freshwater onto the beach would make keeping a trench open difficult and may risk exposure of the cable during adverse weather conditions.	**Landfall Discounted** Consultation with the Port of Waterford was undertaken on 09 March 2016. At the meeting the Harbour Master advised the Booley Bay landfall be dropped from further consideration. A 100m wide corridor (marked on Admiralty Chart) is dredged at Duncannon approximately 3-4 times a year, to stop the shipping channel from silting up. The offshore approach to the landfall would intersect this area risking both the ports activities and the cable.

3.5 Offshore Route Selection

The development of the submarine cable route balances the need for a technically feasible and economically viable route corridor whilst limiting disturbance to people and the environment, and minimising cable length. In identifying preferred options, and determining if a route is feasible, the physical, environmental and human aspects were considered.

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 to ALARP levels (i.e. As Low As Reasonably Practicable) while also accommodating other factors.

Three main objectives have driven route development:

- To avoid where possible, or otherwise minimise the distance through which the route crosses reef habitat within the Hook Head SAC (Proposed Development) and Pembrokeshire Marine Special Area of Conservation (SAC) (Marine Wales); and
- To minimise disruption to shipping associated with Waterford Port (Proposed Development), Milford Haven (Marine Wales), and offshore traffic separation schemes (Marine Wales); and
- To avoid where possible, or otherwise minimise the distance through which the route crosses the Castlemartin Firing Range (Marine Wales).

The stages of the process to define the Greenlink route are described in detail below, but can be summarised as follows:

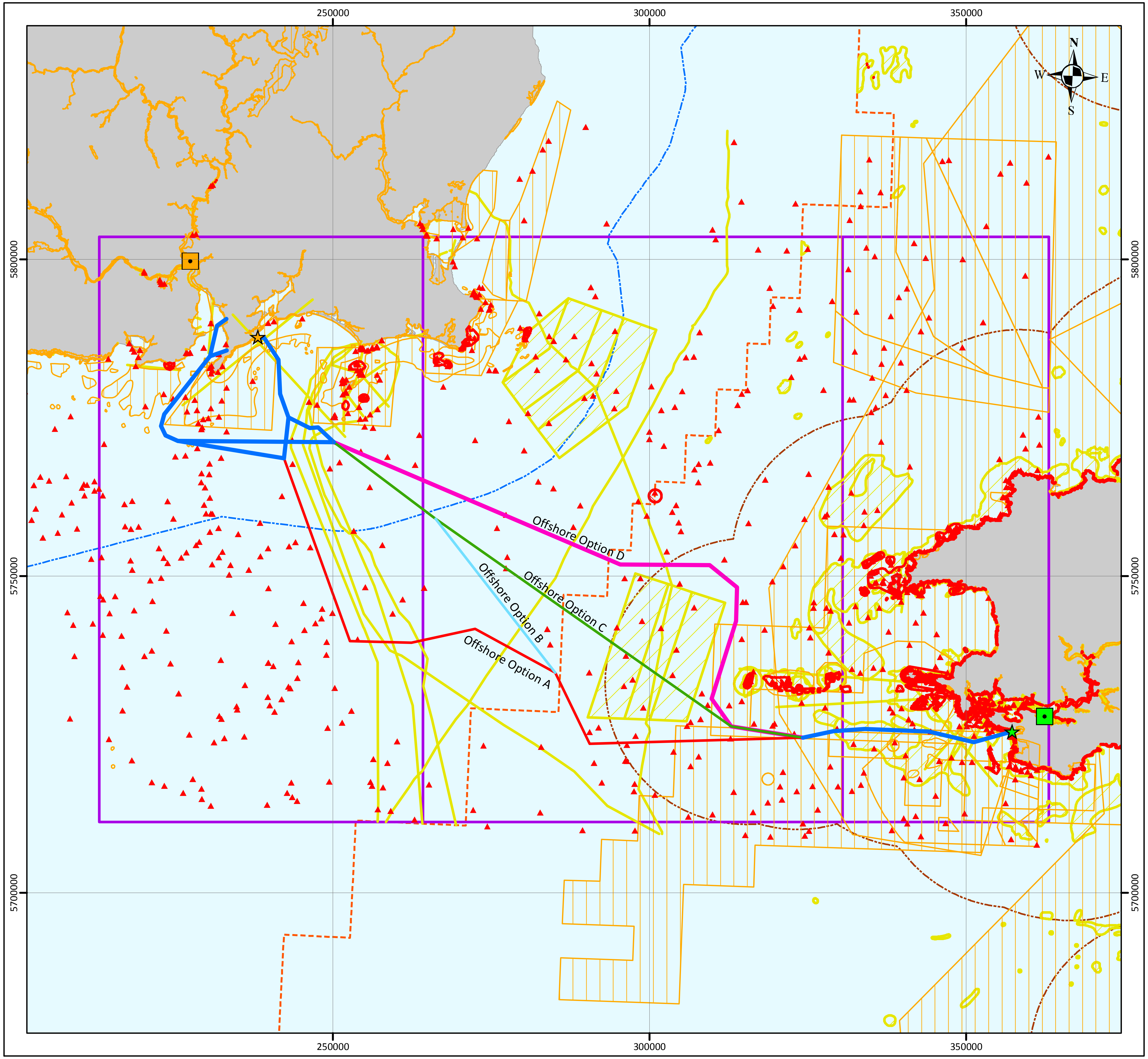
2015	Desk-top study (Intertek 2015) develops four offshore routes (Options A, B, C and D) between Freshwater West, Wales and three short-listed landfalls (Boyce's Bay, Booley Bay and Baginbun Beach) in Ireland.
Dec 2015	Consultation with Irish National Parks & Wildlife Service (NPWS) concludes in re-instatement of fourth Irish landfall; Sandeel Bay.
Dec 2015	GIL and Intertek routeing workshop discounts Options B, C and D but introduces Options E and F.
Feb - Aug 2018	Re-examination of routes ahead of cable route survey. Consultation and new data leads to refinement and new route option development. Option E and Option F re-named to Route A and Option C respectively. Routes B and E (Wales Marine) and Option D (Irish Marine) developed.
Sep - Dec 2018	Reconnaissance survey of Route A and Route E in Welsh waters. Consultation with NRW and further survey leads to final route being defined.

3.5.1 Desk-top study 2015

GIL commissioned Intertek EWCS to undertake a desktop study (Intertek EWCS 2015) to identify feasible submarine cable corridors between three short-listed landfalls in Ireland (Boyce’s Bay, Booley Bay and Baginbun Beach) and the recommended landfall at Freshwater West, Wales for further investigation.

Constraints within the study area were identified and categorised as major, moderate, minor or no constraint, according to the likely impact on cable installation. The constraint categories were mapped and routes were designed to take cognisance of the constraints and their categorisation.

The outcome was four offshore routes with options to connect to each of the landfalls in Ireland; Figure 3-3 (Drawing P1975-LOC-005). These were identified as Options A to D; with the shortest route Option A being 145km and the longest Option D being 186km. Options B, C and D all crossed a large area of sand waves. These sediment features can complicate installation activities and notably, existing telecommunication cables have been routed around these sand waves.



GREENLINK INTERCONNECTOR

ROUTE OVERVIEW
Preliminary Route Options

Drawing No: P1975-LOC-005 | **A**

Legend

Substation
- Pembroke Power Station
- Great Island

Landfall
- Freshwater West
- Baginbun Beach

Preliminary Route
- Nearshore Route Options (Dependant on Final Landfall)
- Offshore Option A
- Offshore Option B
- Offshore Option C
- Offshore Option D
- ROI 12nm Territorial Sea Limit
- UK 12nm Territorial Sea Limit
- Median Line
- Study Area

Challenging Constraints
- Minor
- SAC ROI
- Major

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Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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0 5 10 15 20 km

3.5.2 NPWS consultation December 2015

On 09 December 2015 the National Parks & Wildlife Service (NPWS) was consulted regarding the Irish landfalls, resulting in the re-instatement of a fourth landfall site; Sandeel Bay.

3.5.3 Route workshop December 2015

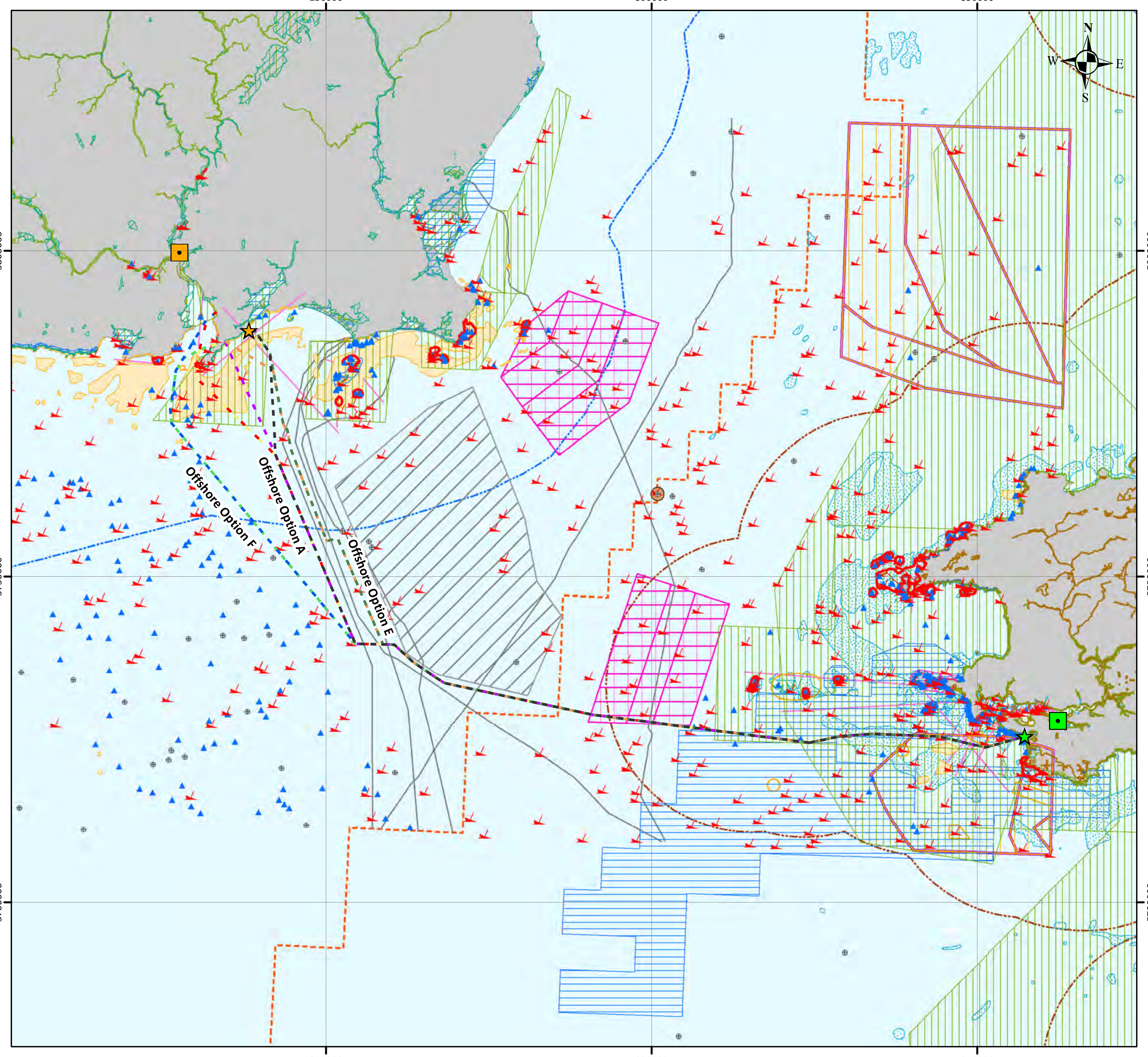
GIL and Intertek EWCS conducted a routeing workshop on 10 December 2015. At this workshop preliminary research into the area of sand waves was presented, concluding that the heights of waves are between 10 – 15 m with slope angles in excess of 10°. The sand waves by their nature are likely to be mobile, however there is little confirmation of the rate of this mobility and it would require several bathymetric campaigns at different times to determine the mobility. A decision was made to discount Options B, C and D from further investigation.

An alternative Option E was introduced, during the workshop, to alter the approach to the cable-crossings. Option E sought to conduct the cable-crossings in a ‘stepped’ approach and thus shorten the route. The result was a 2km reduction in cable length when approaching the Baginbun Beach landfall.

Refinements were also made to Option A & E in the Irish nearshore region owing to additional bathymetric and geological data being available. In addition, an Option F was developed as an alternative shorter option to Option A to the landfalls on the west coast of the Hook Head Peninsula.

Options A, E and F as defined after the workshop are shown in Figure 3-4 (Drawing P1975-LOC-006).

Intertek EWCS (2016b) subsequently concluded that the ‘preferred route’ for survey depended on the Irish landfall chosen, but based on the shortest, least constrained route, Option E was currently the preferred route.



GREENLINK INTERCONNECTOR

ROUTE OVERVIEW

Options A, E, and F as defined in December 2015

Drawing No: P1975-LOC-006	A

Legend

Substation
- Pembroke Power Station
- Great Island

Landfall
- Freshwater West
- Baginbun Beach
- Option A to Baginbun
- Option A to Booley Bay
- Option A to Boyces Bay
- Option A to Sandeel Bay
- Option E to Baginbun
- Option E to Sandeel Bay
- Option F to Booley Bay
- Option F to Boyces Bay
- ROI 12nm Territorial Sea Limit
- UK 12nm Territorial Sea Limit
- Median Line

Constraints
- Well
- Obstruction
- Wreck
- Offshore Installation
- Navigation Line
- Traffic Separation Scheme
- Military Practice Area
- Dumping Ground
- Foul Ground
- Rock
- Sandwaves

Environmental Sites
- SAC
- SPA
- NHA
- pNHA
- SSSI

Rocky or Biogenic Reef Confidence
- High
- Potential

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File Reference	J:\P1975\Mxd\01_LOC\ P1975-LOC-006.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Greenlink

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0 5 10 15 20 km

3.5.4 February to August 2018

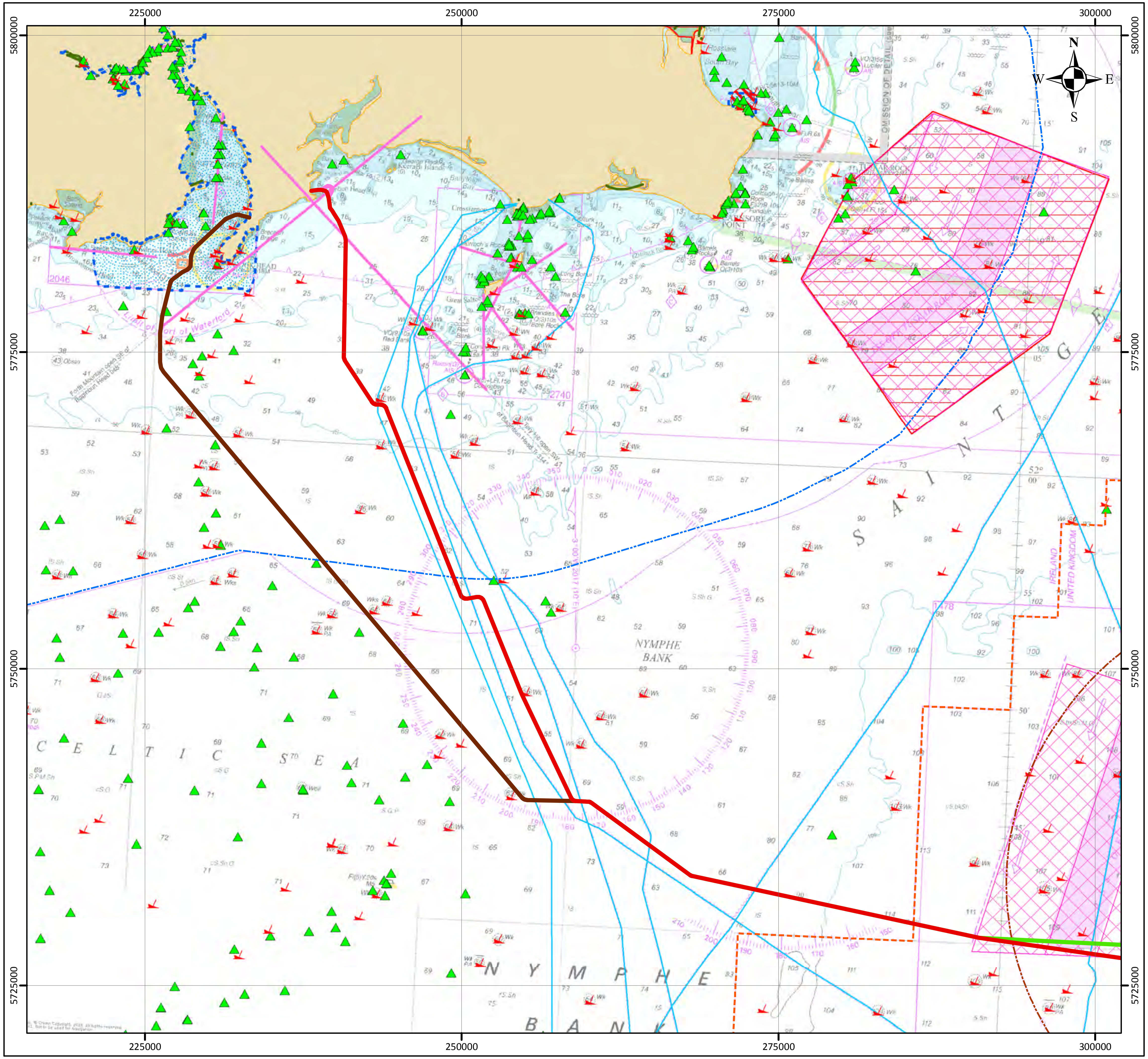
Ahead of the cable route survey Option E (to Baginbun Beach) and Option F (to Boyce's Bay) were re-examined in light of new data and consultation undertaken with Port of Waterford Company, and in Wales, Natural Resources Wales, Castlemartin Firing Range and Milford Haven Port Authority.

These two routes were renamed to become Route A (to Baginbun Beach) and Option C (to Boyce's Bay) respectively in the subsequent route development work as reported in Intertek EWCS (2018b).

3.5.4.1 Ireland

Consultation with the Port of Waterford Company (identified serious reservations with the Irish landfalls on the western side of the Hook Head Peninsula (Boyce's Bay and Booley Bay). Port of Waterford Company requested that any route within the estuary should avoid the main navigation channel and follow or be as close to as possible the outcropping rock on the eastern coastline. This constraint combined with the environmental sensitivities of the River Barrow estuary (i.e. reef habitat and important twaite shad spawning habitat), led to the recommendation that Baginbun Beach should be considered the preferred landfall for cable route survey. This therefore identified that Route A would be the 'preferred route' for survey, but with Option C to Boyce's Bay retained in case survey of Route A proved unfeasible ground conditions were present (Figure 3-5, Drawing P1975-LOC-007).

On the approach to Baginbun Beach, Option D was developed as an option to Route A to avoid an area of outcropping rock identified on bathymetric survey data obtained from INFOMAR; shown on Figure 3-6 (Drawing P1975-BATH-005).



GREENLINK INTERCONNECTOR

ROUTE OVERVIEW

Pre-Survey Irish Route Development

Drawing No: P1975-LOC-007	A

Legend

Greenlink Interconnector Proposed Routes

- Route A Rev1
- Route E Rev1
- Option C Rev0
- Option D Rev1

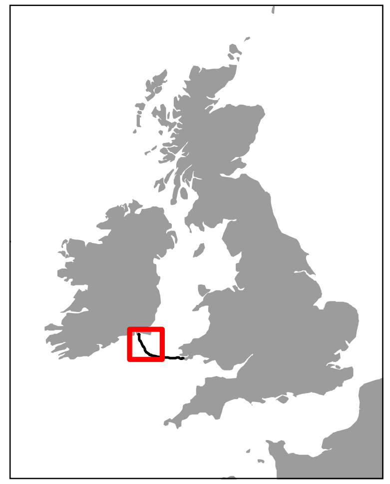
- ROI 12nm Territorial Sea Limit
- UK 12nm Territorial Sea Limit
- Median Line

Marine Structure or Obstruction

- Obstruction
- Wreck
- Cable
- Shoreline Construction

Marine Use Areas

- Navigatuion Line
- Harbour Area (Administrative)
- Traffic Separation Zone
- Dumping Ground
- Caution Area
- Restricted Area



NOTE: Not to be used for Navigation

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Data Source	UKHO; DCCAE; CDA; KISORCA; GEBCO MarineFind; Oceanwise; Greenlink
File Reference	J:\P1975\Mxd\01_LOC\ P1975-LOC-007.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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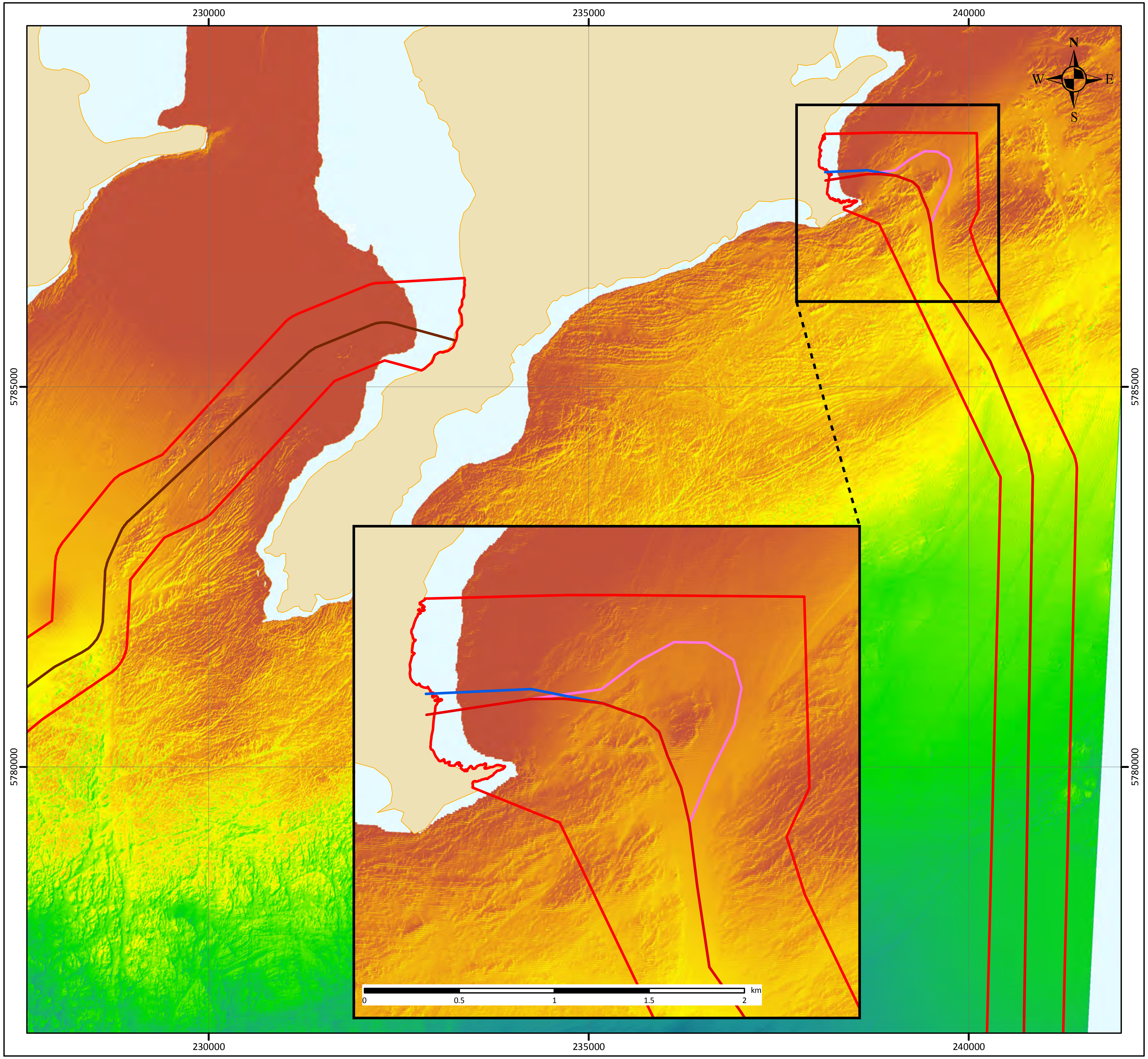
0 2.5 5 7.5 10 km



GREENLINK INTERCONNECTOR

BATHYMETRY

Nearshore ROI Waters

Drawing No: P1975-BATH-005	A

Legend

Greenlink Interconnector Proposed Routes

- Route A Rev1
- Route B Rev0
- Option C Rev0
- Option D Rev1
- Proposed Development

INFOMAR Bathymetry

Bathymetry (below LAT)

-4m

44m

Date	Monday, April 8, 2019 09:32:29
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	UKHO; OSI; INFOMAR; Greenlink
File Reference	J:\P1975\Mxd\04_BATH\ P1975-BATH-005.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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0 0.5 1 1.5 2 km

3.5.4.2 Wales

Further route development occurred to reduce the distance of the route either in protected sites or reduce distance through sensitive habitat features as follows:

Route A

- Minor route amendments were made to move the route further south, reducing the distance the route crossed the Skomer, Skokholm and the Seas off Pembrokeshire Special Protection Area (SPA). Routeing is constrained by the location of a disused explosive dumping ground in this area.
- Where appropriate, alterations were made to minimise the length of the route across potential reef features, a designating feature of the Pembrokeshire Marine SAC.
- The route was optimised to consider new information obtained on wrecks and obstructions.
- Nearshore route adjustments were made using SEACAMS bathymetric data provided by Bangor University. A channel infilled with sediment was identified within the outcropping rock. The routes were revised to follow this channel.
- The amendment resulted in the route going further into the Castlemartin Firing range. Consultation with the MoD confirmed that this was feasible.

Route B

- An alternative to Route A in Welsh waters, this route sought to reduce the distance within the Pembrokeshire Marine SAC and crossing of potential areas of bedrock reef habitat.
- This option encroaches further into the Castlemartin Firing Range; although this was confirmed as acceptable through consultation with the MoD.
- Route B was later discounted from further investigation, as although it reduced the distance through the Pembrokeshire Marine SAC it did not minimize the length of potential reef habitat crossed. Consultation with NRW confirmed that reef habitat outside the SAC should be regarded in the same manner as reef habitat within the SAC.

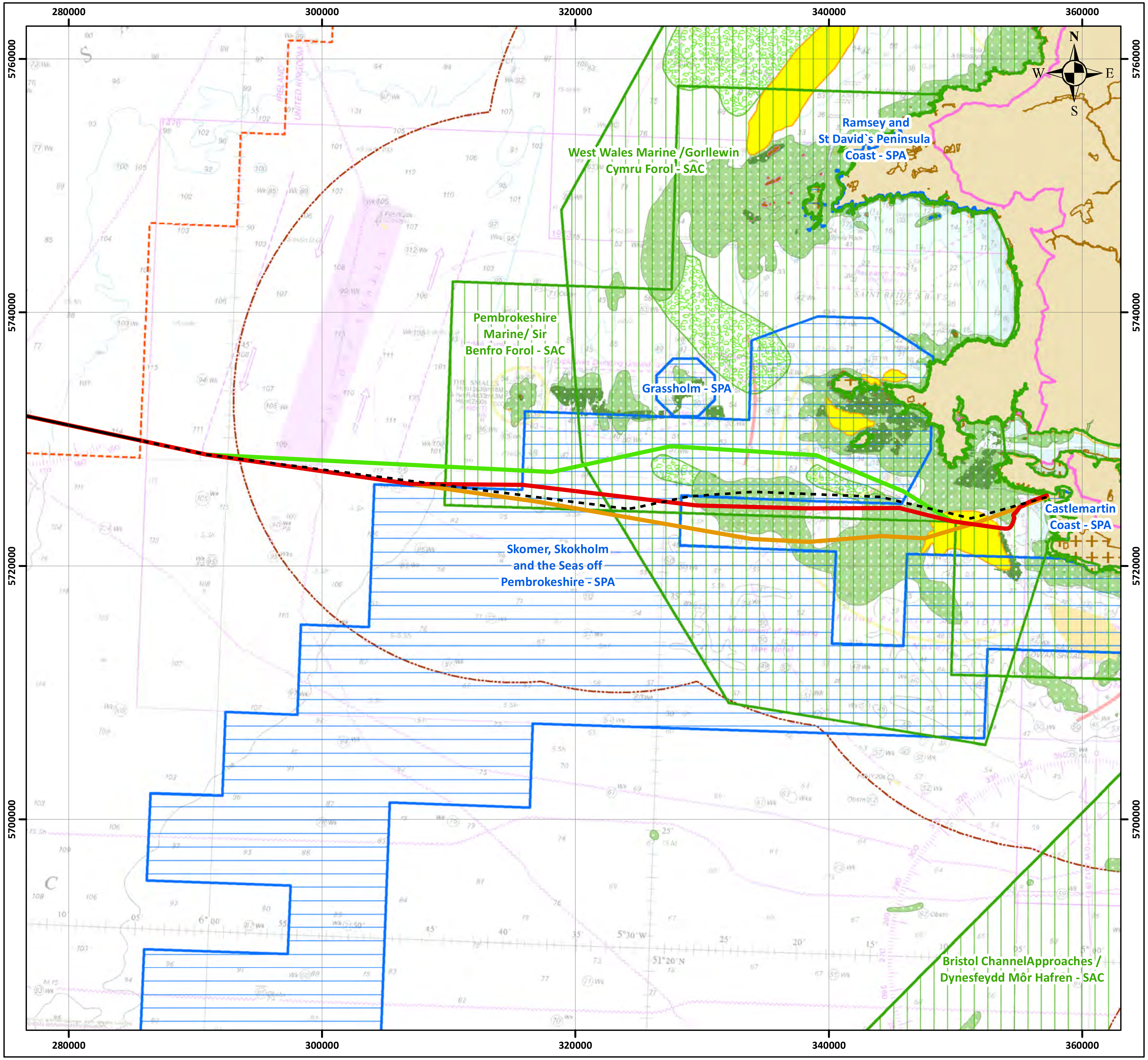
Route E

- Following consultation with NRW, it was concluded that further efforts should be made to avoid the potential areas of reef; a designating feature of the Pembrokeshire Marine SAC.
- Route E sought to avoid potential areas of reef by routeing around it to the north.
- Routeing closer to the Milford Haven harbour entrance was confirmed as possible through consultation with Milford Haven Port Authority.

Routes A, B and E are shown in Figure 3-7 (Drawing P1975-LOC-004).

Intertek EWCS (2018b) concluded the preferred option for survey was Route A, due to it being the shortest route. However, it was recommended that an initial reconnaissance survey was undertaken to assess the presence and quality of reef and / or sensitive habitats along Route A within the Pembrokeshire Marine SAC. If reef habitat was identified then investigation of Route E should be undertaken to allow comparison and selection of a route that minimizes the potential effects on the habitat.

A strategy was developed and agreed with NRW, that provided a decision making process to be followed during the survey. The objective of the strategy was to provide a framework for comparing the environmental results from Route A and Route E leading to a decision on the final route for survey. The area defined as the 'reconnaissance survey' is shown in Figure 3-8 (Drawing P1975-SURV-011).



GREENLINK INTERCONNECTOR

ROUTE OVERVIEW

UK Route Development

Drawing No: P1975-LOC-004	A

Legend

- Original Proposed Route
- Route A Rev1
- Route B Rev0
- Route E Rev1

Environmental Designations

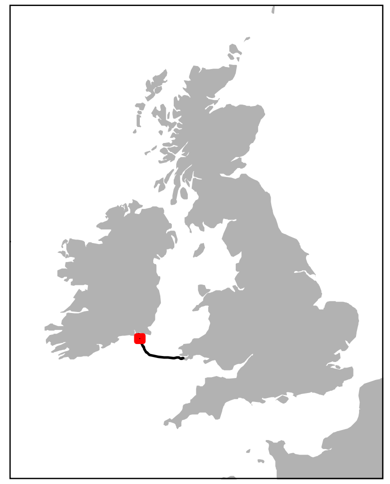
- SAC
- SPA
- SSSI
- National Park

Protected Sandbank Slightly Covered by Seawater

- Sandbank Area (High Confidence)
- Potential Sandbank

Potential Reef

- Bedrock (High Confidence)
- Bedrock (Potential)
- Stony (Potential)



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File Reference	J:\P1975\Mxd\01_LOC\ P1975-LOC-004.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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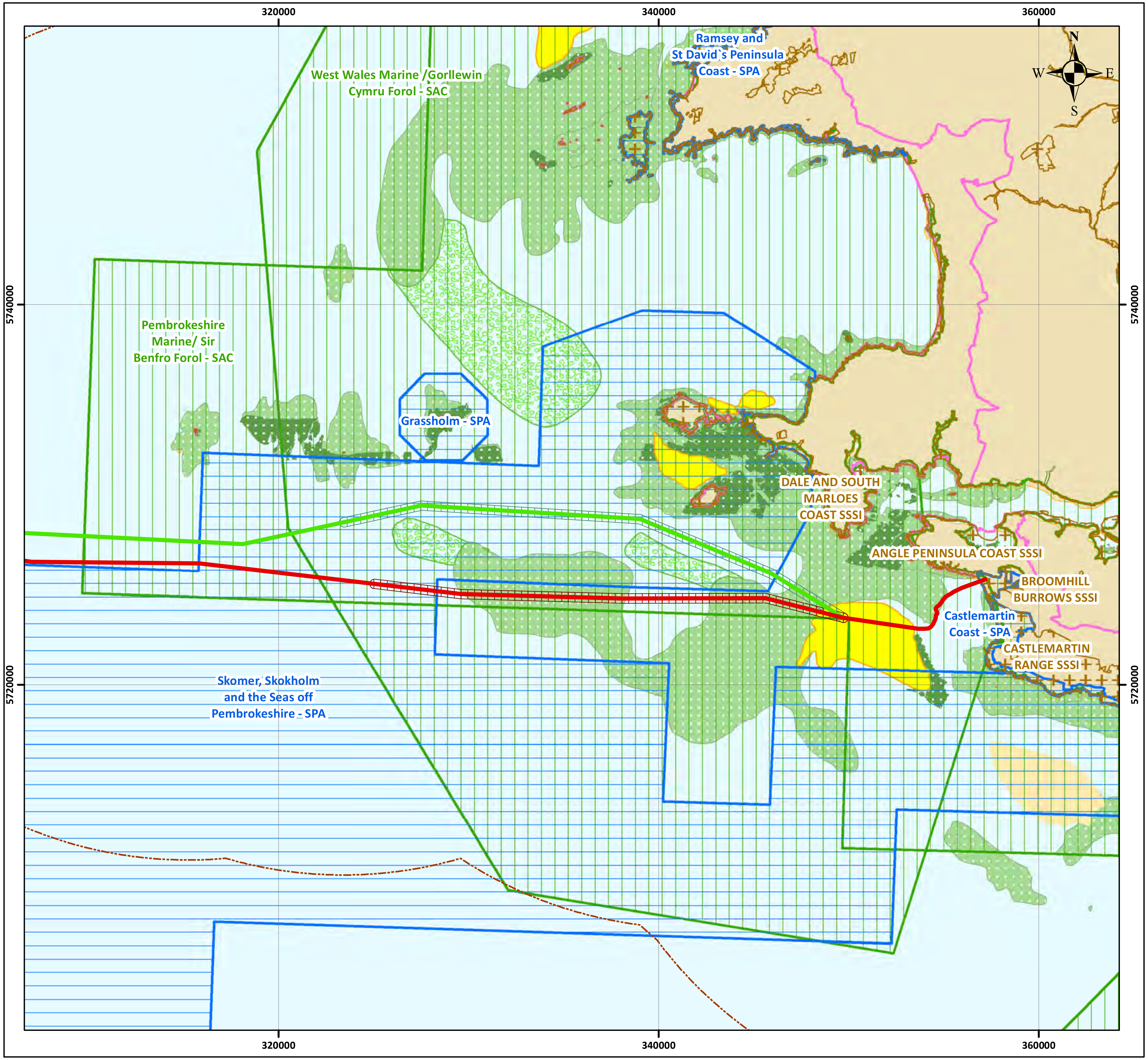
0 3 6 9 12 km



GREENLINK INTERCONNECTOR

ROUTE OVERVIEW

UK Route Development

Drawing No: P1975-SURV-011	A

Legend

- UK 12nm Territorial Sea Limit

Greenlink Interconnector Proposed Routes

- Route A Rev1
- Route E Rev1

Reconnaisance Section

- Route A (24.84km)
- Route E (27.62km)

Environmental Designations

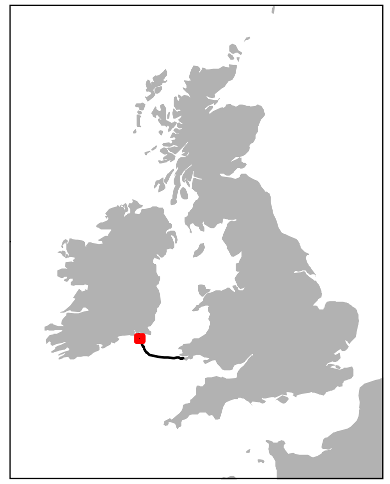
- SAC
- SPA
- SSSI
- National Park

Protected Sandbank Slightly Covered by Seawater

- Sandbank Area (High Confidence)
- Potential Sandbank

Potential Reef

- Bedrock (High Confidence)
- Bedrock (Potential)
- Stony (Potential)



NOTE: Not to be used for Navigation

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Data Source	UKHO; CDA; NRW; JNCC; GEBCO; Greenlink
File Reference	J:\P1975\Mxd\02_SURV\ P1975-SURV-011.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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0 2 4 6 8 km

3.5.5 Route refinements during survey

Extensive route development was carried out during the cable route survey. This fell into two categories;

- minor refinements as a result of identification of potentially challenging areas for cable installation e.g. large sand waves and areas of hard ground; and
- major route development to avoid reef habitat.

3.5.5.1 Minor route refinements

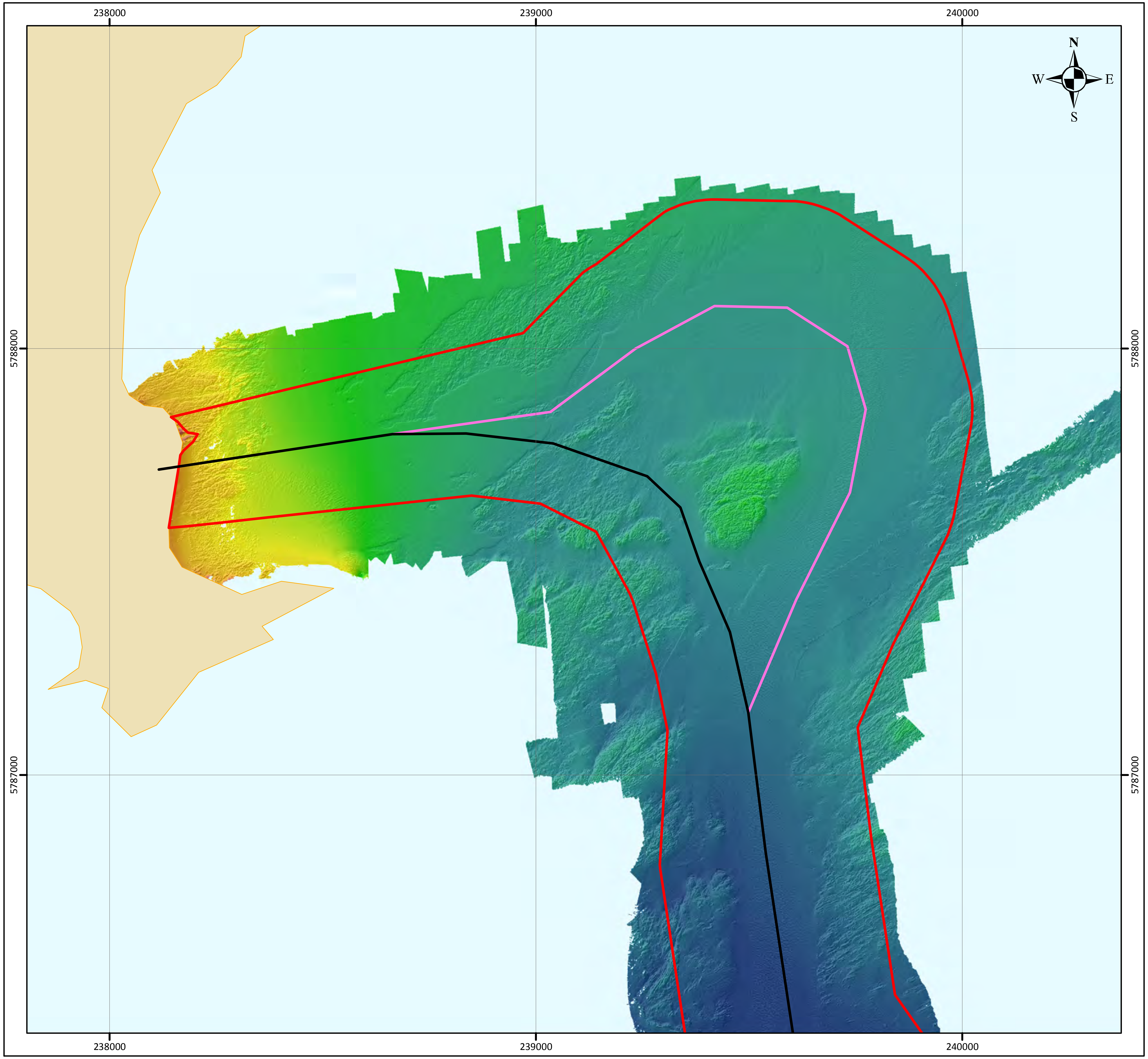
Proposed Development
On the approach to Baginbun Beach both Route A and Option D were surveyed (Figure 3-9, Drawing P1975-SURV-013). The small sand channel on Route A between outcropping rock features was approximately 35m wide at the narrowest point. This outcropping rock falls under the definition of Annex I Reef (Stony Reef); a Qualifying Interest Feature of the Hook Head SAC. Mapping of the bedrock reflector shows that installation of the cable along Route A would likely require external cable protection measures e.g. rock berm, in order to protect the cable.

However, mapping of the bedrock reflectors on Option D shows that there is sufficient sediment depth around the loop to achieve the likely required burial depths and protection for the cables. Therefore, although Option D increases the length of the cables, it has been selected as the preferred route as it avoids the sensitive reef habitat.

Marine Wales
At KP26 large sand waves are present (Figure 3-10, Drawing P1975-SURV-004). Additional survey lines were carried out to determine the extent of the sand waves and investigate the feasibility of routeing around them. The sand waves proved to be a sequence of sand waves that were too extensive, and a route around was not viable. No change to the indicative centreline could be made.

Pre-survey analysis of available SEACAMS bathymetric data provided by Bangor University identified a possible sandy channel system within the extensive rock outcrop (potential Annex I reef habitat) in nearshore Wales. The survey was engineered to acquire data over a 500m corridor with the intent to highlight more of the channel system within the bedrock.

Once the survey was outside the area covered by the SEACAMS data it was identified that the channel system deviated outside the initial survey corridor. Therefore, additional geophysical survey data was acquired showing that it was possible to follow the channel system northwest of the original route. A route was then developed to follow the channel avoiding the outcropping rock where possible, and survey data collected along this alignment; shown in Figure 3-11 (Drawing P1975-SURV-001). Survey data confirmed that there is likely to be sufficient sediment depth within the channel to achieve the likely required burial depths and protection for the cables.



GREENLINK INTERCONNECTOR

SURVEY DATA

Survey Bathymetry for Route A and Option D

Drawing No: P1975-SURV-013	A

Legend

Greenlink Interconnector Proposed Routes

- Route A Rev1
- Option D Rev1
- Proposed Development

Surveyed Bathymetry

Depth Below LAT (m)

High : 20

Low : -10

Date	Thursday, April 25, 2019 08:27:56
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Datum	D_WGS_1984
Data Source	OSI; MMT; Greenlink
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Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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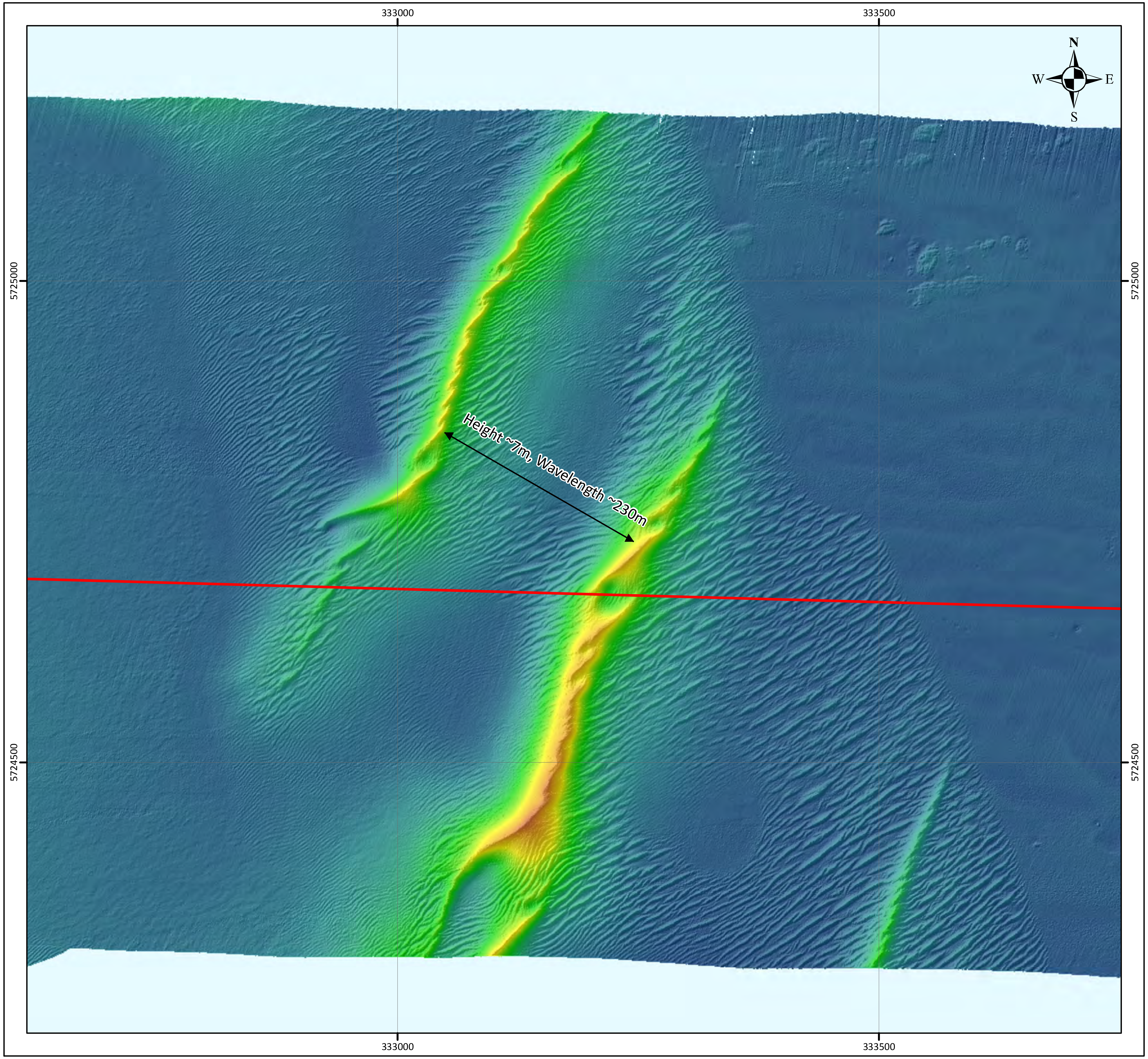
0 100 200 300 400



GREENLINK INTERCONNECTOR

SURVEY DATA

Bathymetry over Large Sandwave Area

Drawing No: P1975-SURV-004	**A**

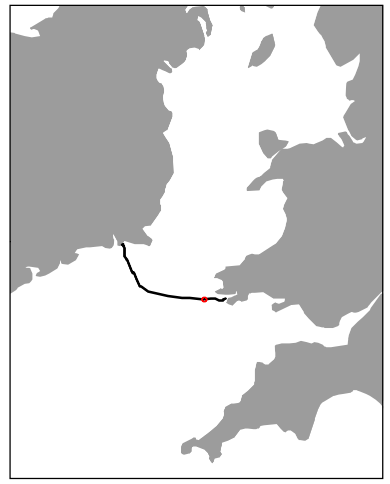
Legend

Post Survey Centreline

Survey Bathymetry Below LAT (m)

High : 60

Low : 45



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File Reference	J:\P1975\Mxd\02_SURV\ P1975-SURV-004.mxd
Created By	Chris Carroll
Reviewed By	Chris Goode
Approved By	Anna Farley

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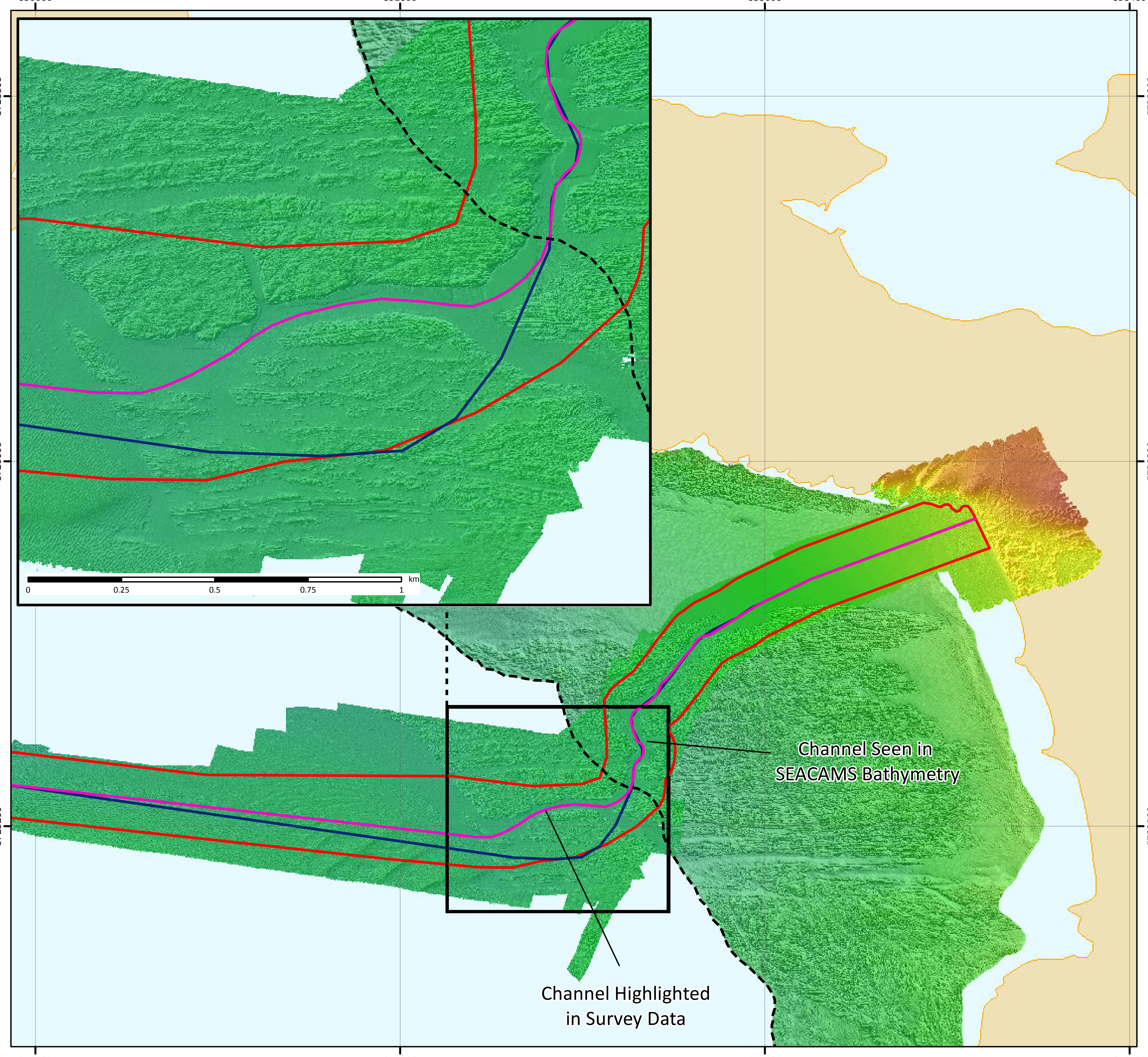
0 50 100 150 200 m



GREENLINK INTERCONNECTOR

SURVEY DATA

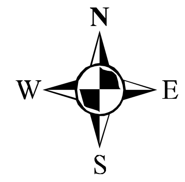
Bathymetry Nearshore Freshwater West

Drawing No: P1975-SURV-001	A

Legend

- Post Survey Centreline
- Pre-Survey Centreline
- Proposed Development
- Desktop Bathymetry Extent

Survey Bathymetry Below LAT (m)
High : 80
Low : -80



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File Reference	J:\P1975\Mxd\02_SURV\ P1975-SURV-001.mxd
Created By	Chris Carroll
Reviewed By	Chris Goode
Approved By	Anna Farley

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0 0.25 0.5 0.75 1 km

3.5.5.2 Major route development

The major route development focused on the route within Marine Wales, but has been included for information purposes as it sought to avoid or reduce the route length across Annex I Reef habitat.

On completion of the reconnaissance survey of Route A and Route E biotope maps, seabed photographs and an interpretive report were submitted to NRW for review. These identified extensive areas of Annex I Reef habitat on both routes. The Conservation Objectives for the Pembrokeshire Marine SAC for Annex I Reef habitat is that "*The overall distribution and extent of the habitat features within the site, and each of their main component parts is stable or increasing*".

Having reviewed the extent of the Annex I Reef biotopes described for the eastern section of Route A, NRW concluded:

"due to the extent of the reef and the type of reef habitats contained within, the presence of a cable and associated construction work and protective covering would compromise the conservation objectives of the feature, should this section of Route A be used. (NRW 2018a)"

The same rationale applied for the eastern sections of Route E where Annex I reef feature has been identified throughout the width of the corridor, the loss of reef in that area would also be too great to be considered insignificant.

NRW (2018a) 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 3-12, Drawing P1975-SURV-012) to identify if possible, the northern extent of the bedrock outcrop which formed the reef feature 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 (Figure 3-12, Drawing P1975-SURV-012).

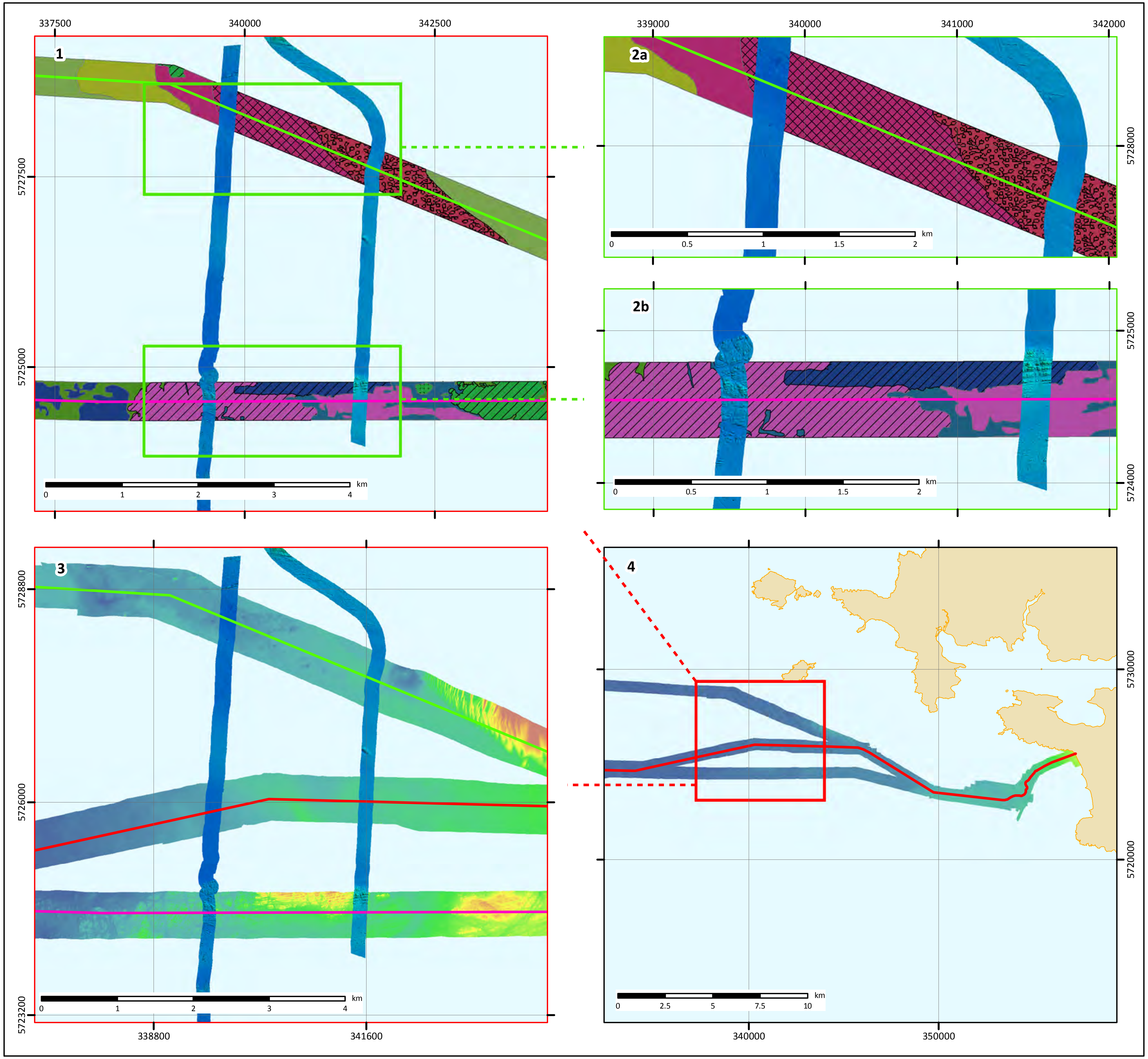
Seabed photographs, a biotope map and interpretative report were subsequently submitted to NRW for the new route section for review. NRW (2018b) considered the biotope to be present should be classified as A5.141 or SS.SCS.CCS.SpiB "*Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles". NRW considers this biotope forms part of the Annex I Reef (stony reef) habitat. However, NRW (2018b) advice concluded:

"NRW considers that this alternative route is likely to be preferable to routes A and E because:

- *The cobble/sediment biotope identified, potentially A5.141, will have a low sensitivity to the cable lay. If the cable is buried within this biotope, and covered with the existing sediments, recovery will occur as the sediments are routinely scoured and moved by wave and tidal action. As stated in the JNCC biotope description for A5.141 "This biotope is characterized by a few* *ubiquitous robust and/or fast growing ephemeral species which are able to colonise pebbles and unstable cobbles and slates which are regularly moved by wave and tidal action" and long-lived or delicate species are not regularly present.*

- *There are boulders and other potential Annex I habitats including Sabellaria reef present. The side scan and drop-down video however appear to indicate that these habitats can be avoiding through micro-siting of the cable.*

At this stage, and without prejudice to later comments made during the application phase, NRW would not consider that there would be significant issues with laying a cable within A5.141, should burial of the cable be possible within this habitat with covering of local sediments from A5.141 biotope. (NRW 2018b)"



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

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

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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

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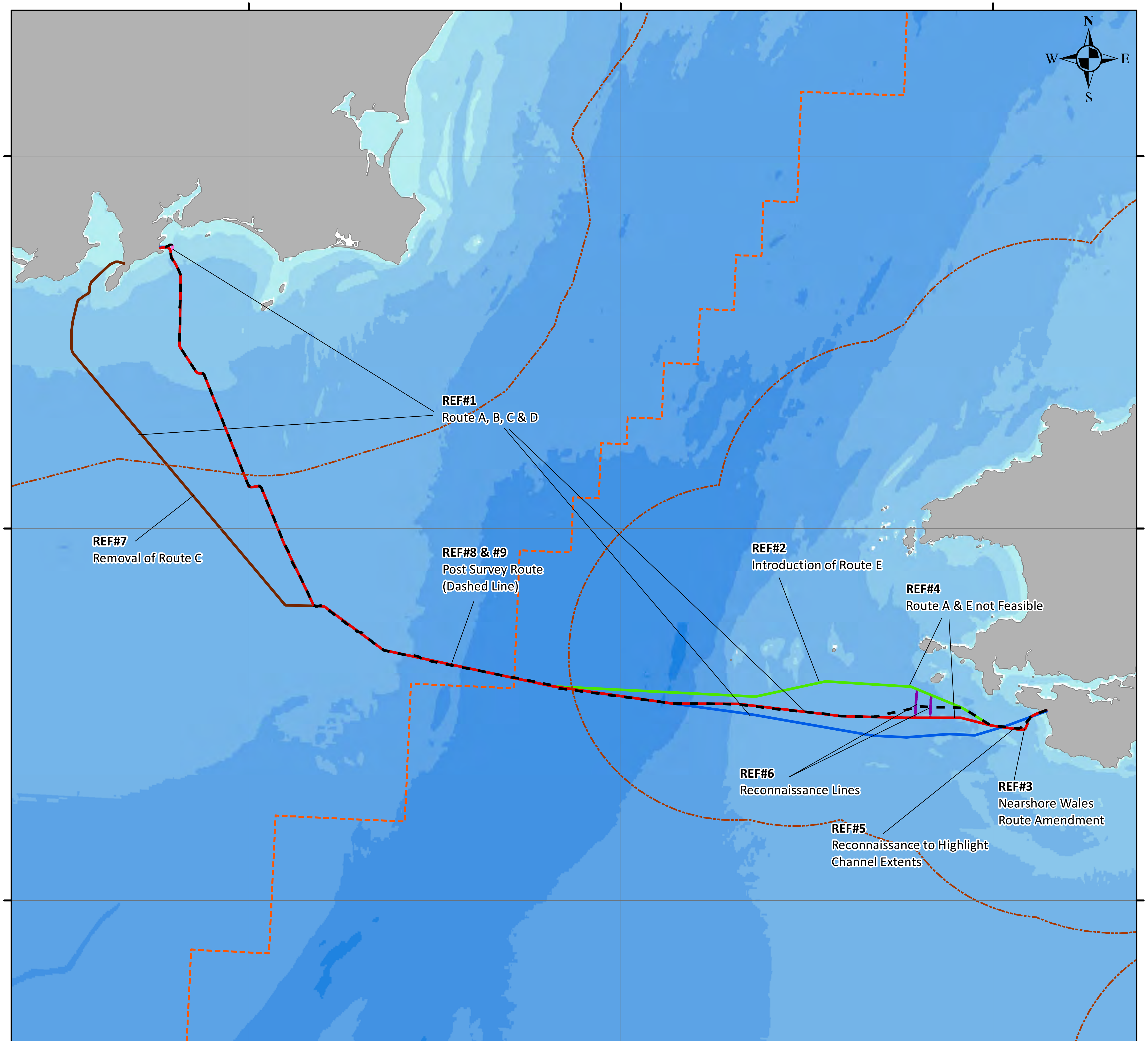
3.5.6 Summary of Route Development

The following flow diagram summarises the route evolution of the indicative Greenlink centreline and how the routes were developed during the offshore survey campaign. The reference numbers on the left hand side are to be read in conjunction with Figure 3-13 below (P1975-LOC-008-A).

REF#1 **Pre-Survey proposed routes**	• **Route A** – Preferred route from Freshwater West, Wales to Baginbun, Ireland • **Route B** – Route deviated to the south of a disposal area and into Castlemartin Firing Range • **Route C** - Route to different landfall (Boyce's Bay) in Ireland in case the preferred landfall, Baginbun, was not feasible • **Route D** – Small additional route at the Irish nearshore to avoid outcrop
REF#2 **New route to reduce impacts of crossing a designated reef feature**	• **Route E** – CMS (Greenlink lawyers, 18 April 2018) raised the concern that as reef is a designating feature of the Pembrokeshire Marine SAC, the project will need to demonstrate that all possible alternatives have been considered.
REF#3 **Amendment to nearshore Wales routes**	• **Route A & Route E Rev1** – Amended at the Welsh nearshore area and have been engineered into a natural channel within outcropping rock (Identified in the SEACAMS data). These are now displayed as Rev1. With the introduction of Route E, Route B was dropped.
REF#4 **Reconnaissance surveys along Route A and Route E**	• **Route A & Route E Rev1 –** Surveys carried out in October 2018 showed both routes contained area identified as an Annex 1 habitat and were not feasible.
REF#5 **Reconnaissance survey to highlight channel extents**	• **Route A & Route E Rev1** – The full extent of the channel area was not highlighted in the SEACAMS data therefore additional reconnaissance bathymetry lines were acquired to visualise a wider area to highlight where the channel ended and if it was feasible to practically install a cable.
REF#6 **Re-routed area avoiding Annex 1 habitats identified on Route A & Route E**	• **Re-Routed area** – North-South Reconnaissance lines were carried out between Route A and E to find the extent of outcrop associated with the Annex 1 habitat. Once the outcrop was highlighted, Geophysical Survey data was acquired within a new East-West oriented survey corridor which joined Route E to A.
REF#7 **Excluding Route C from Geophysical investigation work**	• **Route C** – Once survey was complete on the preferred Route A in Ireland and that the preferred landfall at Baginbun was confirmed as feasible, Route C was removed.
REF#8 **Post Survey Centre Line**	• **Greenlink_WGS84_UTM30N_09112018_Rev0** – The post Survey Greenlink route has used a combination of Route A, Route E, Route D, the re-routed area to avoid Annex 1 habitats and reconnaissance at the end of the old river channel area to arrive at a single route centreline.
REF#9 **Post Survey Centre Line Rev1**	• **Greenlink_WGS84_UTM30N_09112018_Rev1 –** Further refinement of the Greenlink route using processed survey data to avoid identified constraints and areas interpreted as Annex 1 habitat.



GREENLINK INTERCONNECTOR

ROUTE OVERVIEW

Pre Survey & Post Survey Route Centre Lines

Drawing No: P1975-LOC-008	A

Legend

Post Survey Route Centre Line

- Greenlink Route Cenreline (Indicative)*
- Median Line
- 12nm Territorial Sea Limit

Pre Survey Route Centre Line

- Route A Rev1
- Route B Rev0
- Option C Rev0
- Option D Rev1
- Route E Rev1

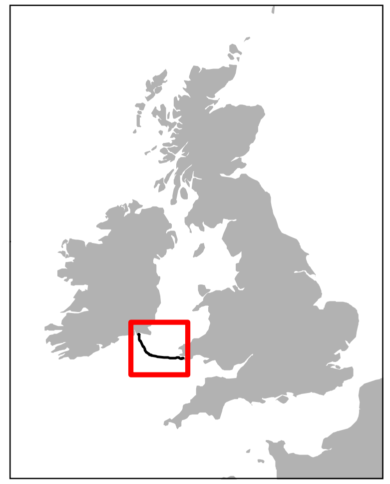
Survey Reconnaissance Lines

- North South Reconnaissance Lines

Bathymetry (m)

- -150 - -125
- -125 - -100
- -100 - -75
- -75 - -50
- -50 - -20
- -20 - -10
- -10 - 0

*Greenlink_WGS84_UTM30N_05042019_Rev1.shp



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File Reference	J:\P1975\Mxd\01_LOC\ P1975-LOC-008.mxd
Created By	Chris Carroll
Reviewed By	Chris Goode
Approved By	Anna Farley

Greenlink

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intertek

0 5 10 15 20 km

3.6 Summary of Alternatives

Table 3-3 summarises the alternatives considered and the environmental considerations behind the decision to discount options.

Table 3-3 Summary of alternatives

Category	Option	Description and Environmental Considerations	Decision
Strategy	Do Nothing	• The 'do nothing' option dictates that generation of electricity needs to be based in the country where it is used and constrains export of electricity when generation exceeds demand. • Option is not supported by Irish government and EU policy as it goes against the European Commission's priorities and commitments to combating climate change.	DISCOUNTED
	Install Interconnector	• Increases the transmission capacity between countries and improves security of supply. • Supports the growth and integration of low carbon energy. • Greenlink has been awarded Project of Common Interest (PCI) status by the European Commission, making it one of Europe's most important energy infrastructure projects and granting it the "highest national significance" possible.	SELECTED
Technology	HVAC	• HVAC interconnector between the Irish and GB grids is not technically and economically feasible as: - The Irish and British grids are not "synchronized",- without this synchronization, power cannot be successfully transmitted between the grids with an HVAC interconnector; - The capacity of HVAC underground or subsea cables to transmit power reduces significantly with distance travelled such that an HVAC interconnector would not be an economic means to transmit power between Ireland and GB • HVDC cable is the more efficient technology experiencing lower losses (e.g. heat) when compared to HVAC cable.	DISCOUNTED
	HVDC		SELECTED
Connection Point	Great Island	• 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.	SELECTED

Category	Option	Description and Environmental Considerations	Decision
Landfall / Offshore route	Direct to Great Island via River Barrow	• Would require routeing through the River Barrow and River Nore SAC an important spawning area for Annex II listed fish species including Salmon, Twaite shad and three lamprey species. • Would require technically challenging shallow water installation. Substantial constraints in the form of navigation channels, dredged channels and designated anchor zones. • Port of Waterford Company had significant concerns about any route within the estuary.	DISCOUNTED
	Baginbun Beach	• Offers the shortest overall offshore cable route length and met the technical requirements other landfalls fell short on. • A sand channel with sufficient depth to achieve cable burial has been confirmed during the cable route survey through the Hook Head SAC, ensuring significant adverse effects on the Reef Qualifying Interest can be avoided.	SELECTED
	Sandeel Bay	• Sandeel Bay was de-selected when analysis of INFOMAR bathymetric data identified likely extensive reef habitat offshore. Any route to the landfall would likely require extensive external cable protection on the Qualifying Interest Reef. It could not be discounted that this would not lead to significant adverse effects on the Hook Head SAC.	DISCOUNTED
	Boyce's Bay	• The Port of Waterford Company expressed strong reservations regarding the route as it entered the shipping channel. The Port Company required the cable route to be as close to the headland as possible, an area which may have only a veneer of sediment overlying rock which would likely result in external rock protection being required. • The outcropping rock is likely to be Annex I Reef (Stony Reef) habitat and although not within the Hook Head SAC, forms part of the wider habitat for which the site is designated. • The landfall was discounted in 2018 when the cable route survey confirmed a route into Baginbun Beach was feasible.	DISCOUNTED
	Booley Bay	• Consultation with the Port of Waterford was undertaken on 09 March 2016. A 100m wide corridor (marked on Admiralty Chart) is dredged at Duncannon	DISCOUNTED

Category	Option	Description and Environmental Considerations	Decision
		approximately 3-4 times a year, to stop the shipping channel from silting up. The offshore approach to the landfall would intersect this area risking both the ports activities and the cable. Therefore, Booley Bay was dropped from further consideration on environmental grounds as it would have a significant effect on another marine user.	

3.7 *Proposed Development*

The final Greenlink route being taken forward for consent in Ireland and Wales is shown in Figure 1-1 (P1975-LOC-001). Figure 3-14 (Drawing P1975-CORR-002) presents the Proposed Development in Ireland. An indicative centreline is shown on the Figure, noting that this will be subject to change as micro-routeing is undertaken within the consented corridor by the Installation Contractor.

The advantages of the final route, in comparison to alternative routes considered are:

Proposed Development

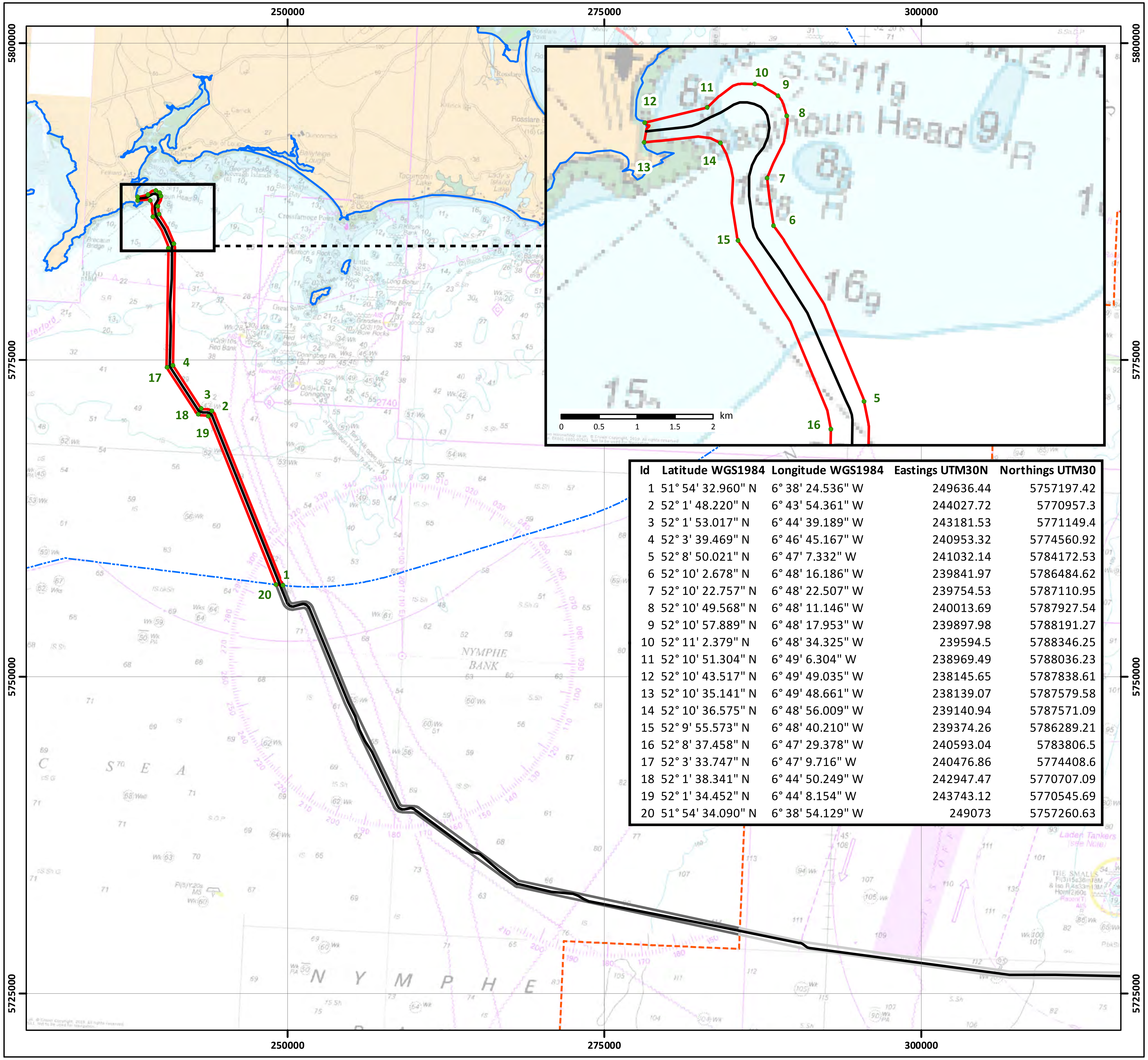
- The installation solution at the landfall has been selected as horizontal directional drilling, which will ensure that intertidal Annex I reef habitat is not affected by the Proposed Development, and disruption to the recreational use of the beach is minimised.
- The route uses an existing sand channel between extensive Annex I reef habitat within the Hook Head SAC. Survey has confirmed that the sand channel contains adequate sediment cover to allow full burial of the Greenlink cables; although a contingency to place external cable protection at the HDD exit points is being considered as a worst case.
- The route avoids shipping channels in to and out of Port of Waterford.

Offshore Ireland

- The route avoids the extensive area of sand waves by routeing to the south.

Marine Wales

- The route minimises the area of Annex I reef habitat crossed and avoids the most sensitive habitats where cable installation may have significantly affected the conservation objectives of the Pembrokeshire Marine SAC.
- The route minimises the length within the Castlemartin Firing Range while avoiding other constraints such as presence of Annex I reef and historical dumping sites.



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GREENLINK INTERCONNECTOR
PROPOSE DEVELOPMENT
ROI Waters

Drawing No: P1975-CORR-002 | **A**

Legend
- Application Area Points
- Greenlink Route Centreline (Indicative)
- Proposed Development
- Irish Offshore
- Wales Marine
- ROI Mean High Water
- ROI 12nm Territorial Sea Limit
- Median Line

Date	Tuesday, April 23, 2019 08:39:30
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; OSI; CDA; GEBCO; UKHO; MarineFind
File Reference	J:\P1975\Mxd\03_CORR\ P1975-CORR-002.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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3 Intertek EWCS (2016a). Greenlink Interconnector Route Selection Report, P1975_RN3929_Rev2, January 2016.

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5 Intertek EWCS (2018a). Greenlink Cable Route Report, P1975_BN4437_Rev1, February 2018

6 Intertek EWCS (2018b). Greenlink Cable Route Report, P1975_BN4437_Rev2, August 2018

7 Intertek EWCS (2019). Greenlink Cable Route Report, P1975_BN4437_Rev3, April 2019.

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4. Project Description

4.1 Introduction

This Chapter presents information on the Proposed Development – the Irish Marine components of Greenlink from mean high-water springs (MHWS) at Baginbun Beach, Co. Wexford, to the 12nm limit. It also includes information on the Campile Estuary component of Greenlink - an area of foreshore at the Campile Estuary where the land cables cross underneath the River Campile.

Information is also provided on the Irish Offshore components of Greenlink from the 12nm limit to the Republic of Ireland / UK median line.

The installation, operation (including repair & maintenance) and decommissioning phases of Greenlink are described in terms of the likely component options and their installation as follows:

- **Installation:** Options for the submarine cable installation process including the pre-installation surveys, the range of vessels to be used and different installation techniques which could be employed in submarine cable laying, jointing and burial.
- **Operation:** The physical characteristics of the submarine cables including information about their design, operation, repair and maintenance. Emissions produced during operation, in the form of heat, and electric and magnetic fields are discussed.
- **Decommissioning:** The recovery and dismantling activities involved in decommissioning a typical submarine power cable at the end of its operational life.

A summary of the elements of Greenlink is provided in Section 4.2.

4.2 Project overview

Greenlink is a proposed subsea and underground electricity interconnector cable between the existing electricity grids in the Republic of Ireland and Great Britain with a nominal capacity of 500 megawatts. Greenlink will provide a new interconnector between EirGrid's Great Island substation in County Wexford (Ireland) and the National Grid's Pembroke substation in Pembrokeshire (Wales). The power will be able to flow in either direction at different times, depending on supply and demand in each country.

The high voltage grid systems in the UK and Ireland operate using high voltage alternating current (HVAC). To transport the electricity from one country to the other, the HVAC power is converted to high voltage direct current (HVDC) at a converter station located onshore and transmitted by means of HVDC cables to the other converter station, whereupon it is converted back from HVDC to HVAC for integration into the high voltage work in the other country.

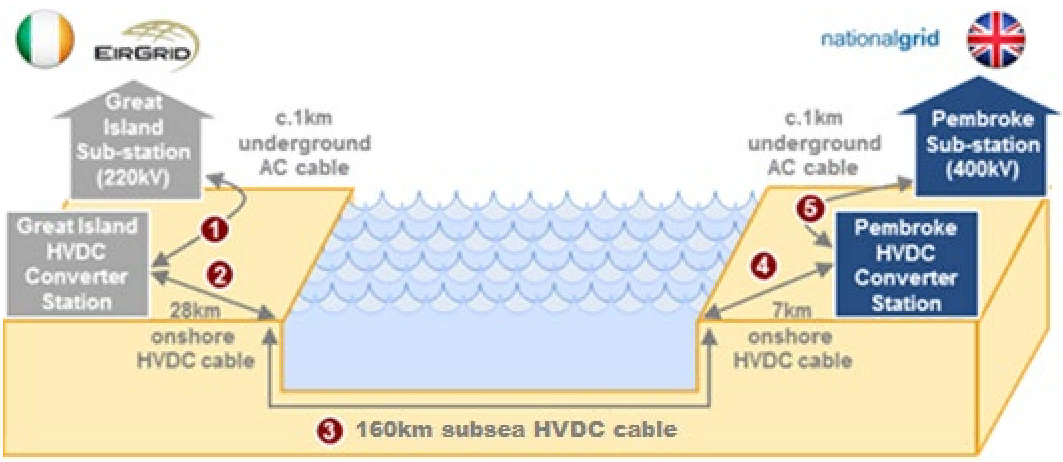
Greenlink will consist of two converter stations, one close to the existing substation at Great Island in County Wexford (Ireland) and one close to the existing substation at Pembroke in Pembrokeshire (Wales). The converter stations will be connected by two HVDC cables under the Irish Sea. HVDC provides the most efficient and effective means to transport electricity over the distance involved.

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 (this application). An application for consent for the Irish Onshore components of Greenlink will be submitted to An Bord Pleanála. Further to this, an application will be submitted to Pembrokeshire County Council for the Welsh Onshore components.

A Marine License application for the installation and operation of submarine cables has been submitted to Natural Resources Wales that covers the Welsh Marine.

The proposed connection points are Freshwater West, Pembrokeshire, Wales and Baginbun Beach, Co. Wexford, Ireland. Figure 4-1 presents a schematic of Greenlink, and Figure 4-2 (Drawing P1975-CORR-002) presents the Proposed Development. The total length of the Greenlink marine cables is 159.27km of which 35.65km forms the Proposed Development in Irish territorial waters and 49.72km is within Irish Offshore waters.

Figure 4-1 Pictorial representation of Greenlink



4.3 Submarine cable route description

The submarine cable corridor derived from preliminary cable route engineering, consultation with stakeholders and survey is shown in Figure 4-2 (Drawing P1975-CORR-002). Kilometre points (KPs) have been assigned to the route running from KP0 at MHWS, Freshwater West to KP159.27 at MHWS, Baginbun Beach. The proposed submarine cable corridor crosses the UK/Republic of Ireland median line at KP73.8.

The proposed submarine cable corridor (for which consent for installation of the marine cables will be applied for) is generally 500m wide. A small part of this width will be required for installation (of the order of 10-20m) once the final cable route within this corridor is agreed. 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, such as avoidance of:

- Unexploded ordnance (UXO);
- Boulders;
- Undulations as troughs and ridges;
- Mobile sand features as sand waves;
- Areas of hard soils and gravels;
- Sensitive habitat features such as bedrock, stony or biogenic reef;
- Steep slopes;
- Any debris not removed prior to installation; and
- Other magnetic anomalies.

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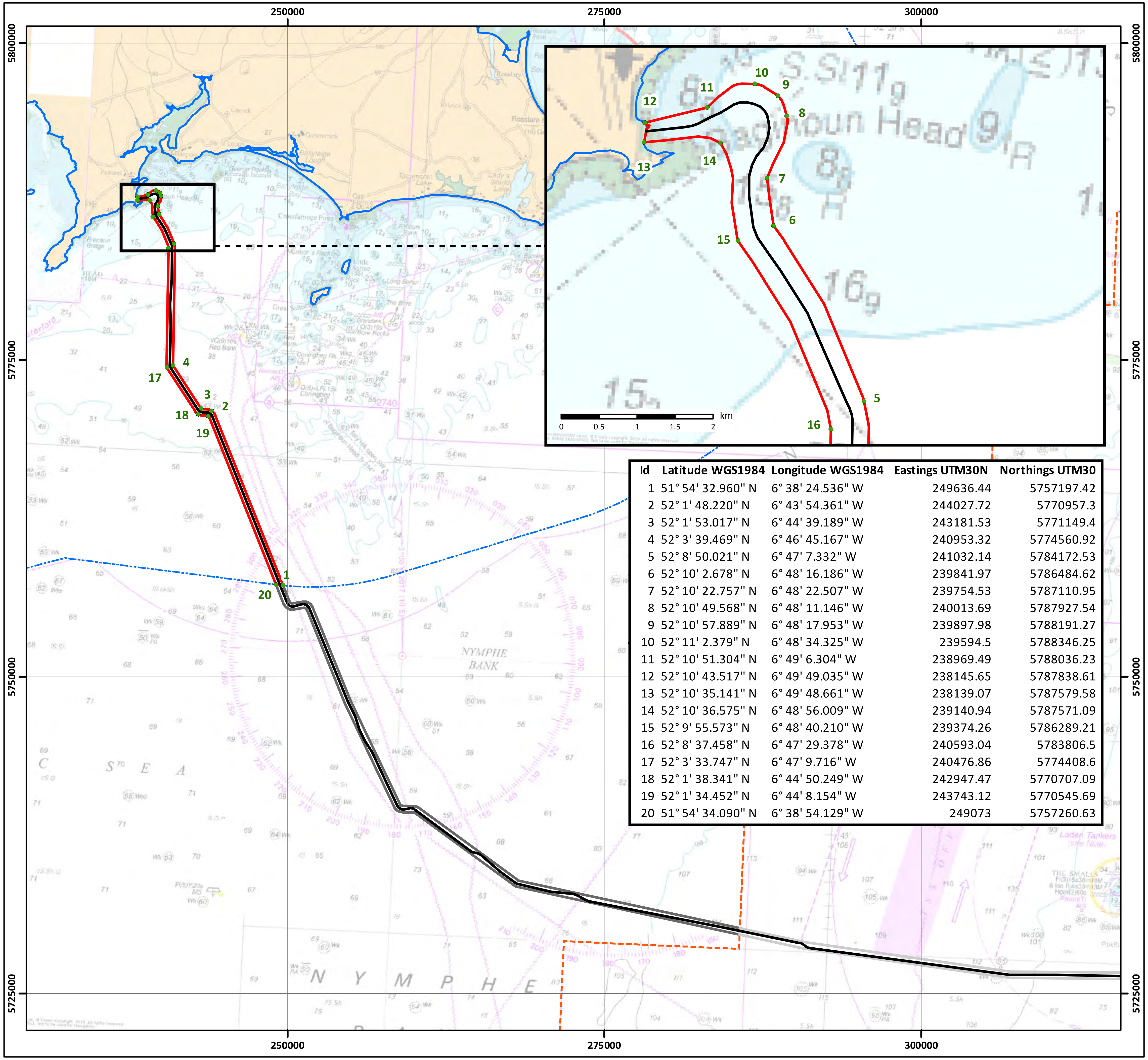

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Legend
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N E S W

NOTE: Not to be used for Navigation

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Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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4.4 Submarine cable description

Greenlink will be a submarine cable system including two HVDC cables, laid alongside each other. A fibre optic cable will also be laid for control and communication purposes. It is likely that cables will be bundled together and installed with no separation between the cables (Figure 4-3).

The cable will be a cross linked polyethylene (XLPE) cable (Figure 4-4). XLPE is an extruded polyethylene material that is thermoset after extrusion through a controlled heating process. XLPE cables have been in use for alternating current (AC) applications since the 1980s and for HVDC applications since around 2000 and have proven to be reliable.

Figure 4-3 Typical cable bundle arrangement

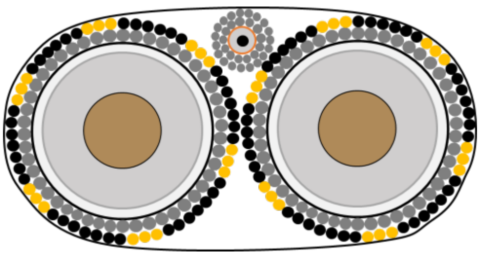
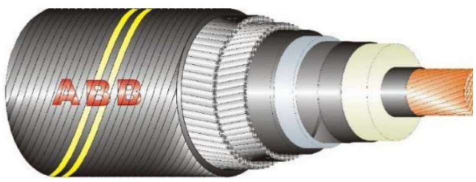


Figure 4-4 Example of XLPE submarine cable



The cable will have a lead sheath, to ensure no moisture can penetrate the insulation, and steel wire armour to protect the cable from external damage during installation and burial/protection. The armouring is made from round or flat steel wire wound in a helical form. Over the armour wires a polyethylene sheath is applied to make the cable easier to handle and ensure the armour wires remain in place during bending. The cable conductor will be either Aluminium or Copper.

Each cable will be approximately 120-130mm in diameter (260mm per bundle) and will weigh approximately 35-40kg/m. They will operate at a voltage of 320kV.

4.5 Indicative programme

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 project is envisaged to commence on-site construction in late 2020 and be fully operational in 2023. Table 4-1 presents an indicative programme of 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 EIA process.

The exact timing of the landfall works will be dependent upon the offshore works and licensing conditions that will be designed to limit the potential for significant effects on features of conservation interest. The landfall preparatory works may be undertaken in winter months when there will be fewer people using the beach areas.

To determine whether Project Specific Mitigation is required the EIA has assumed activities could occur at any time of the year.

Table 4-1 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

4.6 Pre-installation works

4.6.1 Unexploded Ordnance (UXO) survey

Given the nature of the marine development, there is a risk that UXO may be encountered during intrusive activities e.g. during survey campaigns and the subsequent cable installation. UXO can present a high risk to vessels, personnel and the environment if encountered within the Proposed Development and specifically within the footprint of the installation equipment.

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 study determined the relevant military history of the area crossed by the Proposed Development, the types of UXO used, and the expected presence and distribution of these UXO. The study concluded that the risk from different types of UXO is not homogenous and broadly split the Greenlink route into four zones:

1. Zone 1: Welsh mainland – risk from land service ammunition (LSA), small arms ammunition (SAA) and unexploded bombs (UXB's) identified.
2. Zone 2: Eastern offshore – larger items such as sea mines, but also risk from smaller items such as projectiles and other land service ammunition (LSA).
3. Zone 3: Western and central offshore – primary risk is from larger items of ordnance, mainly sea mines.
4. Zone 4: Irish mainland - no significant risk of UXO identified.

The Proposed Development lies within Zones 3 and 4. The assessment concluded that for Zone 3 the risk is medium to high; and low for Zone 4 (see Technical Appendix J, Appendix i and ii).

It is possible that an UXO survey, using a magnetometer array, will be undertaken prior to installation. This is typically undertaken by the cable installation contractor within six months of cable installation starting, using one vessel. It is unlikely that the entire cable route would be surveyed; instead potential hotspots would be targeted. It has been assumed that UXO survey would be required in the Proposed Development.

Magnetometers are passive devices which detect magnetic anomalies compared to the earth's magnetic field such as those caused by geological faults and buried metallic objects (e.g. pipelines, cables, ordnance) that may not be detected by standard geophysical survey equipment i.e. side scan sonar survey.

4.6.2 Geophysical survey

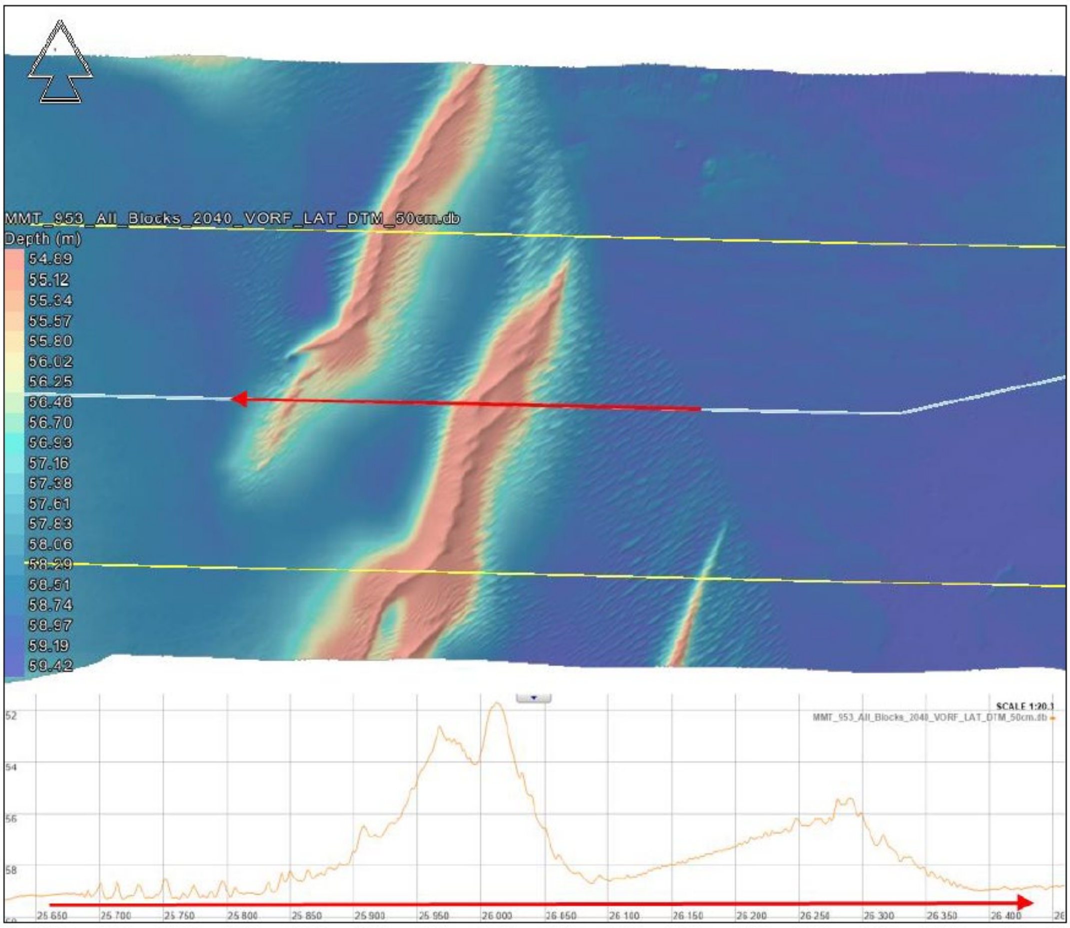
Although detailed engineering surveys have been completed for Greenlink (September to December 2018), there is the potential that the Installation Contractor will conduct further surveys prior to the commencement of cable installation.

The objectives of these surveys are to confirm that no new obstructions have appeared on the seabed since the original marine surveys were undertaken, and to confirm the viability of the proposed centreline of the marine cables within the submarine cable corridor with regard to seabed conditions, bathymetry and any other seabed features.

The survey will involve standard geophysical survey techniques as follows:

- **Bathymetry:** Swathe and multi-beam acoustic echo sounder systems are used to record water depth, prepare a 3D digital terrain model of the route and to describe the seabed topography along the submarine cable corridor. The 3D terrain model built from the bathymetrical data will be used to identify mobile seabed features and, where applicable, to assess the mobility of these mobile seabed features by comparing its location relative to the previous route survey. An example of the type of data obtained is presented as Figure 4-5.

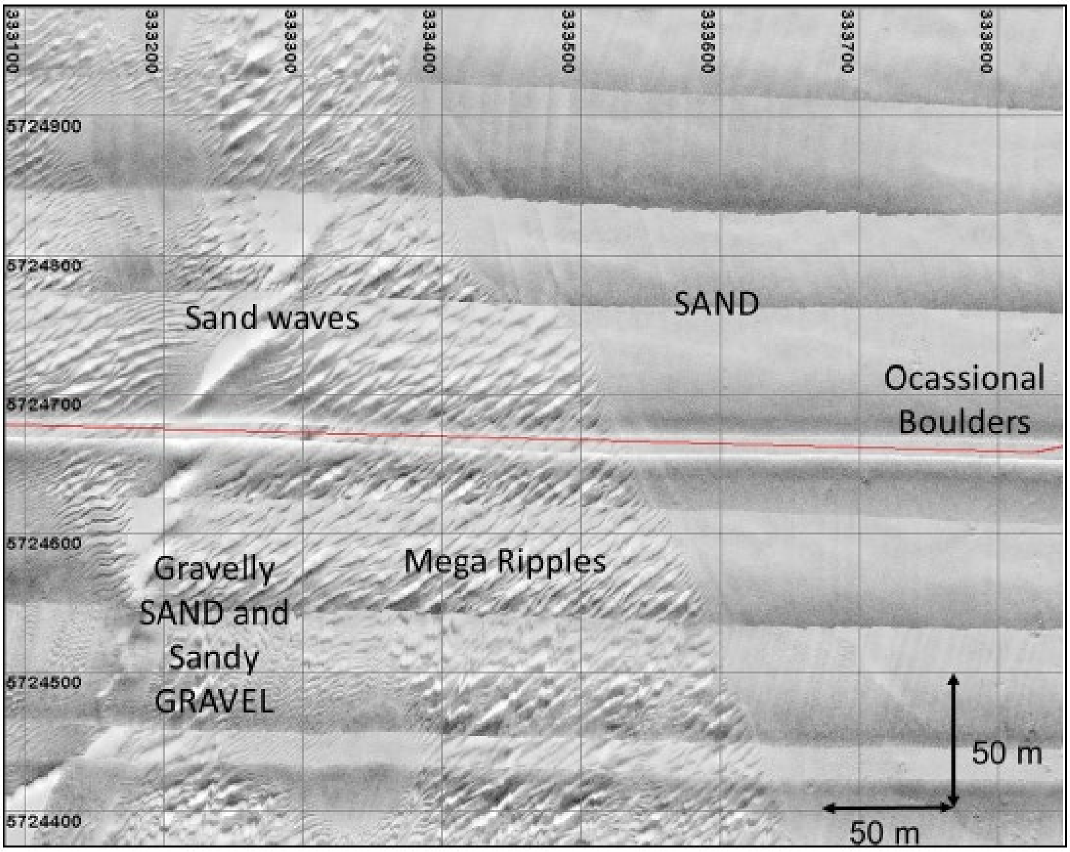
Figure 4-5 Example multi-beam image from Welsh Marine



Source: MMT (2019) – Shaded bathymetric relief showing ripples and sandwaves between KP25.685 and KP26.390

- **Side Scan Sonar (SSS):** The sonar signal is emitted from a towfish towed behind the survey vessel along the submarine cable corridor. Reflections from sediments and other hard objects are received back at the towfish and processed on board the survey vessel to produce an image of the seabed. This technique enables mapping of the seabed surface and identification of sediment types, but cannot determine the thickness of sediments. Obstacles lying on the seabed, such as wrecks, trawler debris and telecommunication cables that might impede cable installation can be identified from the SSS image. An example of the type of data obtained is presented as Figure 4-6.

Figure 4-6 Example SSS image



Source: MMT (2019) – SSS plan view from KP25.369 to KP26.129.

- **Sub-Bottom Profiler (SBP):** It is unlikely that this survey is required. In the event that the installation contractor chooses to obtain additional data, this technique involves injecting a pulse of acoustic energy into the seabed and detecting the reflections from the sub-surface geological units. From the reflections the thickness of the sediment can be assessed, but the type of sediment can only be inferred until "ground-truthing" geotechnical data is obtained.

In addition, geotechnical investigations may be taken to verify ground conditions in the light of cable burial as well as to assess the bearing capacity of the soil with regards to crossing structures and trenching equipment intended to be used.

Greenlink crosses six existing telecommunication cables; five in service and one out of service. Although the 2018 marine route survey included visual inspection of the crossing locations and depth of burial measurements with a remotely operated vehicle (ROV), it is possible that the third-party asset crossing agreements (see Section 2.5) may stipulate that additional ROV inspection is required.

4.6.3 Route preparation

A pre-lay grapnel (see Section 4.6.3.1 below) will be towed along the entire route to prepare the cable centreline for installation. Other types of seabed preparation may be required in certain areas. Examples include:

- UXO clearance; and
- Route preparation at subsea cable crossing locations.

4.6.3.1 Pre-lay grapnel

Seabed debris such as scrap trawler warps or ships' crane wires that may have been jettisoned by vessels onto the seabed and other debris can be detrimental to the installation process. To clear the route of detected and any undetected debris, a small vessel will be mobilised to remove them during an operation known as a 'pre-lay grapnel run' (PLGR). The PLGR vessel tows a wire with a string of specially designed hooks, or grapnels, along the centreline of the cable route until it encounters debris. The tow winch is fitted with a strain gauge which will detect the rise in tension as an object is hooked. The PLGR grapnel will be designed to snatch debris on the surface and just below the surface.

Debris caught with the grapnel will be recovered to the deck of the vessel for appropriate licensed disposal ashore. Cable installation will be carried out in several campaigns, the length of which is related to the cable carrying capacity of the main lay vessel. The PLGR operation may therefore be phased to ensure that the route is clear of any recent debris before each campaign.

4.6.3.2 UXO clearance

The primary objective will be to avoid encountered potential UXO by micro-routeing within the permitted corridor (Proposed Development). Typically, a standoff distance of 15-25m relative to potential UXO, and depending on the nature of the UXO and installation method, is considered safe for cable installation purposes.

If re-routeing around a particular potential UXO appears not to be possible, this potential UXO will be investigated. If visual inspection confirms a UXO, then if it is safe to do so the UXO will be removed, or as a last resort demolition measures will be undertaken in accordance with Best Practice.

As a precautionary measure, GIL will apply for permission to detonate one UXO up to 794 kg in size. This is the maximum size of charge identified as potentially present within the Proposed Development by the 1st Line Defence UXO desk-based study (Technical Appendix J) and correlates to a sea mine from World War II.

4.6.3.3 Route preparation at subsea cable crossing locations

The submarine cable corridor crosses two types of cables: out of service (OOS) and in-service (IS) telecommunications cables.

OOS cables

Greenlink crosses one OOS telecommunications cable; the Celtic telecommunications cable, within the Proposed Development. GIL is in discussion with the cable owners (BT) to cut the cable. To do this a de-trenching grapnel is used to retrieve the OOS cable from the seabed. The de-trenching grapnel typically penetrates 1.5 – 2.0m into the seabed. Once retrieved the OOS cable is cut and the ends secured to the seabed in accordance with International Cable Protection Committee (ICPC) recommendation No 1 (ICPC 2014), i.e. with clump weights which reduces the risk of hooking behind the cable ends by for instance fishing gear.

The clearance of OOS cables will be undertaken by a dedicated vessel equipped with a ROV for subsea intervention.

IS cables

Greenlink crosses five IS telecommunication cables. Of these four are in the Irish Offshore component of Greenlink and one is in the Wales Marine area. The assets and crossing locations are provided in Section 4.7.4, Table 4-2 below.

As explained in Section 2.5, the crossing of third-party infrastructure is made with prior agreement of the owners following a negotiated formal Crossing Agreement. This will lay out the design of the crossing, describing aspects such as crossing angle and the vertical separation to be achieved between the Greenlink interconnector and the third-party asset.

The crossing physical design will vary according to, among other things, the size, type, location and burial state of the crossed asset. Generally, the Greenlink interconnector will cross over the IS cables on a 'bridge' comprised of either aggregate (rock) or concrete mattresses. It is this first layer of protective material that will be positioned during route preparation. Construction of the remainder of the crossing is described in Section 4.7.4. The EIA process considers the worst case dimensions for the crossing.

4.7 Cable installation

4.7.1 Installation vessels

The cable lay operation will be performed on a 24-hour basis to ensure minimal navigational impact on other users and to maximise efficient use of suitable weather conditions and vessel and equipment time. Notifications will be issued in accordance with statutory procedures to ensure navigational and operational safety. In addition to the installation vessel(s), additional vessels (i.e. guard vessels) will be involved with the operation. Although exact details may change, it is likely that the vessels to be used will consist of:

- Cable lay vessel (CLV) – undertakes cable lay and burial;
- Jack-up barge (JUB) – may be used at the horizontal directional drill exit point to support the pull-in of the cables.
- Cable lay barge (CLB) – may be used in water depths of less than 10m;
- Small work boats – support the CLV, CLB and JUB e.g. during cable pull-in operations;
- Guard vessel(s) – used to protect areas of exposed cable prior to external protection being applied;
- Rock placement vessel – used to deposit the external protection material e.g. rock berms;

4.7.1.1 Cable lay vessel (CLV)

The cable lay vessel (CLV) is a specialist ship designed specifically to carry and handle long lengths of heavy power cables. CLV's are equipped with dynamic positioning (DP) systems, which enable the ship to be held very accurately in position despite the effects of currents and wind.

Figure 4-7 Cable lay vessels

The cable is loaded onto the ship at the cable factory. The CLV's have powered turntables so that the cables can be wound on without coiling. The factory is also equipped with a turntable as well as a purpose built dock with rollers and guides so the transfer of cable is smooth and safe for the integrity of the cable. Once loaded the vessel transits to a port, close to the worksite for final mobilisation of cable handling crew, client's staff and equipment prior to heading to the work site. The vessels can carry long lengths of cable, up to and perhaps in excess of 100km, depending on the vessel used and the final design of the cable.

Figure 4-8 Typical factory and cable laying vessel turntables

4.7.1.2 Jack-up barge (JUB)

The shore crossing i.e. where the submarine cables come ashore and connect to the land cables, will be made by a horizontal direction drill (HDD). This is described in detail in Section 4.8. The HDD ducts will exit below the low water mark. It is likely that the HDD will be completed ahead of the cable lay campaign.

A jack-up barge (JUB) may be used at the HDD exit to either excavate the end of the HDD duct and/or support the cable pull-in through the HDD.

A JUB is a small platform that typically has four to eight legs. The number of legs used for the operation is dependent on seabed conditions, current strength, wave action and the selected contractor. The JUB would be towed into position by a tug, which is likely to remain close by, in a support capacity, through-out the operation.

4.7.1.3 Cable lay barge (CLB)

The main CLV cannot typically operate in water depths of less than 10m so cannot reach the beach to directly land the cables. Therefore, a separate shallow water spread, such as a CLB, may also be needed.

Shallow water spreads are normally based upon flat-top pontoon barges that are mobilised on an ad-hoc basis for cable work. They will be fitted with all the necessary cable storage and working gear and a four to six-point mooring system (anchors), which is used to manoeuvre the barge during cable work. Occasionally two barges are combined into a single spread, with one providing storage and deck working space and another providing motive power by use of anchors or thrusters.

The CLB may be assisted by a team of small boats and divers, depending on the installation technique selected by the contractor.

The horizontal direction drill for the shore crossing will exit approximately 700m to 1km from the HDD compound. It is unlikely that a CLB would be required.

4.7.1.4 Guard vessel

Where deemed necessary, the CLV, CLB or other vessel operations with restricted vessel manoeuvrability will be accompanied by a guard vessel(s). The guard vessel(s) will maintain surveillance around the main vessel to advise other vessels keep clear of the installation to avoid the threat of collision and to protect the cable prior to burial.

A guard vessel may also be used to warn fishing vessels of temporarily unprotected sections of cable e.g. between cable lay and installation of external cable protection.

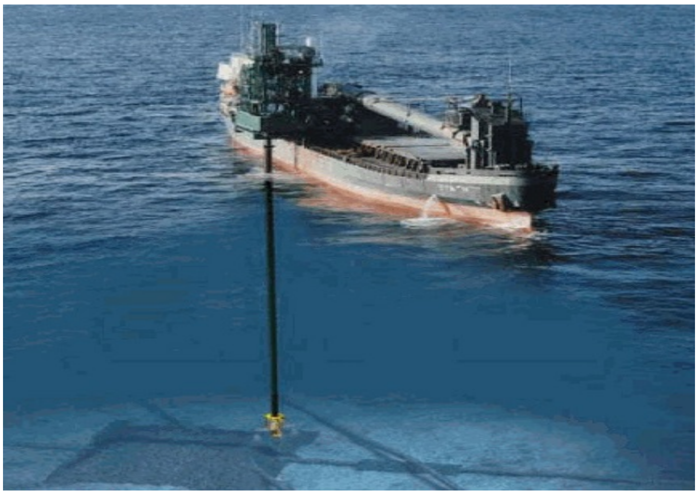
4.7.1.5 Rock placement vessel

Rock placement will be used at the cable crossings and potentially at the HDD exit point. Rock-placement vessels feature a large hopper to transport the rock, and a mechanism for deployment of the rock on site. The usual mechanisms are:

- Side dumping, whereby the rock is pushed or tipped over the side of the vessel;
- Split hopper, the halves of which separate to allow the rock to fall through the vessel; and
- Flexible fall pipe, where a retractable chute is used to control the flow of rock to the seabed.

Fall-pipe vessels have a big advantage, in comparison to the other techniques, in that the rock can be more accurately placed.

Figure 4-9 Typical fall-pipe vessel



4.7.2 Cable laying

When the CLV arrives on site the cable is transported via cable engines to the over-boarding point of the ship (usually the aft end). Under a hold back tension, it is guided over into the water. It is either laid onto the seabed for later burial or emerges from the plough at a point below the seabed consistent with the specified burial depth.

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.

The sea surface footprint of a cable installation spread will depend on the technique to be used. It will incorporate that of the vessel, or vessels if working in concert, and the surrounding area, commensurate with being a "vessel restricted in its ability to manoeuvre". Typically, a large CLV will be up to 150m in length and other vessels will be requested to remain a "safe" distance from the operation, typically 500m radius or potentially up to 2km if the CLV has anchors.

The temporal effect of the spread will be dependent on the slowest moving element, usually the burial spread, which will most likely be moving at a speed of between 100 – 300m per hour, depending on the soils encountered and the type of trencher used. This, in terms of other shipping, will appear to be effectively stationary. The only interruptions to the marine installation may be for cable joints that need to be made along the route (see Section 4.7.3).

Cable laying without simultaneous cable burial can progress at speeds of up to around 500m an hour. This operation can continue in fairly heavy weather, up to Force 7 winds and a significant wave height of 3m. The vessel can stay on station typically in Force 8 or 9 winds. While operating in poor weather the CLV will slowly lay cable against the wind. After riding out the storm the length of cable laid during the storm will be retrieved from the seabed and cable lay will start again where operations were previously suspended.

In the most severe weather, the vessel may have to cut and cap the cable and leave the work site. In this case the vessel will return when the weather has improved, recover the end of the cable, make a joint and continue the laying operation.

In shallow waters the sea surface footprint of the spread will also be dependent on whether anchors are used. The anchors may be placed up to 500 to 1000m from the vessel depending on the amount of wire present on the vessel winches and on the space available for placing the anchors. The same precautions are necessary with respect to the vessel and the anchor pattern although there is inherently less risk of interaction with large volumes of shipping traffic in shallow water. The anchor handling vessels will in this case normally also act as guard vessels for the spread.

4.7.3 Cable jointing

CLV's typically have a carrying capacity of 5,000 to 10,000 tonnes. For Greenlink, this equates to cable lengths in bundled configuration up to or even over 100km. However, this means that it may be necessary to install the cable in at least 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.

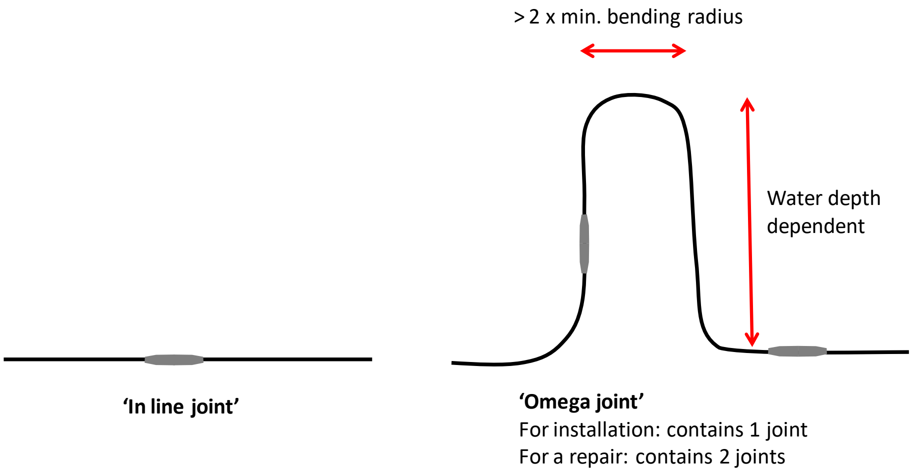
There are two types of cable joints; in line joints and omega (or hairpin) joints. An 'in line' joint is when cable laying is continued after picking up a cable end (as illustrated in Figure 4-10). An omega joint is made between a cable which has been laid towards another cable, or when a repair is required in an existing cable.

The jointing process for an omega joint requires extra cable approximately equal to twice the depth of water to be introduced into each of the two cables to allow for the jointing operation to take place. When joints are deployed onto the seabed they are laid down in a loop formation, referred to as an "omega" (or "hairpin") owing to its shape. The loop size and shape are controlled as the cables are deployed onto the seabed to ensure the cable minimum bend radius requirements are met (see Figure 4-10).

The joints and the short section of adjacent cables left on the seabed at the 'final' joint location will be buried using a jetting machine, a mass flow excavation unit or protected by concrete mattresses or rock protection.

GIL will ensure, as far as possible, that joints are not located in higher risk areas, e.g. shipping channels and anchoring grounds, where the prolonged location of the installation spread is not desirable.

Figure 4-10 Examples of subsea cable joints



4.7.4 Cable crossings

Greenlink will cross five in-service cables, and one out-of-service cable at the locations provided in Table 4-2.

Table 4-2 Crossing locations

Greenlink Component	Asset name	Operator	Status	Indicative crossing location (decimal degrees) *			Crossing angle	Burial depth at crossing position
				Latitude	Longitude	KP		
Proposed Development	Celtic	BT	OOS	52° 01.73" N	06° 44.47" W	KP139.098	87°	0.2m
Irish Offshore	SOLAS	Vodafone	IS	51° 53.71" N	06° 37.40" W	KP121.535	94°	0.4m
	ESAT 1	BT	IS	51° 45.30" N	06° 29.17" W	KP102.513	95°	0.7m
	Pan European Crossing 1	Century Link (Level 3)	IS	51° 43.56" N	06° 24.31" W	KP95.935	95°	0.1m
	Hibernia Seg D	GTT Communications (Hibernia Atlantic)	IS	51° 41.89" N	06° 16.94" W	KP86.7	92°	0.3m
Welsh Marine	Pan European Crossing 2	Century Link (Level 3)	IS	51° 39.77" N	05° 53.85" W	KP59.791	93°	0.2m

* Decimal degrees. Datum: WGS84 UTM 30N

During route preparation (see Section 4.6.3.3 above) a layer of aggregate or concrete mattresses will have been placed over the existing (buried) in-service cable to create a 'bridge'. These will be positioned to either side of the cable and will prevent the overlaid cable/bundle and mattresses from contacting the buried cable as they settle into the sediment.

The Greenlink cable bundle will then be surface-laid across the mattresses. To do so the cables will have to transition from a buried state in the sediments close by to surface lay. An exclusion zone either side of the existing cable (distance as agreed with the third-party cable owner) will be observed for burial equipment. If a plough is used, it must transition out of the soil before reaching the exclusion boundary. Burial will continue after cable lay progresses outside the burial exclusion zone on the other side of the crossing.

Additional mattresses or rock protection will be laid along the Greenlink interconnector where it is surface laid in the burial exclusion zone.

Figure 4-11 (overleaf) illustrates a typical crossing design for a buried cable.

A minimum vertical separation between the existing cable and Greenlink, typically 300mm, will be agreed with the cable owners; and the crossing engineered to achieve the agreed vertical separation distance.

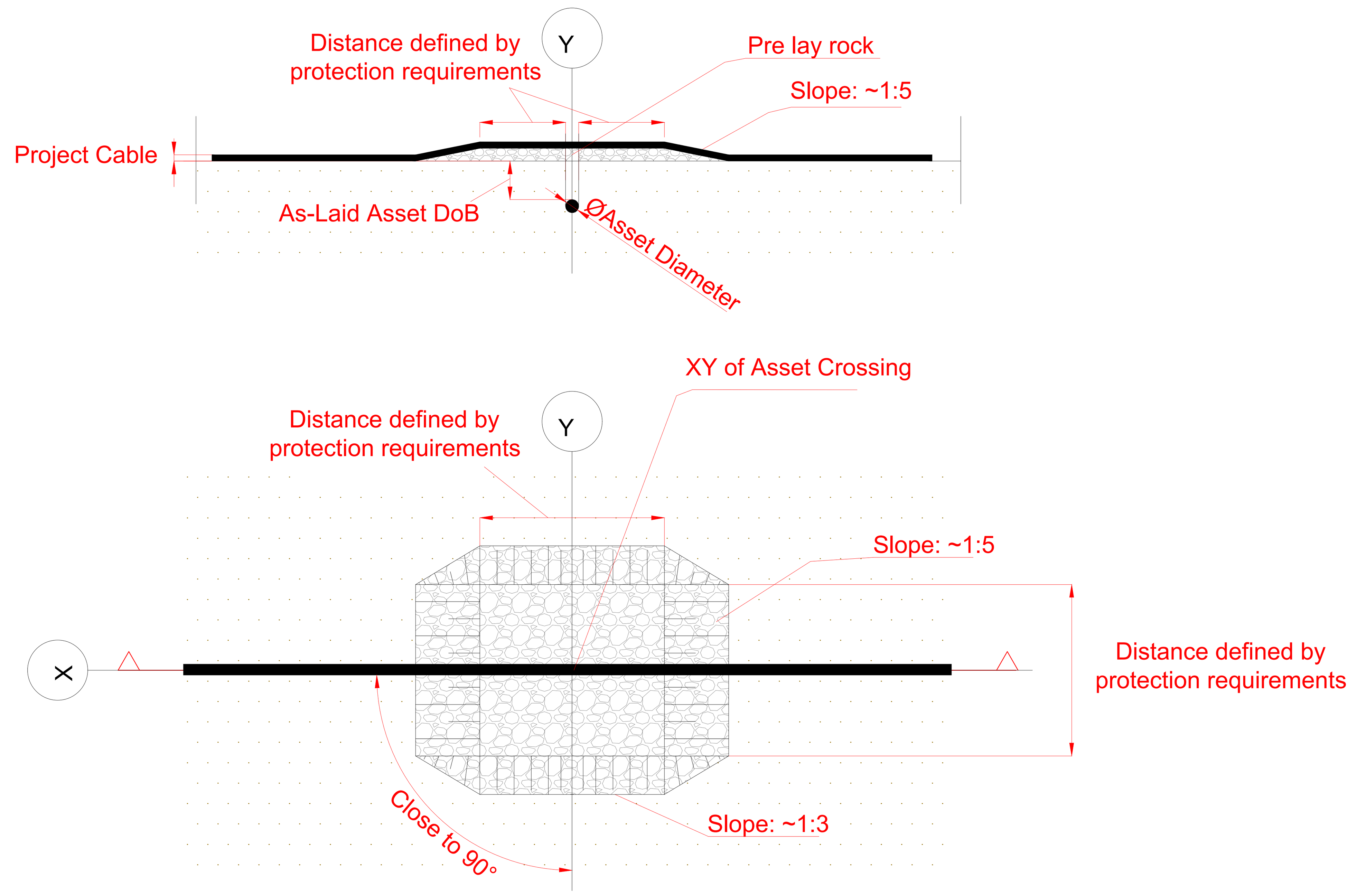
The crossing design for each asset crossed will indicate the footprint of the impact to the seabed. For the purposes of assessment, it has been assumed that cable protection will be required up to 60m either side of the third-party asset[1]; 200m in total. The rock berm will be up to 1.2m high and 8.2m wide, with a berm crest of 1m and a side slope of profile of 1:3.

Table 4-3 provides the worst-case dimensions and assumptions that have been used in the assessment.

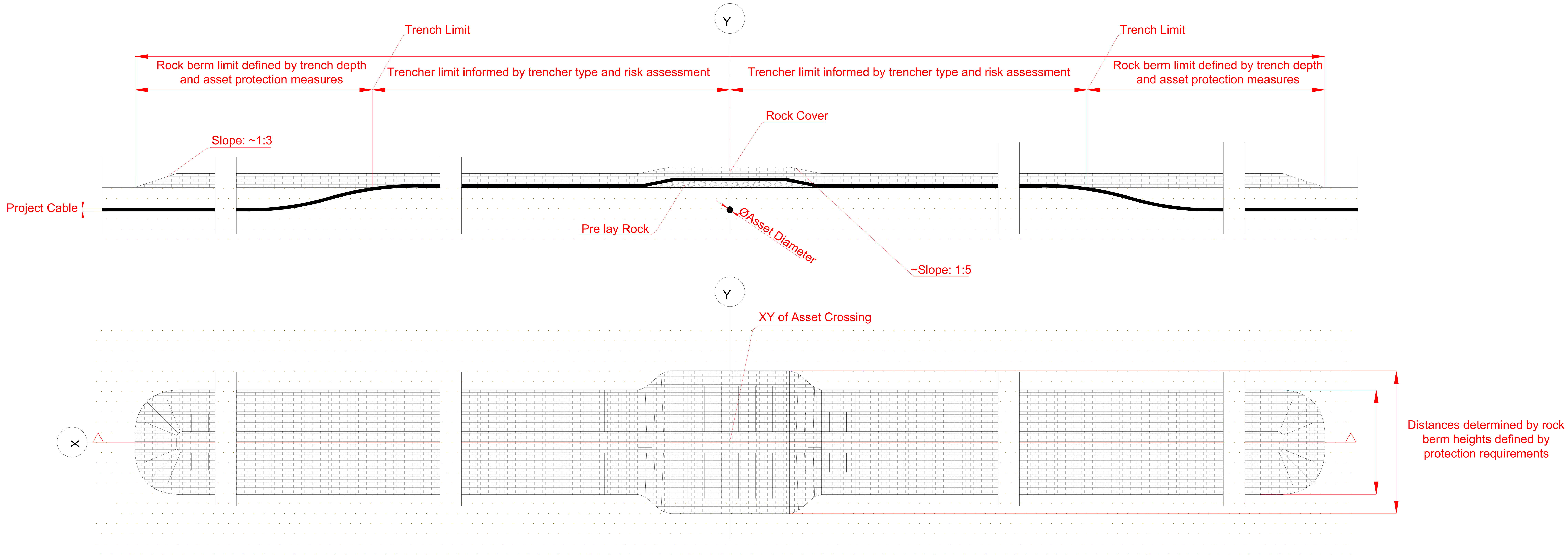
Table 4-3 Key worst-case assumptions for crossings

Asset name	Total length of external protection (m)	Seabed footprint of crossing (m^2)	Total external protection volume (m^3)	Sediment	EUNIS Habitat
Irish Offshore					
ESAT 1	120	1009	583.5	Sand	A5.272 - *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand
SOLAS	120	1009	583.5	Sand	A5.242 - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand
Pan European Crossing 1	120	1009	583.5	Sand	A5.252 - *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand
Hibernia Seg D	120	1009	583.5	Sand	A5.252 - *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand

[1] 50m berm at either side of crossing plus 10m grade out to provide over-trawlable profiles.



PRE LAY ROCK BERM



POST LAY ROCK BERM

4.7.5 Cable burial and protection

Once laid on the seabed the cables need to either be buried or otherwise protected from the threat of external damage such as anchors or fishing activity.

The choice of burial technique or protection method will vary along the route depending upon the seabed conditions in each section. Where possible the cables will be buried in the seabed as this provides the best protection for the cable and minimises potential for interference with fishing activity. Where the seabed composition is not suitable for burial, external mechanical protection will be provided through either rock-placement or application of concrete mattresses.

4.7.5.1 Burial depths

The recommended target burial depths along the cable length were determined in a detailed Cable Burial study completed in 2019 (Intertek EWCS 2019) using the Carbon Trust cable burial risk assessment (CBRA) methodology. This considered cable design, regulatory requirements, route, seabed composition and dynamics, and risk of hazards (shipping, existing infrastructure, UXO) and potential for damage from external sources (fishing gear and ship's anchors).

The cables will be buried into the seabed along the maximum length possible. The target burial depth is:

- 1.0m for all areas of loose sediment (sands / gravels); and
- 0.6m for areas of glacial till.

4.7.5.2 Installation techniques

The nature of the seabed influences which installation tool is selected. The seabed varies along the cable route from sands and gravelly sand/ sandy gravel with local areas of gravel and silt. Bedrock is found outcropping and sub-cropping mainly in the nearshore area of the Proposed Development (MMT 2019).

A preliminary assessment of the cable installation methods is presented as Table 4-4. It is estimated that at least 89% of Greenlink will be buried within sediment; which increases to almost 100% in the Proposed Development. Given the sediment conditions, it is likely that the main technique used will be jet-trenching and ploughing. External cable protection will also be required at the third-party asset crossing locations.

Table 4-4 Potential installation method

Cable Protection Option	Length (km)		
	Wales Marine	Irish Offshore	Proposed Development
Burial in sediment (jetting or ploughing)	57.44	49.24	35.63
Rock placement only	0.12	0.48	0.02
Potential burial in rock or rock placement	16.34	0.00	0.00
Total	73.9	49.72	35.65

4.7.5.3 Jet trenching

Suitable seabed type: Sand, silt

Description: Powerful water-jetting tool used to fluidise seabed and allow pre-laid cables to sink to required burial depth.

Most jetting trenchers are a self-propelling ROV which is powered and controlled from the CLV or another support vessel. Some are towed rather than self-propelled.

The jetting trencher will sit on the seabed and follow the pre-laid cables. High powered pumps inject sea-water into the seabed either side of the cables through jetting ‘swords’ (Figure 4-12). This fluidises the seabed beneath the cables allowing them to naturally sink to the required burial depth. The seabed sediments naturally re-form and ‘back-fill’ the trench covering the cables, only creating localised and temporary (less than one tidal cycle) turbidity plumes. If the required burial depth is not achieved, several passes can be made. The system does not remove any seabed sediments from the area.

Whilst jetting is considered to have the least impact 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).

Figure 4-12 Typical water-jetting machines

4.7.5.4 Plough

Suitable seabed type: cohesive soils such as clay through to rock; and non-cohesive soils such as loose coarse sand to fine dense sand.

Description: Like ploughs used in farming, a narrow blade (the plough ‘share’) is pulled through the seabed to create a furrow. The plough can either be towed by the

CLV to simultaneous lay and bury the cables or more usually is towed by a separate vessel to bury the cables post-lay.

The cable is feed into a bellmouth at the front of the plough and is guided down through the share to emerge in the trench the machine leaves as it passes through the seabed. The displaced by the plough share is pushed to either side of the trench as berms. These berms may be simultaneously pushed by the plough back into the trench to cover the cables; pushed into the trench by a separate back-fill plough pulled along in the wake of the first plough; or left in place to 'naturally back-fill' the trench via the natural movement of sediment on the seafloor.

The overall body of the plough is approximately 10m wide and rides on hydraulically adjustable skids which are used to control the depth of protrusion of the share, and therefore the burial depth of the cable. The trench created by the plough can be up to 5m wide; although for power cable installation a trench of 1m wide is more typical.

The action of the plough causes a relatively large amount of ground disturbance (in comparison to jetting), because seabed material is displaced and piled up at either side of the trench (National Grid and SP Transmission 2011). In addition, cable ploughing temporarily suspends finer bottom sediments into the water column creating a localised and temporary plume (less than one tidal cycle).

Figure 4-13 Typical plough

4.7.5.5 Cutting

Suitable sediment type: Hard clay, cemented sand, sand stone, rock

Description: Cutting of trench using a wheel or a driven chain cutter to break and move rock and hard sediments. Can be used either pre-lay (so the cable can be laid into the trench) or post-lay.

Mechanical trenchers can work in all sediments including those with high shear strength and even weak bedrock. These machines are usually mounted on tracked vehicles and use chain saws or wheels armed with tungsten carbon steel teeth to cut a defined trench. Most spoil is ejected from the trench by the cutting action and the cable is guided into the trench base by a depressor.

The mechanical action may be augmented in some cases by eductors that suck disrupted material out of the trench and deposit it to the side. The open trench can be back-filled or left to refill naturally. A typical mechanical trencher can make a trench of 0.3-0.7m in width and the overall footprint of the mechanical trencher is approximately 5-15m.

For all burial techniques, machine function is controlled from the surface vessel via an umbilical cable. However, in shallow water less than 5m deep, some trenchers require the assistance of divers, to load the cable to the cable depressor.

This operation is relatively slow and typically requires frequent maintenance.

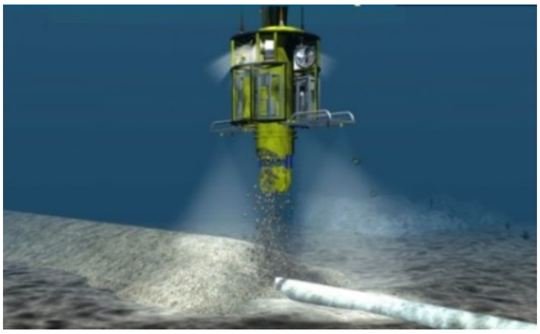
4.7.5.6 Rock placement

Rock placement is used to protect subsea cables by covering them in a continuous profiled berm of graded rock. Rock placement will be used at the cable crossings, and has been included as a contingency at the HDD exit point.

The berm provides a strong protective cover to prevent potential impact and snagging, and also ensures stability by shielding the cable from the current flow.

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 22cm. 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.

Figure 4-14 Rock placement



4.7.5.7 Concrete mattressing

Concrete mattresses are matrices of interlinked concrete blocks which form a close-fitting layer over the cable. Typically, concrete mattresses are 6m long by 3m wide.

The mattresses are installed via a crane from either a dive support vessel or a construction support vessel; which lowers them one at a time or in batches using a special frame.

The protection afforded by the concrete layer is substantial, and the risk of cable damage due to dragged or dropped objects is effectively reduced for the cable beneath. However, they are slow and expensive to install and hence are used only for localised, temporary or intermittent applications at cable crossing locations or jointing.

Figure 4-15 Concrete mattress deployment (courtesy of FoundOcean)

4.8 Landfall installation

4.8.1 Cable landfall

The landfalls are where the marine cables come ashore. In Ireland, the landfall is Baginbun Beach, Co.Wexford (illustrated in Figure 1-1 Drawing P1975-LOC-001).

The shore-crossings will be accomplished by horizontal directional drilling (HDD) which will exit seaward of the low water mark, avoiding any activity on the beach.

The landfall will be prepared in advance of the arrival of the CLV, so that that 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 from the TJP to below mean low water, avoiding any activity on the beach.

4.8.1.1 Transition joint pit (TJP)

The land cables will connect with the marine cables in a TJP, buried in the ground above the high-water mark. At both landfalls 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. The TJPs are outside of the scope of the Proposed

Development and this EIAR as they are above MHWS, but further information is provided in the Irish Onshore EIAR. The TJPs are located away from the beach.

4.8.1.2 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 4-16 illustrates a typical shore to sea bore.

The HDD is accomplished in three stages:

- Pilot Hole Drilling;
- Hole Opening Operations (Reaming); and
- Pre-lay messenger (draw) wire.

The first stage involves drilling a small diameter pilot bore which is stabilised by filling it with drilling mud, typically consisting of bentonite clay and water. Any materials used will be inert.

Maintaining an open bore is of critical importance. Drill pipes (approximately 9.0m in length) are added to the end of the drill string on the drilling rig one at a time and drilled down into the ground in succession. Pilot hole drilling continues until the drill bit exits the ground at the required exit point.

The second stage involves enlarging the drilled hole to the required diameter for installation of the cable, a process known as pilot hole reaming. At the exit point a back reamer replaces a drill bit and is pulled back towards the pilot hole entry.

The final stage involves inserting a messenger wire within the duct to enable future cable pull in operations. Ducts will be capped prior to cable installation to avoid excessive build up of debris.

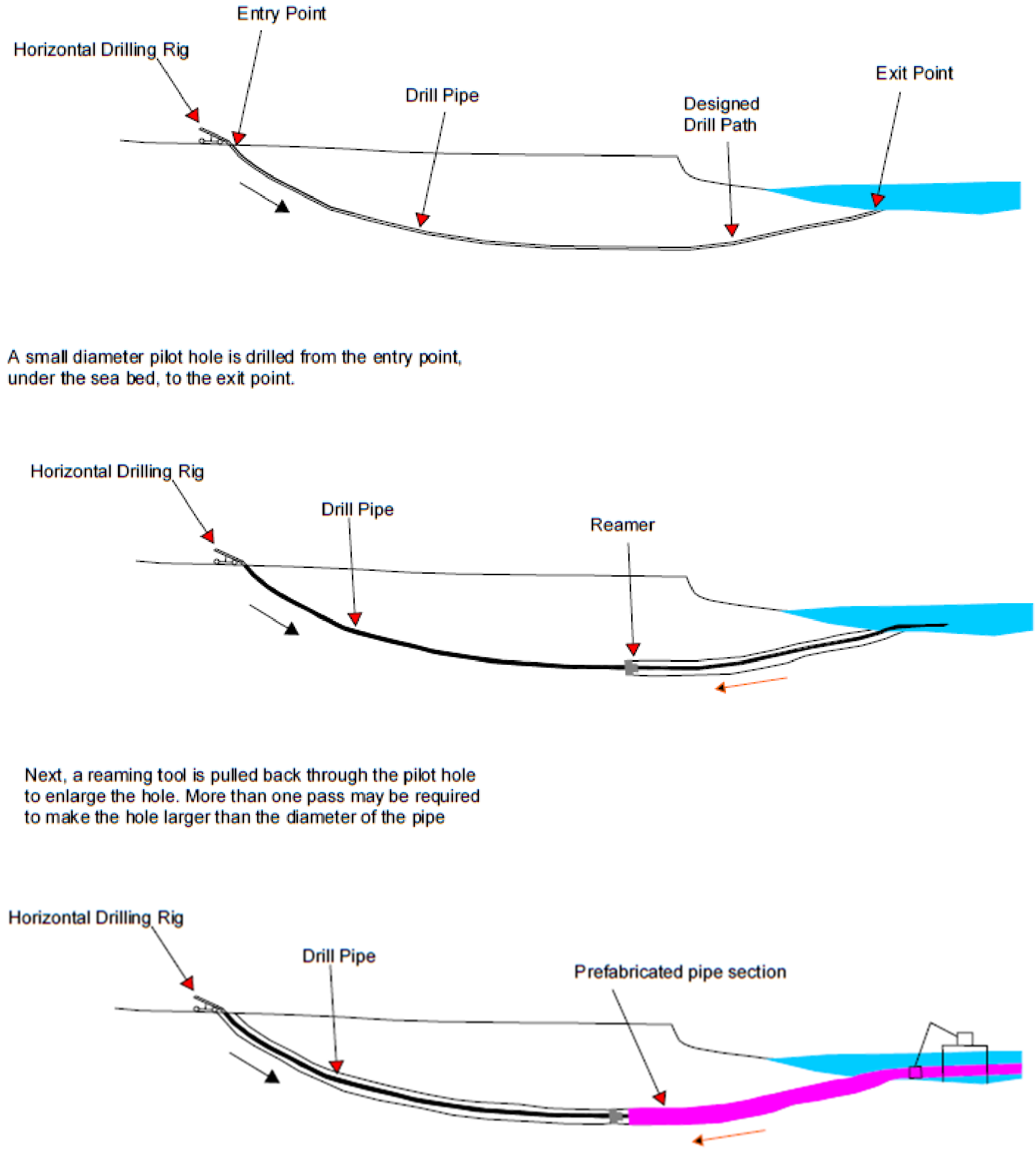
The HDD compound, from which drilling will take place, will be sited above MHWS. The site has been selected taking the following into consideration:

- Distance from neighbouring properties;
- Adequate space for the construction of a HDD compound; and
- Adequate set-back distance from sensitive features e.g. cliff face at Baginbun Beach.

The location for the compound is shown in Figure 4-17 and a typical HDD compound layout is presented in Figure 4-18. Further details are provided in the Irish Onshore EIAR.

Three ducts will be drilled at each landfall; 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. The cable ducts will pass approximately 10m below the beach.

Figure 4-16 Typical HDD



Prefabricated pipe is attached to a swivel behind the Reamer and pulled into place under the beach

Figure 4-17 Indicative location of HDD compound – Baginbun Beach, County Wexford (including illustration of borehole trajectory)

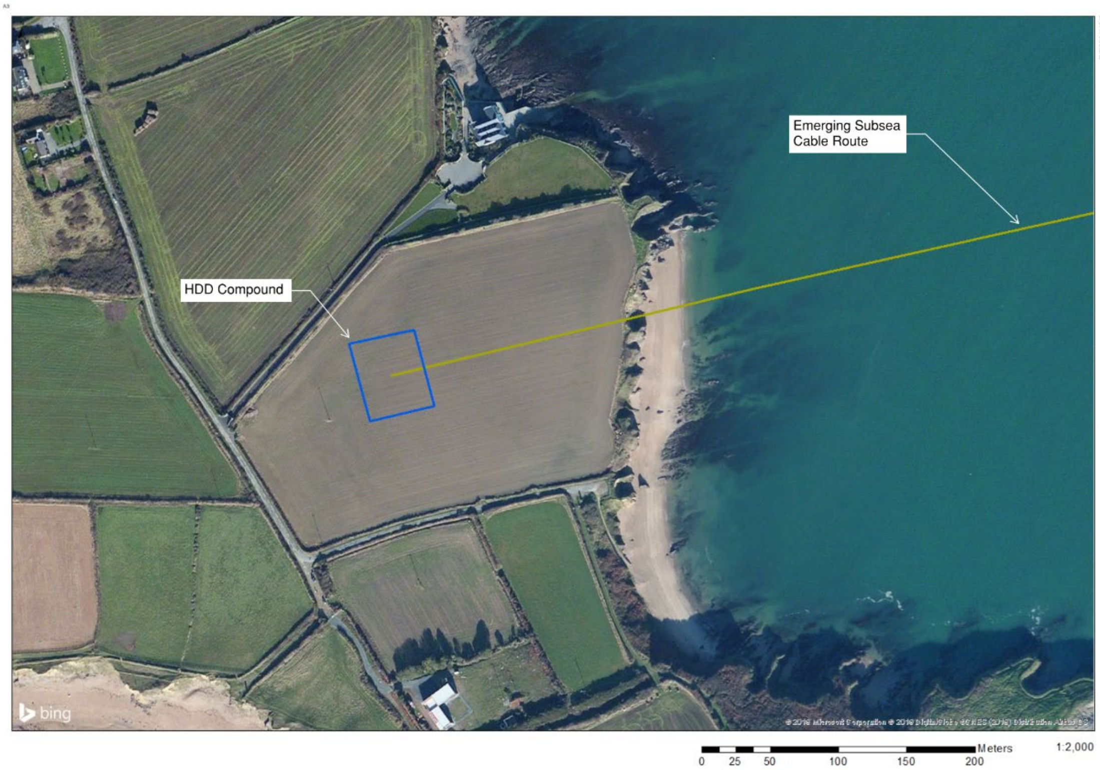
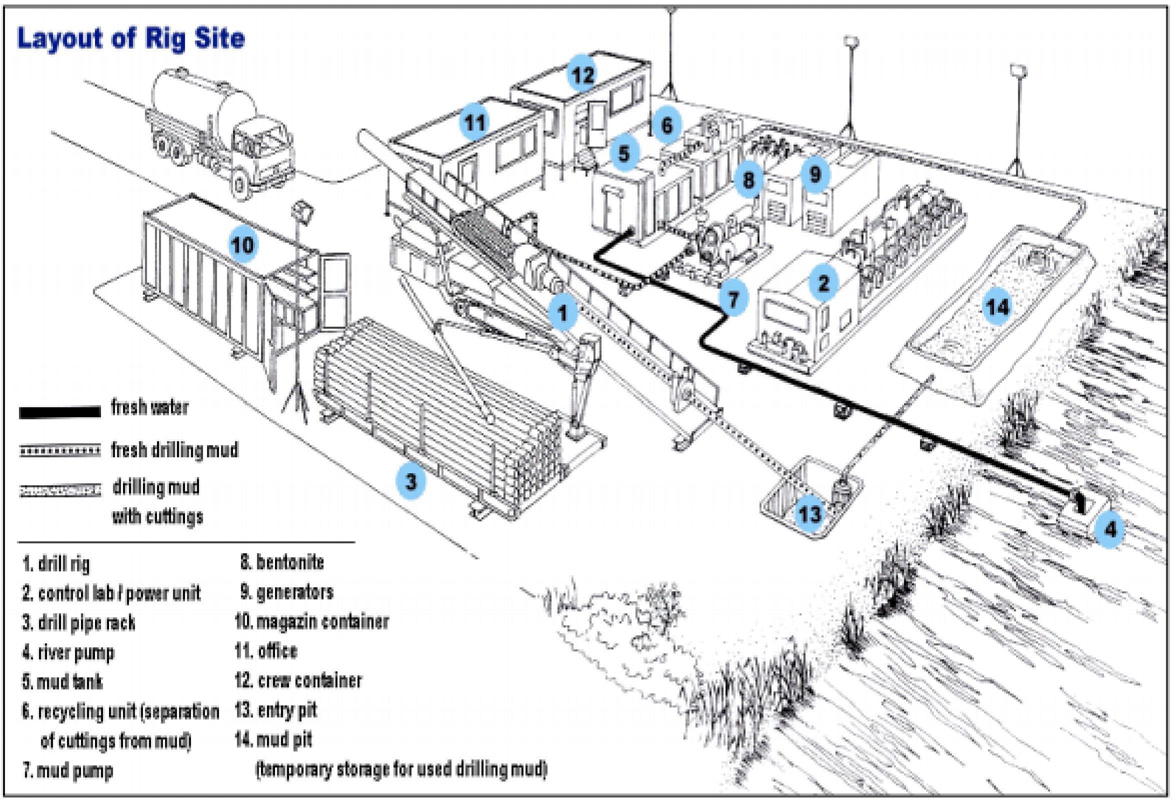


Figure 4-18 Typical layout of HDD compound



4.8.1.3 HDD exit point

The shore crossing will be made using HDD from an agricultural field behind Baginbun Beach to a point below the low water mark; avoiding any works on the beach.

The Greenlink cable route survey established that an area of Annex I Bedrock Reef habitat extends from the intertidal zone to below the low water mark. The feature extends across the width of the Proposed Development and is approximately 200m long (from beach to sea).

As the final design of the HDD has not been completed the EIA process assumed, for the purposes of worst-case assessment, that the HDD could exit within this area of fringing Bedrock Rock. However, in order to protect the cables from the HDD point to a depth where burial in sediment is achievable, it is likely that cutting equipment would be required to cut a trench in the Bedrock Reef. The cables would also need external cable protection; likely in the form of a rock berm up to 10m wide.

GIL have consulted with NPWS throughout the design of the project regarding routeing a cable through the Hook Head SAC. NPWS have been clear from the start that the use of external cable protection on Qualifying Interest Reef habitat has the potential to have a likely significant effect on the habitat. Although there is scope that external cable protection will be colonised by a similar reef habitat, potentially reducing the significance of the effect, other factors were taken into consideration when considering the environmental implications of the HDD exit point. For example:

- A rock berm just below the low water mark on the fringing reef would modify wave patterns, which in turn will affect sediment transport along the beach;
- There would be a local scour concern with respect to the feature (current and wave driven);
- A rock berm would have a significant visual effect on the landscape values of the beach. As a popular public beach, with historic connections, a negative change in the recreational value of the beach would be considered significant.

The EIA process concluded that the significance of the effects was uncertain without coastal processes modelling but there was the potential that effects could be significant and would likely affect the integrity of the Hook Head SAC. For this reason, an engineering solution was investigated to avoid the negative environmental effects.

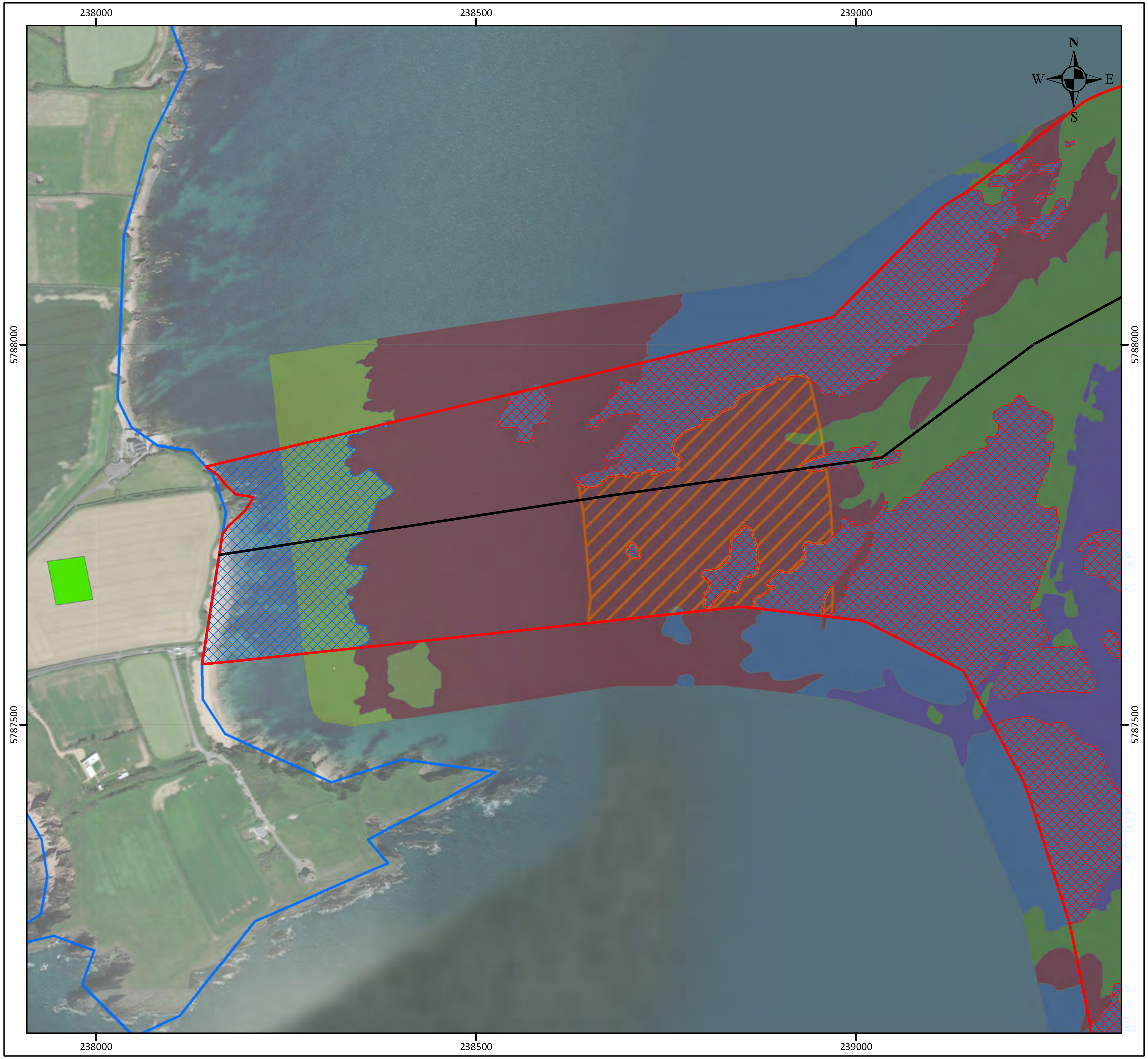
Review of the Greenlink geophysical data has been undertaken to determine where there is a sufficiently deep sediment unit to allow the HDD ducts to exit and the cables to be trenched directly into the seabed post-lay. Data suggests that burial in sediment is achievable past the 9m water depth contour. 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 Baginbun Beach, a target area for the HDD exit has been prescribed and will be imposed on the Installation Contractor. Presented as the orange hatched box in Figure 4-19 (Drawing P1975-INST-002), the area starts at the 9m water depth contour. The length of HDD proposed (between 700m – 1km) is feasible and has been proven on other engineering projects.

By prescribing a target area for the HDD exit, the pressure receptor-pathway between the Proposed Development and the fringing Bedrock Reef around the low water mark has been removed.

The design being assessed in this EIAR is that the HDD will exit in the orange hatched box presented in Figure 4-19 (Drawing P1975-INST-002) or further seaward, avoiding the intertidal area and any intrusive activity on the fringing Bedrock Reef.

There is a risk that due to the underlying geology, the HDD could exit at an angle which would mean that a small area of external cable protection could be required at the end of the two ducts. As a contingency (and for the purposes of worst-case assessment), the EIA assesses the deposition of external cable protection in the form of two rock berms, both 5.2m wide by 20m long with a height of 0.7m within the orange hatched box shown on Figure 4-19 (Drawing P1975-INST-002); one at each duct exit. It is estimated that the footprint of external protection within this area would cover of 208m^2 (0.000208km^2).

Engineering design has not yet been completed for external cable protection at the HDD exit point but rock sizes will be in the range of 2cm to 22cm.



GREENLINK INTERCONNECTOR

INSTALLATION

Indicative HDD Exit Point - ROI Landfall

Drawing No: P1975-INST-002 | A

Legend

- Indicative Greenlink Route Centreline
- Proposed Development
- Mean High Water Mark
- HDD Compound
- Indicative HDD Exit Point
- Trenching Exclusion Zone
- Annex I Habitat Exclusion Zone

EUNIS Habitat Classification

- A3.11
- A3.2
- A5.23
- A5.24
- A5.43
- A5.44

NOTE: Not to be used for Navigation

Date	Wednesday, May 8, 2019 11:00:32
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-002.mxd
Created By	Chris Goode
Reviewed By	Chris Carroll
Approved By	Anna Farley

Co-financed by the European Union
Connecting Europe Facility

0 50 100 150 200 m

4.8.1.4 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 pit 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 (Figure 4-20).
- 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.

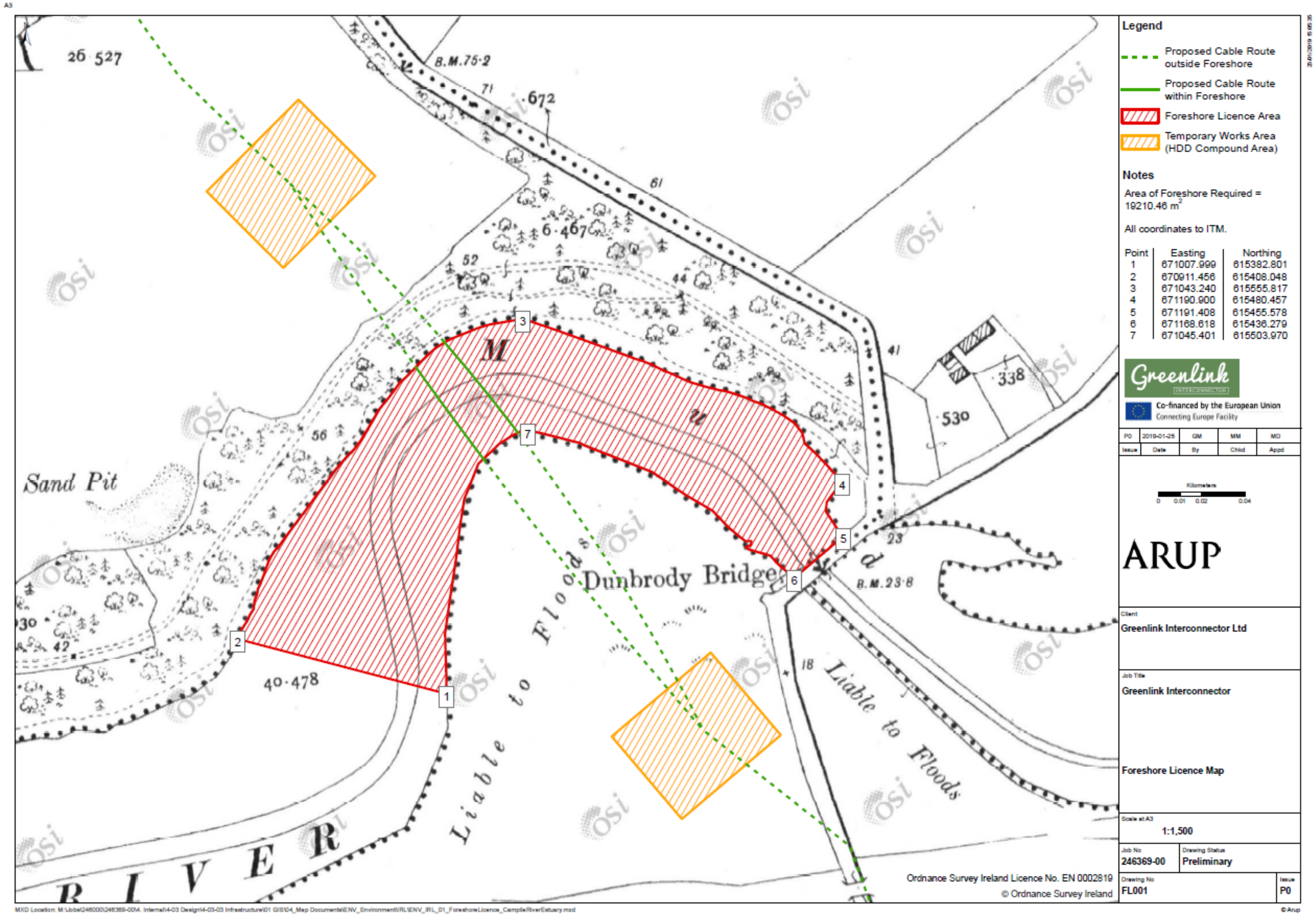
Figure 4-20 Example of a cable being floated-in

4.9 Campile Estuary

The onshore cable route between Baginbun Beach and Great Island crosses the Campile Estuary. It is proposed to use HDD under the Campile Estuary to make the crossing. The depth of the ducts will be greater than 10m below the river bed. Compounds either side of estuary will be setback above MHWS, within areas of improved agricultural grassland primarily used as pasture.

Figure 4-21 shows the indicative location of the HDD compounds in relation to the Campile Estuary. The 'Campile Estuary' component of Greenlink encompasses the area of foreshore between MHWS on either side of the river. The Irish Onshore EIAR provides a description of the layout of the drilling compounds and works.

Figure 4-21 Campile Estuary crossing (including indicative HDD compounds)



4.10 Cable operation

Following installation, routine maintenance work to the submarine cables is not anticipated. However, some work (described below) may be required to maintain the burial of the cable to protect it from adverse interactions with other sea users and marine processes which might damage it. The cable and its installation will be designed to minimise any maintenance requirements.

Repair and maintenance activities will have a similar impact to the installation activities assessed in this EIA, however, they will be on a smaller and localised scale, and as such are not expected to have any significant impacts. Any impacts will be lower than those identified for installation operations.

4.10.1 In-service survey operations

It is likely that routine surveys using standard geophysical survey equipment and/or ROVs 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.

Survey techniques used will be similar to those employed for pre-installation surveys described in Section 4.6.2 e.g. multi-beam echosounder, side scan sonar and magnetometer. In addition, shallow sub-bottom profiling and cable tracking may be used.

Shallow sub-bottom profiling involves injecting a pulse of acoustic energy into the seabed and detecting the reflections from the sub-surface geological units. From the reflections the thickness of the sediment can be assessed, and the depth of cable burial can be ascertained.

Regular survey of cable crossings may also be a requirement of a particular cable crossing agreement. Periodic inspections may be undertaken to identify cable exposures or spanning.

4.10.2 Marine cable repairs

Cable repairs to correctly installed and protected marine cables are infrequent but require operations which temporarily intrude on the environment and the activities of other users of the sea. The most common reason for repair of a marine cable in water depths <200m is damage caused by external interaction, typically by trawlers and commercial ships' anchors. Globally around 70% of cable faults can be attributed to man-made activities and about 12% are caused by natural hazards e.g. induced abrasion or earthquakes (KIS-ORCA – Seafish 2019).

Faults caused by man-made activities are usually localised depending on the energy of the interaction and whether the cable is merely impacted, mauled (where something is dragged with force along the cable for a distance) or dragged from the seabed.

Where a cable fault is detected, 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 or remove external protection such as rock-berms. Once de-buried, measurement and testing will be conducted to establish the section of cable that needs to be replaced. If de-burial is not considered necessary the cable will be first retrieved from the seabed and pulled up by a suitable vessel.

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 (DP) cable vessel will be used. Vessels carrying out cable repair operations are restricted in their ability to manoeuvre and will display the required navigational lights and signals. Divers and/or ROV are expected to be used with associated vessels.

The actual operational details and the exact configuration of a repair spread will depend on the type of repair and the contractor's facilities and would typically follow:

- Loading of spare cable to the repair vessel;
- Location of the damage;
- Cable de-burial;
- Cable cutting and recovery to the surface;
- Splicing in the replacement section of cable; and
- Re-deployment of cable onto the sea bed and re-burial.

A cable repair invariably requires the insertion of additional cables and two additional cable joints, the initial and the final. The additional cable length in the case of point damage may be equal to approximately three times the depth of water at the site and longer if the cables have been damaged over a distance or if the fault is difficult to locate. The greatest water depth is 134m indicating that for a repair at this depth a minimum of 400m of cable would be required. As the fault location may be uncertain up to 1km has been allowed for as a replacement length.

For the repair of a single cable in a bundled pair, the pair of cables would need to be cut and both brought to the surface. However, it is possible that both cables might be repaired as a precaution against undetected damage; this would double the length of cable required for repairs.

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; but still within the proposed submarine cable corridor. The excess cable and first joint of a longer repair section can be laid 'in-line' along the original route whilst the final joint will form an 'omega' loop on the seabed.

The additional joints and the extra cable length will be buried, typically using jetting machines, concrete mattresses or rock placement deployed from either the repair vessel itself or a separate specialised vessel.

A cable repair operation might be expected to take between two and six weeks depending on the type and extent of damage, burial requirements and operational constraints such as weather.

Spare marine cable will normally be stored at the premises of the nominated repair contractor or a nearby port facility.

GIL requires a permit to cover discrete incidents of repairs or replacement over the operational lifetime of the cable (40 years) limited to a maximum single cable length of 1km x 3 (i.e. for bundled cable including the fibre optic).

The area of seabed affected by repair operations will depend on the location of the fault, and the burial / protection method used for the original installation. All repair activities will be undertaken within the coordinates that make up the red line boundary of the Foreshore Licence application area (the Proposed Development). When considering the effects of a cable repair the EIA assumed the following:

- the bundled marine cables require a maximum 1km long x 3 repair (i.e. two power cables and a fibre optic cable);
- marine cables can be re-trenched; and
- the removal and re-burial footprints will not overlap (a worst case, as in reality they might).

Should re-trenching not be feasible, the Foreshore Licence also applies for consent to use an alternative protection method e.g. rock or concrete mattresses. The EIA assumes that external cable protection for cable repair will be up to 10m wide.

GIL is requesting licences that cover up to five incidents in each jurisdiction over the operational life time of the cable (40 years). This is in line with the industry used ‘rule of thumb’ which is one fault every ten years per 100km; based on historic experience.

4.11 Emissions

4.11.1 Introduction

There are a number of emissions which may occur to varying degrees during installation or operation of the Project. These emissions include:

- Electric and magnetic fields
- Heat
- Noise

4.11.2 Electromagentic fields (EMF)

4.11.2.1 General

Electromagnetic fields (EMF) are generated by submarine power cables due to the electric current flowing along the cables. The movement of electricity induces both an electric field (E field) and a magnetic field (B field), which are collectively referred to as EMF (National Grid & Energinet 2017; Tethys 2019). The distance over which the EMF persists is dependent on the strength of the electric current and the density of the surrounding material (Tethys 2019).

The electric (E) field exists between the high voltage conductor of a cable and the grounded screen and armour and since the armour is at the same electric potential as the ambient outside, there is no electric (E) field outside the cable. However, these materials are permeable to magnetic (B) fields, which therefore emanate into the surrounding environment. These magnetic (B) fields attenuate with distance (both horizontally and vertically) from the cable conductor. Movement through the generated magnetic field creates induced electric fields (iE field). This can occur as a result of water current movement or from an organism swimming through the field (Normandeau et al 2011). Owing to the dependence of iE field magnitude upon B field magnitude, iE fields will attenuate with both horizontal and vertical distance from the cables.

4.11.2.2 Background EMF

The background geomagnetic field for the Celtic Sea is approximately 48.7 μT (Natural Resources Canada 2019). The naturally occurring iE field varies continuously because of the varying speeds and directions of the water flow that are consequences of the tides and weather conditions, but it is essentially a static field.

The background iE field has been calculated as ranging between 34.09 μV/m and 48.7 μV/m in Irish waters. This calculation is based on the equation below:

Induced electric field (μV/m) = Velocity (m/s) x Magnetic field (μT) (National Grid & Energinet 2017).

Peak tidal current velocities for the ebb and flood tide were taken from Hydrographic Department (1974) for the submarine cable corridor in Irish waters as 0.7 m/s (flood) and 1.0m/s (ebb).

4.11.2.3 Greenlink EMF

The HVDC cables will be installed in direct contact with each other (bundled configuration), with currents flowing in opposite directions. Therefore their magnetic fields are also anti-directional and cancel each other out to a large extent. As a result, the magnetic field decreases very rapidly as a function of distance from the pair of HVDC cables.

The Greenlink circuit has a nominal capacity of 500 MW, with a 320 kV voltage cable current. It is the current that produces the magnetic field. With the cables bundled and buried at 1m below the seabed, the magnetic (B) field has been calculated (using Cyme-Cap software) as:

- 21μT[2] on the seabed (directly over the cables), reducing to 6μT at 1m above the seabed and 3μT at 2m from the cable.

At the HDD exit there is the potential that the cables will be up to 30m apart for a short distance before they are bundled together. Where they are not in a bundled configuration the magnetic field will be higher as there will be no cancellation effect between the cables. Using the same software the magnetic field has been calculated as:

- 80μT on the seabed (directly above the cables), reducing to 15μT at 10m from the cable.

How the Greenlink magnetic field reacts with the naturally occurring background geomagnetic field will depend on the direction of the two fields. The worst case will be an additive effect; although in reality it is likely to be less. This will be the same whether the cables are in bundled configuration or laid separately (as at the HDD exit points).

Assuming a straight additive effect the magnetic field on the seabed directly above the bundled cables will be approximately 69.7μT, reducing to close to natural background levels at 2m from the cables. For the unbundled cables the magnetic field on the seabed will be 128.7μT reducing to 63.7μT at 10m from the cable, and to close to natural background levels within 12m.

The lowest limit for static magnetic fields referenced by ICNIRP (International Commission on Non-Ionizing Radiation Protection) is 500μT to protect wearers of implantable electronic medical devices. From a human health point of view the EU recommends a limit of 40 milli tesla (40,000μT) (EMF Recommendation 1999/519/EC).

The values calculated as generated by the cables are significantly smaller than the exposure limits for the general public, indicating that there is no public health issues.

4.12 Magnetic compass deviations

The influence of the Greenlink HVDC system on the total geomagnetic field along the design route is expected to be insignificant to compass deviation (less than 3 degrees compass deviation) due to the depth at the HDD exit point, and the bundled configuration and water depth for the remainder of the Proposed Development.

4.12.1 Heat

During the operation of an HVDC cable heat losses occur because of the resistance in the cable/conductor. GIL is likely to install XLPE cable. These cables have maximum design operating conductor temperatures of between 70°C and 90°C, which leads to maximum temperatures of 60°C at the cable surface; although temperatures are more likely to be 40°C to 50°C. When the interconnector is in operation there will

[2] Microtesla

be localised heating of the environment surrounding the cables (i.e. sediment for buried cable or water in the interstitial spaces of rock protection). The rate of heat dissipation, and magnitude of environmental heating, will be determined by a number of factors; most notably the amount of power passing through the cables; the design of the cables; and the thermal properties of the surrounding media.

4.12.2 Sound

The predominant sound generating activities during the different phases of Greenlink are:

- Geophysical survey equipment (e.g. side scan sonar, multi-beam echosounder, sub-bottom profiler and magnetometer);
- UXO detonation (if required);
- Cable trenching;
- Rock or mattress placement; and
- The movement of project vessels.

These activities are required during installation, cable repair and maintenance and decommissioning. No sound will be produced during operation of the cables.

Based on frequency and intensity characteristics, anthropogenic sound is categorised into two groups:

1. high-intensity impulsive sound - characterised by large fluctuations of pressure in time, and typically exhibit rapid rise times. Examples of impulsive sound includes pulses generated during pile driving, seismic surveys and explosives.
2. continuous sound - characterised by low levels of sound spread over a longer period of time, typically many seconds, minutes or even hours. The amplitude of the sound may vary throughout the duration, but the amplitude does not fall to zero for any significant time. Examples of continuous sound includes vessel noise and noise from small geophysical surveying equipment such as sub-bottom profilers.

Each group is associated with particular effects on marine fauna. The significance of the effect depends on:

- the predicted source level – the apparent strength of a sound source at a reference distance, typically 1m; and
- how the sound propagates (spreads) through the water – as sound spreads through water the acoustic power decreases with distance travelled. The rate of decrease is influenced by factors such as the frequency of the sound, temperature, salinity, water depth, and seabed conditions. High frequency sounds attenuate rapidly with distance, whilst low frequency sounds can travel great distances (Genesis 2010).

There are different 'metrics' used to describe the levels of sound received at their measurement position. The common ones, which have been used in the EIA are sound pressure levels (SPL) and sound exposure levels (SEL). There are several ways SPLs can be reported which depends on how the amplitude of the sound wave has been measured. They are: peak sound pressure (0-peak); peak-to-peak sound pressure (p-p); and root mean square (rms). The SEL is a measure of the energy of the sound; therefore it depends on both the amplitude of the sound wave and duration. When assessing the effects of sound on marine fauna it is important to ensure that the same metrics are compared.

Underwater sound is a complex topic and for further information OSPAR Commission (2009) 'Module 2: Background on Underwater Sound' provides a useful description of the nature of sound and the basic concepts associated with sound measurements.

The SPLs generated by the Proposed Development are provided in Technical Appendix C.

4.12.2.1 Background noise context

Sound produced by Greenlink in the marine environment is set against a background of sound produced by natural sources (e.g. wind, rain and animal vocalisations) and other anthropogenic activity in the area (e.g. shipping, dredging). Shipping includes vessels transiting through the Celtic Sea using the main shipping lanes; merchant vessels, ferries and crude oil tankers of up to 300,000 dead weight tonnes arriving at Milford Haven; and cruise ships and merchant vessels arriving at the Port of Waterford.

4.13 Decommissioning

4.13.1 Introduction

Along with the construction and operational phases of a project, the EIA Directive also requires assessment of the decommissioning phase of a project. 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. In some circumstances, the least environmentally damaging option may be to leave the cable in-situ. This option raises the issue of liability for any claims from fishermen or other third parties that come in contact with the cables. This issue will be addressed in the planning stage of cable decommissioning.

4.13.2 Extent of decommissioning

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:

- 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
- External cable protection - to be left in-situ

4.13.3 Retrieval of buried cables

Should cables be required to be removed from the seabed, the following operation is typical.

The first stage of the operation would be to expose a section of buried cable to either attach a gripper directly onto the cable or to install a cable "under roller" to de-bury the full length of the cable. This local cable de-burial operation would be undertaken using either a jetting device to expose a short section of cable or to use a grapnel tool to raise the cable to the surface.

Once a section of the cable is exposed, there are then two alternative methods to de-bury the full length of cable. Providing cable "peel out" forces are not too excessive, a gripper could be attached to the cable to then lift a cable end back to the cable recovery vessel. Cable recovery could then proceed directly. Alternatively, a cable under roller could be used to run the full length of the buried cable. This device would be connected back to a vessel by a steel wire and raises the cable back to seabed level. Both schemes would ensure that a cable end is recovered back onto the cable recovery vessel. Cable recovery would then commence for the full cable length, or lengths would be cut and stored separately. The cable recovery process would essentially be the reverse of a cable laying operation, with the cable handling equipment working in reverse gear and the cable either being coiled into tanks on the vessel or guillotined into sections approximately 1.5m long immediately as it is recovered. These short sections of cable would be then stored in skips or open containers on board the vessel for later disposal through appropriate routes for material reuse, recycle or disposal. When back in port, the cable recovery vessel would unload the cable onto the quayside.

The submarine cable route would be surveyed to ensure that all cable had been removed. This survey would be provided as proof of removal.

4.13.4 Disposal / re-use of components

During decommissioning the wastes must be handled, stored and disposed of according to the following:

- Waste management legislation
- Environmental Best Practice

At the time of decommissioning a waste management protocol will be drafted addressing the treatment of waste and its minimisation, re-use and recycling where possible, to reduce environmental damage, risks to health and safety, and address economic concerns.

4.13.5 Decommissioning programme

The decommissioning programme is expected to be similar to that during installation; and involve similar vessels and timescales to the installation phase.

4.14 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.

In Ireland:

- An additional route option D was surveyed that sought to avoid crossing an area of reef habitat by following a possible sand channel.
- Geophysical survey was widened in selected places to investigate the extent of potential reef habitat and sand wave features to see if they could be avoided.

In Wales:

- Three possible routes through the Pembrokeshire Marine Special Area of Conservation (SAC) were designed for further investigation (see Chapter 3). Natural Resources Wales (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 bedrock reef. 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 final application area.
- Geophysical survey was widened in selected places to investigate the extent of sand wave features to see if they could be avoided.
- 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, GIL and its contractors 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 design is outlined in Table 4-5 below.

Table 4-5 Embedded mitigation

ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM1	Early consultation with relevant contacts to warn of impending activity, with vessels requested to remain at least 500m away from cable vessels during installation, repair and decommissioning.			
EM2	Project vessels will comply with the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) – as amended, particularly with respect to the display of lights, shapes and signals.			
EM3	Project vessels will exhibit signals in accordance with the Irish requirements for marking and identification of offshore installations as specified in the Safety, Health and Welfare (Offshore Installations) Act, 1987.			
EM4	Project vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.			
EM5	Control measures and shipboard oil pollution emergency plans (SOPEPs) will be in place and adhered to under MARPOL Annex I requirements for all project vessels.			
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.			
EM7	Chemicals will be stored in a secure, designated area in line with appropriate regulations and guidelines. A Chemical Risk Assessment will be prepared for the use of chemicals. A chemical inventory shall be kept of all chemicals and oils used.			
EM8	The latest guidance from the GB non-native species secretariat (2015) will be followed and a Biosecurity Plan produced pre-installation.			
EM9	An Environmental Management Plan (EMP) and an Emergency Spill Response Plan will be developed and implemented for the installation phase.			
EM10	Notice will be given to sea users in the area via Notices to Mariners, Kingfisher Bulletins, NAVTEX, and NAVAREA warnings. Particular attention will be paid to ensuring the following organisations receive the notifications: Irish Maritime Administration (including the Maritime Safety Policy Division, the Marine Survey Office, the Irish Coast Guard, the Maritime Transport Division, Maritime Services Division), Commissioners of Irish Lights, Royal National Lifeboat Institution (RNLI), the Irish Coast Guard (IRCG), Community Rescue Boats Ireland (CRBI), Harbour and Port authorities, Irish Ferries, Irish South and East Fish Producers Organisation, South East Regional Inshore Fisheries Forum, Irish Sea Fisheries Board individual local fishermen (as identified during marine survey campaign).			
EM11	'As-laid' co-ordinates of the cable route will be recorded and circulated to the Irish Hydrographic Office (IHO), UK Hydrographic Office (UKHO) and KIS-ORCA Service. Cables will be marked on admiralty charts and fisherman's awareness charts (paper and electronic format).			
EM12	Crossing Agreements will be produced with cable owners. The Crossing Agreement describes the rights and responsibilities of the parties and also the design of the crossing. Crossing design will be in line with industry standards, using procedures and techniques agreed with the cable owners.			
EM13	HDD will be used for the cable landfalls to avoid disturbance of sensitive habitats (e.g. intertidal reef habitat) and disruption on beaches.			

ID	Embedded mitigation measure	Project Phase		
		I	O	D
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 which reduces the seabed footprint of installation activities and the electromagnetic field generated during operation, thus minimising any potential compass deviation effects.			
EM16	Procedures to minimise disruption near high density shipping areas will include, for example, avoidance of anchoring near busy areas when Project vessels are waiting on weather; and the presence of a guard vessel in areas of significant vessel traffic. Installation vessels will have passage planning procedures, holding positions (e.g. if waiting on weather), traffic monitoring (e.g. radar, AIS, and visual), means of communication with third-party vessels, and emergency response plans in the event a third-party vessel approaches on a collision course.			
EM17	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed.			
EM18	Project vessels will not exceed 14 knots within the Proposed Development.			
EM19	GIL will require that the appointed contractor(s) follow the Department of Arts Heritage and the Gaeltacht (DAHG) 'Guidance to Manage the Risk to Marine Mammals from Man-made sound sources in Irish Waters' (DAHG 2014); in particular Section 4.3.4			
EM20	Cable protection material (rock berms and mattresses) will be designed to be over-trawlable.			
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.			
EM22	Guard vessels will be used (subject to risk assessment) during installation activities to communicate with third party vessels within the vicinity of cable sections that remain unburied between cable lay and burial.			
EM23	GIL will require that the appointed UXO contractor follows the follow the Department of Arts Heritage and the Gaeltacht (DAHG) 'Guidance to Manage the Risk to Marine Mammals from Man-made sound sources in Irish Waters' (DAHG 2014); in particular Section 4.3.5 'Blasting' including (but not limited to): ▪ At least one qualified and experienced marine mammal observer (MMO) shall be appointed to monitor for marine mammals. ▪ Only the minimum quantity of explosives to achieve the desired result must be used. ▪ Establishing a default 1km mitigation zone for marine mammal observation, measured from the explosive source and with a circular coverage of 360 degrees. ▪ Only commence explosive detonations during daylight hours and good visibility. ▪ 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.			

ID	Embedded mitigation measure	Project Phase		
		I	O	D
	▪ In waters up to 200m deep, the MMO shall conduct a pre-start up constant effort monitoring at least 30 minutes before the detonation. Sound-producing activity shall not commence until at least 30 minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO.	■		
EM24	A cable burial plan will be produced which outlines proposed method statements and cable protection measures for approval by the Foreshore Unit and discussion with fisheries stakeholders	■		
EM25	Effective channels of communication will be established and maintained between the Project and commercial fishing interests. This will include the appointment of a Fisheries Liaison Officer (FLO).	■	■	■
EM26	Post-installation inspection surveys will be conducted along the length of the cables on a regular basis.		■	
EM27	Post-installation compass deviation surveys will be undertaken to confirm compass deviation levels and the results forwarded to the Irish Maritime Administration.	■		
EM28	A protocol will be established for reporting unexpected archaeological discoveries. This protocol will be designed to enable project staff to report any finds made in a manner that is convenient and effective. Should such finds be considered to indicate the presence of a site of archaeological interest, a temporary Archaeological exclusion Zone (AEZ) may be implemented until more data is available.	■	■	
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.	■	■	
EM30	A scheme-specific underwater archaeology impact assessment (UAIA) will be prepared in consultation with the UAU and the National Monuments Service (NMS). This will set out when, how and why archaeological mitigation measures recommended in Chapter 15 are to be implemented and will be prepared in line with the Framework and Principles for the Protection of the Archaeological Heritage (Department of Culture, Heritage and the Gaeltacht 1999).	■	■	■
EM31	A protocol will be established for reporting unexpected archaeological discoveries. This protocol will be designed to enable project staff to report any finds made in a manner that is convenient and effective. Should such finds be considered to indicate the presence of a site of archaeological interest, a temporary archaeological exclusion zone (TEZ) may be implemented until further assessments have been undertaken.	■	■	■
I = Installation; O = Operation (including repair & maintenance); D = Decommissioning				

4.15 Zone of Influence

The zone of influence i.e. spatial extent, over which Greenlink is predicted to have an effect on the receiving environment has been established for the activities discussed above. The zones of influence are based on worst case assumptions as presented in Table 4-6.

Table 4-6 Zone of influence summary

Project Activity		Description	Zone of Influence
Shallow water cable installation (LWM out to 10m water depth)	Vessel positioning	Anchors may be used to maintain the position of the CLB or CLV. Up to 4 anchors may be used, secured up to 500 m from vessel. JUB may be used at HDD exit point. 4-8 legs may be used to keep position. Vessels will be requested to remain a safe distance from the spread.	1km x 2km
	Cable burial	Two power cables & fibre optic cable will be bundled together and laid within the Proposed Development application area	500m wide
		Cable trench will be up to 1m wide	1m
		A typical cable excavation tool has a seabed footprint of 15m.	15m
		Contingency external cable protection at HDD exit	20m long x 5.2m wide x 0.7m high
Deep water cable installation (water depths greater than 10 m)	Vessel positioning	Vessels will be requested to remain at a safe distance from the cable lay spread.	1km wide x 12km along centreline (in any 24-hour period)
	Cable burial	Two power cables & fibre optic cable will be bundled together and laid within the Proposed Development application area	Generally 500m wide.
		Cable trench will be up to 1m wide	1m
		A typical cable excavation tool has a seabed footprint of 15m.	15m
	Crossings	Footprint of deposits at asset crossing	120m long by 8.2m wide (1009m^2)
Operation	Buried cables	There will be a 250m development exclusion zone in place either side of the interconnector	500m
		Heat – based on industry standards for similar installations	1m
		EMF – B & iE fields elevated above background levels	2m

Project Activity		Description	Zone of Influence
	Repair	Vessels will be requested to remain at a safe distance from the cable lay spread.	1km x 1km
		Removal of buried cable	10m wide x 3km
		Re-trenching	10m wide x 3km

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5. Impact Assessment Methodology

5.1 Introduction

Under Directive 2014/52/EU (amending Directives 2011/92/EU and 85/337/EEC) on the assessment of the impacts of certain private and public projects on the environment (EIA Directive), there are three stages to the environmental impact assessment (EIA) process: screening, scoping and assessment.

The chapter outlines the key stages of the EIA process, summarises the conclusions of the screening and scoping stages, and outlines the approach taken to identify and evaluate potential impacts and cumulative effects associated with the Proposed Development, Campile Estuary and Irish Offshore.

The Proposed Development refers to the Irish Marine components of Greenlink from mean high-water springs (MHWS) at the Irish landfall at Baginbun Beach, Co.Wexford to the 12nm limit. 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 Irish Offshore refers to the same components of Greenlink from the 12nm limit to the UK / Republic of Ireland median line. Campile Estuary refers to the land cables where they cross under the Campile River.

The Proposed Development includes the following phases: installation; operation (including repair & maintenance); and decommissioning.

The EIA methodology follows a systematic approach to assess the potential impacts and subsequent effects of the Project on physical, biological and human receptors in a robust and transparent manner.

5.2 Environmental Impact Assessment Guidance

The impact assessment takes into account the guidance provided in the following documents:

- Environmental Protection Agency (EPA) Revised Guidelines on the Information to be Contained in Environmental Impact Statements. Draft August 2017;
- Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report. Directive 2011/92/EU as amended by 2014/52/EU;

- Department of Housing, Planning and Local Government. Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, 2018;
- Environment, Heritage and Local Government, Appropriate Assessment of Plans and Projects in Ireland, Guidance for Planning Authorities, 2009;
- National Parks & Wildlife Service, Marine Natura Impact Statements In Irish Special Areas of Conservation, 2012;
- The Institute of Environmental Management and Assessment (IEMA) Guidelines for Environmental Impact Assessment, 2004;
- The Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal, 2010; and
- IEMA Environmental Impact Assessment Guide to: Delivering Quality Development, 2016

5.3 Screening for Environmental Impact Assessment

The current requirements for EIA for projects offshore in Ireland are set out the EIA Directive.

Given its location across two jurisdictions, the proposed interconnector consists of two distinct but related and complementary developments, as follows:

1. A development being proposed for that portion of the overall interconnection project located in Ireland; and
2. A development being proposed for that portion of the overall interconnection project located in Wales.

The proposed interconnector does not constitute a "project" listed within either Annex I or Annex II to the EIA Directive. Accordingly, an EIA is not required in relation to the proposed interconnector. GIL has been advised that the project categories listed in the EIA Directive must be understood by reference to a wide scope and broad purpose. GIL is therefore following the EIA process for all project components.

Accordingly, GIL invited the competent authorities for both the Irish proposal and Welsh proposals to determine that an EIA is required and an Environmental Impact Assessment Report (EIAR) is required to be submitted with the applications for development consent.

5.4 Scoping and Consultation

GIL has taken a pro-active approach to consultation recognising that it is a critical activity in the development of a comprehensive and balanced EIA. This Section provides a summary of the consultation undertaken during the design of the project and consultation relevant to the environmental scoping and EIAR.

5.4.1 Approach to Scoping and Consultation

Consultation has been undertaken with statutory consultees, stakeholders and the public during key stages of the project. Consultation, including scoping, has had the following aims:

- To provide statutory and non-statutory consultees as well as local communities and other stakeholders with the opportunity to inform the development of the project and the final offshore route design.
- To provide statutory consultees with the opportunity to comment on the proposed specialist studies commissioned to inform the EIA, and the approach to, and scope of the EIAR.

5.4.2 Scoping

Article 5 of the EIA Directive establishes the process for identifying the level of detail of the information to be included by a Developer in the EIAR; typically referred to as scoping. Whilst the stage is not mandatory, it is strongly encouraged by the European Commission as Best Practice. The European Commission's Guidance on Scoping (EC 2017) states that:

"Scoping is an important stage that takes place early in the EIA process. It provides an opportunity for both Developers and the Competent Authority to determine those key environmental impacts and issues of concern that are likely to be of the utmost importance to the Project proposal's decision-making and eliminates those that are less of a concern. In other words, Scoping defines the EIA Report's content and ensures that the environmental assessment is focused on the Project's most significant effects on the factors listed in Article 3 of the Directive, and that time and money are not spent on unnecessary examinations. It also reduces the likelihood that competent authorities will need to request additional information from Developers after the Environmental Report has been prepared and submitted."

In line with the EIA Directive and Best Practice, GIL undertook scoping to assist in identifying the key environmental pressures surrounding their proposal. It provided statutory and non-statutory consultees with an opportunity to comment on the Proposed Development, the scope of the EIA and raise any issues which they consider may be important to the EIA process. Their responses have helped to provide direction on the topics the EIAR should focus on.

The Scoping Report was submitted to stakeholders in November 2018 (and is available at www.greenlink.ie). Stakeholders were identified through two methods; consultation and the project teams experience of interconnector projects. Stakeholders were asked to provide responses on the scoping report by the end of December 2018. If a response was not received, the stakeholder was approached after the deadline (via email & telephone) to ensure that they had the opportunity to provide comment. Table 5-1 identifies the stakeholders that provided a Scoping Opinion.

At the start of each topic chapter a table is provided listing the scoping responses received relevant to that topic and how they have been addressed in the EIA process.

Table 5-1 Stakeholders consulted during Scoping

Stakeholder	Responded?	Steps taken to receive opinion
Department of Housing, Planning and Local Government (DHPLG) – Foreshore Unit	Yes	Feedback on scoping report received through face-to-face meeting.
Department of Arts, Heritage and the Gaeltacht (DAHG) – Underwater Archaeology Unit	Yes	Formal scoping letter received
National Parks and Wildlife Service (NPWS) – Development Application Unit	Yes	Formal scoping letter received
An Bord Pleanála Projects of Common Interest (PCI)	Yes	Responded that they would not typically comment on the scope of the EIAR.
Marine Institute	Yes	Responded via email
Inland Fisheries Ireland	No	
Department of Agriculture, Food & the Marine - Aquaculture & Foreshore Management Division	Yes	Responded that they would not typically comment on the scope of the EIAR.
South East Regional Inshore Fisheries Forum	Yes	Feedback on scoping report received through face-to-face meeting.
Irish South and East Fish Producers Organisation (IS&EFPO)	No	
Irish South and West Fish Producers Organisation (IS&WFPO)	Yes	Feedback on scoping report received through face-to-face meeting.
Irish Sea Fisheries Board (BIM)	Yes	Feedback on scoping report received through face-to-face meeting.
Irish Whale and Dolphin Society (IWDS)	No	

5.4.3 Meetings

GIL have held meetings with stakeholders since February 2016. Details of these meetings are provided in Technical Appendix A; with a list of stakeholders consulted below. Meetings have helped to inform route development, discuss potential areas of conflict and scope the content and information to be provided in the EIAR.

- Department of Housing, Planning and Local Government (DHPLG) – Foreshore Unit
- National Parks and Wildlife Service (NPWS)

- Port of Waterford Company
- British Telecom
- South East Regional Inshore Fisheries Forum
- Irish South and East Fish Producers Organisation (IS&EFPO)
- Irish South and West Fish Producers Organisation (IS&WFPO)
- Irish Sea Fisheries Board (BIM)
- Local fishermen (including public meeting with over 50 fishermen in attendance)

5.4.4 Public Consultation

As a proponent of a European PCI project, GIL is required to conduct public and stakeholder consultation meetings through a variety of means set out in Annex IV(5) of the PCI Regulation. Public consultation was achieved through:

- Regular updates to the Project website (www.greenlink.ie)
- Public consultation meetings
- Newspaper notices published in both local and national newspapers
- Provision of public information brochure (TEN-E Regulation Information Brochure) - published before the start of formal public consultation and updated throughout the development process.

Public exhibitions were held on the following dates:

- 29 May 2018 - Pater Hall, Pembroke Dock, Wales
- 30 May 2018 - Hundleton Sports Pavilion, Hundleton, Wales
- 31 May 2018 – Angle Village Hall, Angle, Wales
- 27 June 2018 - Fethard on Sea, County Wexford, Ireland
- 15 August 2018 - Duncannon, County Wexford, Ireland
- 03 December 2018 – Pater Hall, Pembroke Dock, Wales
- 04 December 2018 – Angle Village Hall, Angle, Wales
- 05 December 2018 – Hundleton Sports Pavilion, Hundleton, Wales
- 16 January 2019 – Fethard on Sea, County Wexford, Ireland
- 17 January 2019 - Duncannon, County Wexford, Ireland
- 28 March 2019 - Ramsgrange, County Wexford, Ireland

The exhibitions were well attended by the community. Feed-back forms were provided so that the public could comment on the proposals. Comments received as part of the consultation process have been considered in the preparation of the EIAR.

Details of public consultation can be found at www.greenlink.ie.

Following submission and acceptance of the Foreshore Licence application by the Foreshore Unit an 8-week public consultation period will commence. This period provides consultees and the public further opportunity to comment on the application and EIAR. At the start of this period copies of the EIAR will be made available to the public at Waterford Garda Station and on the Greenlink project website (www.greenlink.ie).

5.4.5 Scoping Conclusions

The Scoping Report (available at www.greenlink.ie) included an assessment of significance of each potential environmental pressure resulting from the Proposed Development, Offshore Ireland and Campile Estuary to decide which of the pressures could be significant and therefore should be taken forward for further assessment in the EIAR. Those which were deemed to be non-significant were to be scoped out of the EIAR and no further assessment was to be undertaken. This scoping process was refined through the consultation discussed above with some pressures being scoped back-in at the request of stakeholders, or agreement reached that an effect could be scoped out.

Table 5-2 identifies the pressures that have been scoped out of the EIA and the reason for the exclusion. In line with the EC Guidance on Scoping (EC 2017) these pressures will not be discussed further in the EIAR, to ensure that the environmental assessment is focused on the Proposed Development's most significant effects.

Table 5-2 Pressures scoped out from the EIAR and the rationale for their exclusion

Pressure Scoped Out of EIA	Environmental Receptor	Reason for Exclusion
ALL	Air and climate	The proposed marine cable corridor crosses the Celtic Sea which is characterised by low levels of human activity (and therefore away from sources of emissions that may influence air quality). Air quality and particulate matter (as indicated by concentrations of gases which are potentially harmful to human health) is not generally considered to be an issue for offshore developments (Fuzzi et al. 2015). Concerns over air quality are primarily related to emissions from road transport and land-based industry as these are the main sources of combustion products onshore (Defra 2011). Potential air quality pressures from Greenlink will primarily occur from engine exhaust emissions from marine vessels used during cable installation and maintenance. Given that these emissions will be emitted in the coastal or offshore environment away from any major emission sources, emission from the Proposed Development will not cause a deterioration in local air quality (other than briefly). It is therefore concluded, that emissions from the Proposed Development will not be a significant contributor to global emissions and as discussed in Chapter 3, Greenlink will help to reduce CO_2 emissions and meet climate policy targets in the long-term. Any effects on air and climate were assessed as Not Significant.
ALL	Population and human health	The only aspects of the Proposed Development which could affect population and human health are the project vessels ability to briefly effect local air quality and potential effects in relation to electric and magnetic fields (EMF) in the intertidal zone. However, the Proposed Development is located away from residential human populations and is unlikely to cause a deterioration in air quality. The topic of EMF has been scoped out for the intertidal zone based on the depth of burial of the cables (approximately 10m below the intertidal area), calculations showing EMF will emanate a maximum of 2m from the cables (Chapter 4) and the maintenance of adequate separation from sensitive receptors (hospital, schools or dwellings). Any effects on population and human health have been assessed as Not Significant.
Hydrocarbon and PAH contamination	All receptors	Unplanned events (accidental oil or chemical spills) have been scoped out of the EIAR for the following reasons: • The majority of the Proposed Development lies within an area of low shipping density, crossing the main north to south West Celtic Sea shipping lane for a short distance perpendicular to the traffic flow. All project vessels will comply with Irish and International statute with respect to markings, communications and Collision Regulations. The risk of a collision leading to a large oil spill is therefore extremely low, and no greater than that for any other vessel in the region. This conclusion is supported by analysis of statistics from the Advisory Committee of Protection of the Sea (ACOPS) for the Bristol Channel and South Wales region for the period 2015 and 2016 (latest reports available) which shows that total incidents of mineral oil pollution averages 6 incidents per annum, representing 1% of the total number on the UK continental shelf. Of these incidents the majority were in ports and harbours rather than the open sea and consisted of bunkering type incidents from fishing vessels and pleasure craft. During the reporting period analysed offshore support vessels were involved in 14 of the 942 incidents (1.5%) reported on the UK continental shelf.

Pressure Scoped Out of EIA	Environmental Receptor	Reason for Exclusion
		• 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. In addition, the cable has been routed to avoid disturbing historically contaminated sediments (e.g. domestic or industrial waste, munitions) in disposal sites and it is therefore unlikely that contaminated sediments will be resuspended or disturbed during cable installation.
Temperature changes - local	Physical conditions Fish and Shellfish	When cables are in operation, localised heating of the environment surrounding the cables (i.e. sediments including interstitial water, where cables are buried; rock berms/concrete mattresses when cable protection employed) may occur. Seawater temperatures within the Celtic Sea vary seasonally and will accommodate minor localised variations in temperature associated with thermal losses. Effects on seabed temperature will be negligible and Not Significant. As there will not be a significant effect on sediments, there will be no indirect effects on fish and shellfish.
Changes in suspended solids (water clarity)	Physical conditions	The scoping out of this pressure from the EIAR only relates to the activity - discharges from project vessels; other activities will be assessed. Project vessels will comply with the International Marine Organisation (IMO) International Convention for the Prevention of Pollution from Ships (MARPOL) standards. No discharges of waste or sewage are permitted within 12nm of the coast, therefore no effects to bathing waters are anticipated. Effects of discharges offshore will be brief and localised and have been assessed as unlikely to have a significant effect on water quality.
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion (change to seabed features)	Intertidal species	Installation at the landfall will be achieved by HDD. The HDD will exit below the low water mark and therefore intertidal habitats will not be affected. As there is no pressure-receptor pathway this pressure has been scoped out of the EIAR.
	Marine Birds	The scoping exercise had identified the potential for penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion could lead to indirect effect on birds. However, the EIA process, reported in Chapter 8 concluded that the effects of this pressure on fish (including herring and sandeel, which forms part of the food chain for birds in the vicinity of the Proposed Development) will be Negligible and is Not Significant. Therefore indirect effects on birds are not likely and this pressure has been scoped out of the EIAR for marine birds.
Introduction or spread of non-indigenous species	Benthic habitats. Protected sites	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. Marine contractors engaged by GIL will be expected to complete a biosecurity risk assessment. This would include factors such as

Pressure Scoped Out of EIA	Environmental Receptor	Reason for Exclusion
		origins of the vessels and ensuring that relevant equipment is cleaned before use. Implementation of this embedded mitigation will reduce the pathways of effect and any effects will be Not Significant.
Visual disturbance	Fish and Shellfish	The pressure could occur during cable installation, as a result of the presence of the installation vessels and equipment (and associated noise). The presence of vessels and equipment could result in the displacement of fish within the water column. Fish are likely to have reacted to underwater noise generated by project vessels before they react to the presence of the vessel. Effects from underwater noise has been assessed in Chapter 8, concluding that effects are Slight and Not Significant. Visual disturbance from installation operations will be temporary, localised and not significant given existing background levels of noise and shipping in the St Georges Channel and around Waterford Estuary.
Siltation rate changes including smothering (depth of vertical sediment overburden)	Fish and Shellfish	There are three pathways for siltation rate changes to occur: through displacement of sediments during trenching; by the re-deposition of suspended sediment; and by external cable protection being placed on the seabed. Chapter 6 concluded that the significance of siltation rate changes is Imperceptible. The installation activities will increase the levels of SPM in the water column. The magnitude of the increase will be dependent on the seabed conditions. Near the coast, between KP157 and 158, where a major component of the sediment is silt, a plume of 5km could be briefly generated from the trench - similar to suspended sediment concentrations during a storm. This will cloud the water, but as sediments are not contaminated it will not have a detrimental effect on the environment, and water clarity will quickly return as the installation moves on and tidal currents dissipate the suspended sediments. Calculations indicate the concentrations will be within the range of natural variability expected for the region, will be limited in extent and brief in nature. 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 (equivalent to those experienced during storm events) and the significance of the effect is Not Significant.
Death or injury by collision	Marine mammals. Basking shark	Although shipping collision is a recognised cause of marine mammal and basking shark 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 project 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 pressure is not considered further.
Accidental anchoring or emergency anchoring on unburied / buried cable	Shipping, recreational boating	During installation (and repair & maintenance) there is the potential for a ship to accidentally anchor over unburied cable prior to its burial, snagging the anchor and resulting in potential damage to the ship. However, the likelihood of a commercial vessel accidentally releasing its anchor in close proximity to the marine cables is low.

Pressure Scoped Out of EIA	Environmental Receptor	Reason for Exclusion
		This risk will be managed by GIL and their appointed installation contractor through standard industry best practice methods such as informing sea users of the impending works (through Notices to Mariners, Kingfisher Bulletins, radio broadcasts), traffic monitoring, and if necessary the use of guard vessels.
Risk of ship collisions	Shipping	It is recognised that ship to ship collisions could potentially occur. All Project vessels will comply with the International Regulations for Preventing Collisions at Sea 1972 and will be appropriately marked. This risk will be managed by GIL and their appointed installation contractor through compliance with international and national statute and standard industry best practice methods. For example, informing sea users of the impending works (through Notices to Mariners, Kingfisher Bulletins, radio broadcasts), traffic monitoring, and if necessary the use of guard vessels.
Damage to or interference with an external cable asset	Existing cables	The marine cables cross four in-use existing cable in Irish waters. Although, there is the potential for installation and repair & maintenance activities to damage the existing active cable, particularly at the crossing point, this risk is managed through standard operating procedures. The cable asset will be crossed at 90°. Routes have been designed to ensure sufficient separation between the marine cables and existing cables, particularly where they run parallel, to ensure there is no interference. Cable crossing agreements between GIL and the third-party cable operators will include design and installation methods for crossing arrangements. Therefore, the potential for the installation of the Greenlink Interconnector to damage the existing asset is greatly reduced.

5.4.6 Structure of the EIAR

Article 3(1) of the EIA Directive outlines the information to be included in an EIAR. It states that…

"The environmental impact assessment shall identify, describe and assess in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on the following factors:

(a) population and human health;

(b) biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC;

(c) land, soil, water, air and climate;

(d) material assets, cultural heritage and the landscape;

(e) the interaction between the factors referred to in points (a) to (d)."

Table 5-3 provides a signpost to the chapters which cover these factors. A number of these factors were scoped out of the EIAR via the scoping process and Scoping Report. The proposed structure of the EAIR was outlined in the Scoping Report and agreed with the Foreshore Unit.

In line with bullet (e) above, Table 5-4 provides a matrix to show the interactions between different receptors that have been considered by the EIA. For example, if it is established in the Physical Environment and Coastal Processes chapter there will be a significant increase in suspended sediment concentrations then the Benthic and Intertidal Ecology chapter will need to assess the effect of this increase on subtidal habitats.

Table 5-3 Factors to be assessed by an EIAR – signposting to topic chapters

Factor	ES Topic Chapter										
	Ch 6 - Physical Environment and Marine Processes	Ch 7 - Benthic and Intertidal Ecology	Ch 8 - Fish and Shellfish	Ch 9 - Birds	Ch10 - Marine Mammals and Reptiles	Ch11 - Protected Sites	Ch12 - Commercial Fisheries	Ch 13 - Shipping and Navigation	Ch 14 - Offshore Instructure and Other Marie Users	Ch15 - Marine Archeology	Ch 16 - Cumulative Effects Assessment
Population and human health	Scoped out of assessment, justification provided in Table 5-2, Section 5.4.5										
Biodiversity		✓	✓	✓	✓	✓					
Land	Covered by the onshore ES										
Soil (i.e. seabed sediments)	✓										
Water	✓										
Air and climate	Scoped out of assessment, justification provided in Table 5-2, Section 5.4.5										
Material assets							✓	✓	✓		
Cultural heritage and landscape										✓	
Interaction between these factors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 5-4 Interaction matrix

Key

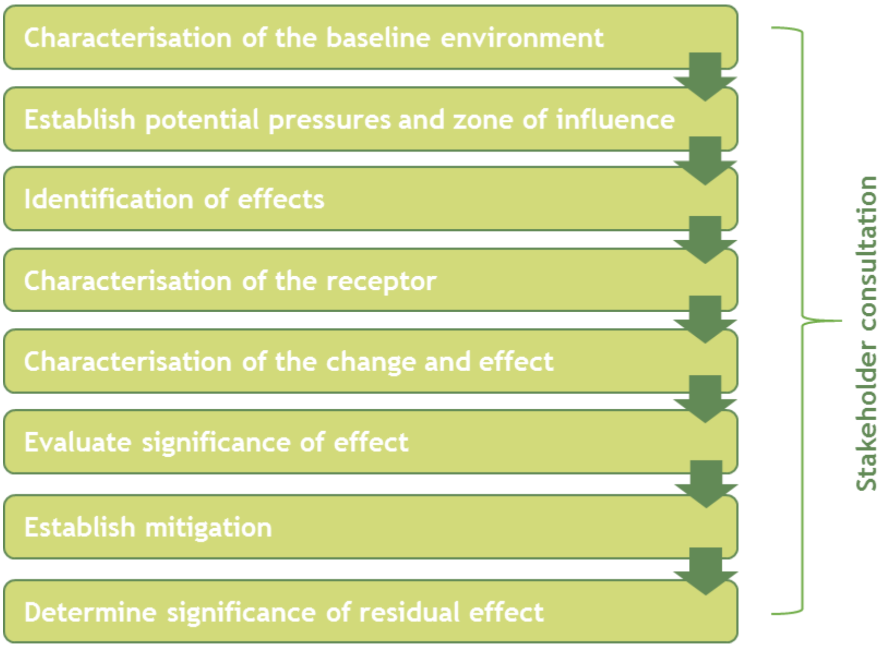
X	No interaction
✓	Weak interaction
✓	Some interaction
✓	Strong interaction

	Air & Climate	Population & human health	Physical conditions	Benthic & Intertidal Ecology	Fish & Shellfish	Birds	Marine Mammals & Reptiles	Commercial Fishing	Shipping & Navigation	Infrastructure & Other Marine Users	Marine Archaeology
Air & Climate		x	x	x	x	x	x	x	x	x	x
Population & human health			x	x	x	x	x	x	x	x	x
Physical conditions				✓	✓	✓	x	✓	✓	x	✓
Benthic & Intertidal Ecology					✓	✓	x	x	x	x	x
Fish & Shellfish						✓	✓	✓	x	x	x
Birds							x	x	x	x	x
Marine Mammals & Reptiles								x	x	x	x
Commercial Fishing									x	x	x
Shipping & Navigation										x	x
Infrastructure & Other Marine Users											x
Marine Archaeology											

5.5 Method of Environmental Impact Assessment

The EIA process reported in this EIAR involves the following main steps as presented in Figure 5-1.

Figure 5-1 Steps of an EIA



The steps are described in more detail below and are followed and presented within the receptor topic chapters of the EIAR.

5.6 Characterisation of the Baseline Environment

To assess the potential effects resulting from the Proposed Development it is necessary to first establish the physical, biological, and human conditions that exist along and within the vicinity of the Proposed Development; and outline the likely natural evolution of the baseline without implementation of the Proposed Development as far as natural changes can be determined based on currently available environmental information and scientific knowledge.

A full understanding of the baseline for each environmental receptor has been achieved through some or all of the following:

- Review of primary baseline studies (field).
- Review of additional specialist desk-based baseline studies.
- Detailed review of all secondary sources (i.e. existing publicly available documentation and literature).
- Stakeholder consultation.

The key data sources used to establish the baseline are described in each receptor topic chapter. The following limitations or assumptions should be noted:

- Third party and publicly available information is correct at the time of publication.
- Baseline conditions are accurate at the time of physical surveys but due to the dynamic nature of the environment, conditions may change before or during the installation and operation phases of the Proposed Development (although the effects of the natural variation are included in the assessment).
- The Proposed Development area will not be subject to force majeure resulting in a complete shift from the existing baseline.

For each receptor topic the baseline has been described from the mean high-water spring (MHWS) at Baginbun Beach, Ireland to the UK/Republic of Ireland median line.

5.7 Establish Potential Pressures and Zone of Influence

The IEMA (2004) guidelines state:

"The assessment stage of the EIA should follow a clear progression; from the characterisation of 'impact' to the assessment of the significance of the effects taking into account the evaluation of the sensitivity and value of the receptors." (p11/2)

For consistency, the terms pressure, interaction, and effect, as defined in Table 5-5 below, have been used throughout the EIAR.

Table 5-5 Definitions of pressure, interaction and effect

Term	Definition
Pressure	A pressure can be defined as "the mechanism through which an activity has an effect on any part of the ecosystem". The nature of the pressure is determined by activity type, intensity and distribution. A list of marine pressures and their definitions has been formally agreed by the OSPAR Intercessional Correspondence Group on Cumulative Effects (ICG-C).
Interaction	The link between a pressure and the receptor. There must be an interaction for an effect to occur.
Effect	The consequence of pressure; a predicted change in the baseline environment, usually measureable. Effects only occur when an activity or environmental impact is present within an environment that is sensitive to it.

For each potential pressure, the zone of influence – the spatial extent over which the activities are predicted to have an impact on the receiving environment – is established. This will vary for different activities and for the different stages of the Proposed Development (installation, operation and decommissioning).

Establishing the zone of influence for different activities, pressures and receptors will be undertaken quantitatively where possible, but if not, it will be undertaken qualitatively where necessary based on the Proposed Development description, project experience and literature reviews.

Potential effects on receptors which occur outside the zone of influence and which cannot or are unlikely to travel into the zone (e.g. benthic communities) have been scoped out. Conversely, mobile species and other mobile receptors such as other sea users can travel into the zone of influence and may therefore be effected by the Proposed Development.

The zones of influence used in the assessment are given in the topic Chapters. The zone of influence will in many cases relate to the seabed and or sea surface footprint of the Proposed Development's activities. These are established in Chapter 4. However, in some cases the zone of influence may extend much further e.g. disturbance from noise may affect birds or cetaceans >1km away.

The zone of influence has been estimated for each potential pressure on the receptor. Where a number of project activities result in the same pressure (e.g. pre-lay grapnel run, trenching, resulting in seabed disturbance) or the installation technique has not been determined, the worst-case spatial extent has been applied.

5.8 *Identification of Effects*

The prediction of potential effects has been undertaken to determine what could happen to each environmental receptor as a consequence of the Proposed Development. The diverse range of potential effects considered in the EIA process results in a range of prediction methods being used including quantitative, semi-qualitative and qualitative. Potential pressures to be assessed are provided in each receptor topic chapter. The definitions used to describe effects are presented in Table 5-6 below.

Table 5-6 Definitions of effects

Term	Definition
Direct effect	Effects that result from a direct interaction between the Project/Project activities and the receiving environment.
Indirect effect	Effects on the environment, which are not a direct result of the Project/Project activities, often produced away from the activity or as a result of a complex pathway (European Commission 1999). For example, loss of habitat from trenching, leading to reduction in prey species availability, having an indirect impact on predators.
Cumulative effect	Effects that result from incremental changes caused by other present or reasonably foreseeable actions together with the Project (European Commission 1999). Generally considered to be the same impact but from different projects e.g. underwater noise from two separate projects combining to affect marine mammals.
Positive / Beneficial effect	An effect that is considered to represent an improvement on the baseline condition or introduces a new desirable factor (IEEM 2010).
Negative / Adverse effect	An effect that is considered to represent an adverse change from the baseline condition or introduces a new undesirable factor (IEEM 2010).

5.9 *Characterisation of the Receptor*

The significance of an effect on a receptor or feature is characterised by the sensitivity, recoverability and importance of the receptor or feature. Characterisation of the receptor is achieved by balancing out these three considerations to determine the Receptors Value. Criteria used for the assessment are presented in Table 5-7.

Sensitivity	• The sensitivity of the receptor relates to its sensitivity/vulnerability to change (including its capacity to accommodate change i.e the tolerance/intolerance of the receptor to change).
Recoverability	• The ability of the receptor to return to the baseline state before the Project impact caused the change.
Importance	• The importance of the receptor or feature is a measure of the value assigned to that receptor based on biodiversity and ecosystem services, social value and economic value. Importance of the receptor is also defined within a geographical context, whether it is important internationally, nationally or locally important.

Table 5-7 Criteria for characterising the sensitivity or value of the receptor (Receptor Value)

Receptor Value	Definition		
High	Receptor has little or no ability to absorb change without fundamentally altering its character. For example:		
	Physical	**Biological**	**Human**
	One or more combinations of: • Receptor has low/no capacity to return to baseline condition within Project life, e.g. low tolerance to change and low recoverability such as a physical feature formed over a geological time scale. • The receptor is a designated feature of a protected site, or is rare or unique.	One or more combinations of: • Receptor has low tolerance to change, e.g. the species population is likely to be killed or destroyed by the Project activity (MarLin 2016). • Recovery to baseline conditions over a very long period, i.e. > 10 years or not at all (MarLin 2010). • The receptor is a designating feature of an International protected site, e.g. European Natura 2000 or RAMSAR site. • Receptor is very rare/unique/or ecologically important.	One or more combinations of: • Receptor has low/no capacity to return to baseline, e.g. low tolerance to change and low recoverability such as loss of access with no alternatives. • Damage to asset(s), e.g. at cable crossing, resulting in major financial consequences for the company. • Receptor is economically valuable.
Medium	**Receptor has moderate capacity to absorb change without significantly altering its character; however some damage to the receptor will occur. For example:**		
	Physical	**Biological**	**Human**
	One or more combinations of: • Receptor has intermediate tolerance to change. • Medium capacity to return to baseline condition, e.g. >5 of up to 10 years. • The receptor is valued but not protected.	One or more combinations of: • Receptor has intermediate tolerance to change, e.g. some individuals of the species may be killed/destroyed by the Project activity and the viability of a species population may be reduced (MarLIN 2016). • Recovery to baseline conditions over a long period, i.e. > 5 or up to 10 years (MarLIN 2010).	One or more combinations of: • Receptor has intermediate tolerance to change, e.g. loss of access but acceptable alternatives, alteration to route but with no significant economic consequences. • Damage to asset(s), e.g. at cable crossings, resulting in financial consequences for the company.

Receptor Value	Definition		
		• The receptor is designated as a national site, e.g. Site of Special Scientific Interest, Nature Reserve, Marine Conservation Zone. • Uncommon or moderately valuable economically or ecologically but not rare or unique.	
Low	**The receptor is tolerant to change without significant detriment to its character. Some minor damage to the receptor may occur. For example:**		
	Physical	Biological	Human
	One or more combinations of: • Receptor has high tolerance to change, e.g. disturbance to unconsolidated seabed sediments or sandwaves. • High capacity to return to baseline condition, e.g. within 1 year or up to 5 years. • The receptor is common and/or widespread.	One or more combinations of: • Receptor has high tolerance to change, e.g. the species population will not be killed/destroyed by the Project activity. However, the viability of a species population will be reduced. • Recovery to baseline conditions is expected in a short period of time, i.e. within 1 year or up to 5 years (MarLIN 2010). • The receptor is neither rare, unique or of significance in terms of economic or ecological value.	One or more combinations of: • May affect behaviour but is not a nuisance to users. • Minor/no financial consequence to the company.
Negligible	The receptor is tolerant to change with no effect on its character. The Project activity does not have a detectable effect on survival or viability of a species (MarLIN 2016). The habitat or species is expected to recover rapidly, i.e. within a week (MarLIN 2010).		

5.10 *Characterisation of Effect*

To fully characterise an effect or level of change from baseline conditions the following parameters are considered. These parameters are used to define the magnitude of change or the Magnitude Value for the effect based on the definitions provided in Table 5-8.

Scale of Change

- The scale of change refers to the degree of change to or from the baseline environment caused by the pressure being described.

Spatial extent

- The extent of an impact is the full area over which the impact occurs.

Duration & Frequency

- The duration is the period within which the impact is expected to last prior to recovery or replacement of the feature. Frequency refers to how often the impact will occur.

Table 5-8 Factors which determine the Magnitude of an Effect

Magnitude Value	Definition
High	Effects are of medium (7 -15 years) through to permeant duration and/or on a regional level or major alteration to key elements / features of the baseline condition such that post development character / composition of baseline will be fundamentally changed.
Medium	Effects are of short-term (1-7 years) duration and/or local level change (greater than the project footprint) or alteration to one or more key elements/features of the baseline conditions such that post development character/composition of the baseline condition will be materially changed.
Low	Effects are temporary (<1 year) or Short-term (1-7 years) in duration, site specific and/or minor shift away from baseline conditions. Changes arising from the alteration will be detectable but not material; the underlying character /composition of the baseline condition will be similar to the pre-development situation.
Negligible	Very little change from baseline conditions. Effect is momentary or brief (<less than a day) and/or barely distinguishable, approximating to a “no change” situation.

5.11 *Evaluation of Significance of Effect*

Having established the magnitude of change (Magnitude Value) and the sensitivity of the receptor (Receptor Value), the significance of the effect can be assessed using the significance matrix adapted from the chart showing typical classifications of the significance of impacts in EPA (2017); presented in Table 5-9.

Table 5-9 Significance matrix

		Magnitude of change			
		Negligible	Low	Medium	High
Sensitivity of receptor (Receptor value)	High	Not Significant	Moderate	Significant	Very Significant / Profound
	Medium	Not Significant	Slight	Moderate	Significant
	Low	Imperceptible	Slight	Slight	Moderate
	Negligible	Imperceptible	Not Significant	Not Significant	Slight

The result of using this matrix approach is the assignment of the level of significance of the effect for all potential pressures of the Proposed Development. This is undertaken prior to any mitigation. Project Specific Mitigation will generally only be proposed if effects are significant.

Definitions of the significance levels (as outlined in EPA 2017) are provided in Table 5-10 below.

Table 5-10 Definitions of significance levels

Significance	Definition	
Imperceptible	An effect capable of measurement but without significant consequences	Effects in these three categories are generally considered as **Not Significant** and adequately controlled by best practice and legal controls. Opportunities to reduce effects further through mitigation may be limited and are unlikely to be cost effective.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.	
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.	
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.	Generally considered as Significant but effects are those, considered to be tolerable. However, it is expected that the residual effect has been subject to feasible and cost-effective mitigation and has been reduced to as low as reasonably practicable (ALARP) and that no further measures are feasible.
Significant	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.	Generally considered as Significant and regarded as unacceptable prior to any mitigation measures being considered.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment	
Profound	An effect which obliterates sensitive characteristics	

5.12 Establish Mitigation

Mitigation measures are the actions or systems proposed to manage or reduce the potential negative effects identified. Mitigation measures are sometimes confused with measures taken to ensure legal compliance, which can be similar. Legislation is often designed to ensure effects to the environment are minimised.

A standard hierarchical approach to identifying mitigation requirements has been used to inform the EIA:

- Avoid or Prevent: In the first instance, mitigation should seek to avoid or prevent the adverse effect at source for example, by routeing the marine cables away from a sensitive receptor.
- Reduce: If the effect is unavoidable, mitigation measures should be implemented which seek to reduce the significance of the effect.
- Offset: If the effect can neither be avoided nor reduced, mitigation should seek to offset the effect through the implementation of compensatory mitigation.

Mitigation measures fall into two categories: mitigation which forms part of the project design which is referred to as embedded mitigation in Chapter 4; and mitigation which is part of the construction and operation of the Proposed Development, which is referred to as Project Specific Mitigation.

5.12.1 Embedded mitigation

As described in Chapter 3, the Proposed Development has been developed through an iterative process which involved seeking to avoid or reduce potential environmental effects through routeing of the marine cables. This was the first project specific step in mitigating potential effects by seeking to avoid or reduce environmental disturbance.

Embedded mitigation measures which form part of the design are an inherent part of the Proposed Development and are considered the ‘base case’ as primary mitigation measures. As well as steps the Proposed Development has taken to reduce environmental effects, the design also includes measures taken to ensure compliance with international and national statute, which also seeks to avoid or abate negative effects.

All embedded mitigation which has been assessed as part of the design is listed in Chapter 4 and the appropriate receptor topic Chapter.

5.12.2 Project Specific Mitigation

Mitigation measures which are to be adopted and implemented during the construction and operation of the Proposed Development to mitigate adverse effects, over and above legal compliance are called Project Specific Mitigation. Appropriate, feasible and cost-effective mitigation measures have been proposed as necessary in each topic Chapter. All Project Specific Mitigation commitments made in the EIAR are additionally listed in a Schedule of Mitigation provided as Chapter 17.

5.12.3 Mitigation Schedule

The package of Embedded Mitigation and Project Specific Mitigation to be incorporated into the design, installation, operation and decommissioning of the submarine cables are set out in Chapter 17 of this EIAR. The mitigation schedule will form the basis of an Environmental Management Plan (EMP) to be implemented in the installation and operation of the marine cables. In stating the mitigation measures within the EIAR, GIL, as well as their appointed contractors, are committed to the effective implementation of all those measures described. This is to ensure that the Proposed Development will not generate significant adverse environmental effects that have not been assessed.

5.13 Determine Significance of Residual Effects

The significance assessment is repeated taking into consideration the application of Project Specific Mitigation i.e. secondary mitigation. This determines whether there is likely to be a residual effect. When applied after mitigation, the resulting significance level is referred to as the residual significant effect. Tables within the topic chapters present the results of both assessments.

Residual effects assessed as Significant after consideration of proposed mitigation measures will normally require additional analysis and consultation in order to discuss and possibly further mitigate effects where possible. Where further mitigation is not possible a residual effect may remain.

5.14 Cumulative Effects Assessment (CEA)

The term cumulative effects refers to effects upon receptors arising from the Proposed Development when considered alongside other present or reasonably foreseeable projects, plans or licensed activities, that result in an additive effect with any element of Greenlink. Cumulative effects can be described as the net effect of cumulative pressures, which includes both direct and indirect effects resulting from cumulative pressures caused by different activities. An individual effect alone may be considered insignificant, but the additive effects of more than one effect, from any number of sources, could result in a significant effect, either positive or negative.

Intra-project effects (effects between different components of Greenlink) are discussed in the relevant topic chapters, and are summarised in Chapter 16.

Potential cumulative effects between the Proposed Development and other present or reasonably foreseeable projects, plans or licensed activities have been assessed using the methodology from the “MMO Strategic Framework for Scoping Effects” (MMO 2014), which consists of six steps:

1. Complete an activity/pressure/receptor matrix for each phase of the Proposed Development and identify the spatial and temporal extents of pressures;
2. Define a study area around the Proposed Development and identify projects, plans and licensed activities within that area;
3. Complete an activity/pressure/receptor matrix for each type of project, plan and licensed activity within the study area to identify common pressures on each receptor;
4. Identify if the Proposed Development's zone of influence overlaps spatially with those from other projects or plans. If there is no spatial overlap, that specific pressure-receptor pathway will be screened out. If there is a spatial overlap, the pathway continues to the next step in the process;
5. Identify if the Proposed Development phases overlap temporally with the scoped-in projects. If there is no temporal overlap or if a review of publicly available information and consultation with the appropriate developer did not identify specific timelines, the specific pressure-receptor pathway will be screened out. If there is a temporal overlap the pathway continues to the next stop; and
6. Undertake the assessment on Screened Projects/Plans, where both a spatial and temporal overlap has been identified.

The CEA is presented in Chapter 16.

5.15 Transboundary Agreement

The Convention on Environmental Impact Assessment in a Transboundary Context 1991 sets out the obligations of parties to assess the transboundary environmental effect of certain activities at an early stage of planning. It also lays down the general obligations of states to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental effect across boundaries.

Greenlink crosses two maritime jurisdictions (UK and Republic of Ireland). An EIA has been conducted for each jurisdiction and as such transboundary assessment has been an integral component of the environmental assessment. It is anticipated that transboundary effects will be limited. This is discussed in 'Chapter 16 – Cumulative Effects Assessment'.

5.16 Uncertainty, Assumptions and Limitations

5.16.1 General

The EIA process aims to assist good decision-making based on information about the potential effects of the Proposed Development. However, there will be some uncertainty as to the exact scale and nature of the environmental effects. This uncertainty arises as the level of detail and information about the Proposed Development available at the time the assessment was undertaken and/or due to limitations to the prediction process itself. Key issues relating to assumptions about the Proposed Development are outlined below. Where assumptions have been made in undertaking the EIA these are set out in each topic Chapter.

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 in the relevant topic Chapter.

5.16.2 Level of design detail for the EIA

It is acknowledged that the development which is eventually designed and constructed may differ slightly from the design details that have been used in the EIA and reported in the EIAR. At the time of writing, the contract to undertake the cable installation work has not been awarded, and therefore the proposed installation methodology and exact timing has not been finalised. However, in order to ensure the EIA is as robust as possible, the EIA assesses the range of likely installation methods and the worst case zone of influence to ensure that the envelope of effects assessed will encompass the worst case and actual installation method, once confirmed. If information was not available, but the spatial extent of an effect could be inferred based on expert knowledge, this approach has been taken.

The potential effects assessed within this EIA has taken into account the range of parameters within which the detailed design will be developed. Generally potential environmental effects will be similar for each discrete environmental topic. For certain topic areas there may be slight differences in the assessment where maximum and minimum dimensions are considered.

5.16.3 Baseline data used in the EIA

Within the EIA, the assessment of potential effects on environmental receptors has been undertaken against present, known, baseline conditions. It is recognised that baseline conditions could change over time. However, it is assumed that the data referenced in this EIA, including survey data, is sufficient to characterise the baseline environment relative to the Proposed Development's effects, and any changes to this baseline characterisation throughout the Proposed Development lifetime are not anticipated. The description of the baseline and cumulative effects assessment is based on the latest available information.

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6. Physical Conditions and Marine Processes

This Chapter describes the existing baseline environment in terms of the physical conditions and marine processes, identifies the pressures associated with the Proposed Development on the receptors, presents the findings of the environmental impact assessment, and describes how significant effects (if any) will be mitigated.

The Proposed Development refers to the Irish Marine components of Greenlink from mean high-water springs (MHWS) at the Irish landfall at Baginbun Beach, Co. Wexford to the 12nm limit. 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, remediation and maintenance activities); and
- Decommissioning.

This chapter also provides information on the Irish Offshore components of Greenlink from the 12nm limit to the Republic of Ireland/UK median line.

Kilometre points (KPs) have been assigned to the route to aid with the description; running from KP0 at MHWS, Freshwater West to KP159.27 at MWHS, Baginbun Beach. The Irish Offshore component of Greenlink lies between KP73.8 and KP123.6. The Proposed Development lies between KP124 and KP159.27.

6.1 Data Sources

Greenlink Interconnector Limited (GIL) commissioned geophysical and geotechnical 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 survey data used to inform the baseline description and assessment include the following:

- Greenlink Geophysical Survey Report (MMT 2019a) – provided as Technical Appendix G;
- Greenlink Geotechnical Survey Report (MMT 2019b).

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

6.1.1 Greenlink cable route survey

A survey of the Greenlink cable route was carried out between September 2018 and January 2019 by MMT to inform cable route design and the environmental assessment. Geophysical, geotechnical and benthic survey techniques were used to:

- Characterise the seabed to a depth of approximately 15-20m in terms of its topology, shallow geological and seabed features, sediment type, sediment particle size and sediment contamination;
- Identify obstructions and debris on the seabed;
- Characterise burial conditions;
- Characterise the benthic community; and,
- Determine the presence of any features that may have conservation significance.

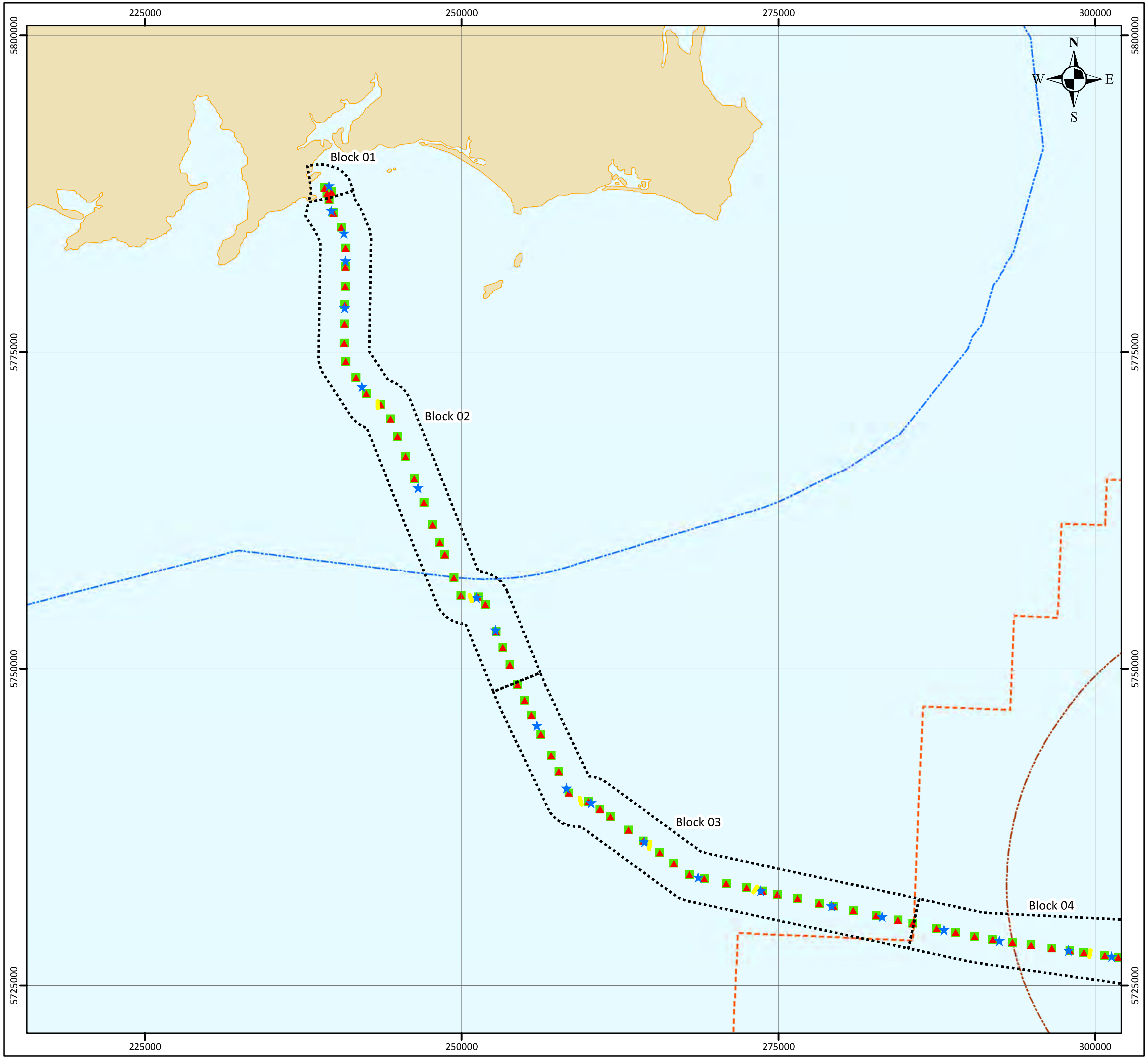
The survey was divided into six blocks. The Proposed Development is located within Blocks 1 and 2, whilst Block 3, covered the Irish Offshore component of Greenlink. Blocks and sampling stations are shown in Figure 6-1 (Drawing P1975-SURV-016).

The scope of work comprised of:

- Onshore/intertidal topographic survey using an unmanned autonomous vehicle (UAV);
- Geophysical/hydrographic nearshore and offshore data acquisition;
- Geotechnical investigations;
- Environmental sampling and imagery;
- Infrastructure crossing survey with remotely operated vehicle (ROV);
- Geotechnical boreholes to inform the feasibility of horizontal directional drilling.

These operations in the nearshore and offshore provide high-resolution and accurate measurements of the bathymetry, seabed features and shallow geological conditions within the Proposed Development and Irish Offshore.

The geophysical survey comprised multi-beam echosounder (MBES), side-scan sonar (SSS), sub-bottom profiler (SBP), transverse gradiometer magnetometer and ROV inspection. Data were acquired along survey lines (generally seven to eight) to create a 500m wide survey corridor centred on the indicative centreline for the cable route. Data quality is described in Table 6-1.



GREENLINK INTERCONNECTOR

SURVEY DATA

Scope of Marine Survey - ROI Waters

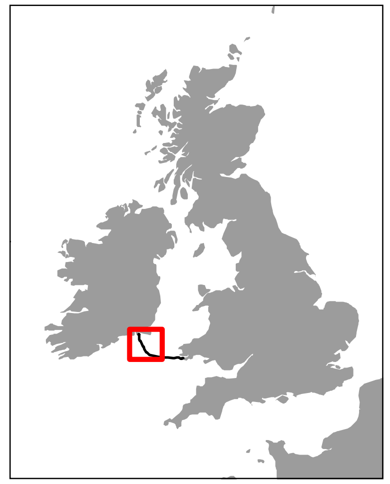
Drawing No: P1975-SURV-016 | **A**

Legend

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

Survey Location

- Grab Sample
- Vibrocore Sample
- CPT Sample
- ROV Track Line
- Survey Block



Date	Friday, April 12, 2019 16:05:17
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	GEBCO; DCCAE; UKHO; CDA; MMT; Greenlink
File Reference	J:\P1975\Mxd\02_SURV\ P1975-SURV-016.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 2.5 5 7.5 10 km

Table 6-1 Survey data quality

Block	Technique	Quality	Comment
Onshore topography	UAV	Good	Met project requirements
Nearshore (Block 1)	MBES	Good	Some gaps in the UAV data, either caused by flat featureless seabed, which means an image is unable to be resolved; or could be due to movement in the water column such as seaweed, or bad light or visibility during the survey.
	SSS	Good	Noise increasing slightly towards the shore
	SBP	Fit-for-purpose	Penetration up to 13.4m.
	Magnetometer	Good	Noise increasing slightly towards the shore
Offshore (Blocks 2 & 3)	MBES	Very Good	In Block 4, there are occasional areas where data quality was affected by the weather. Offshore where the seabed is very flat the overlap between survey lines is sometimes visible. This is to be expected in flat areas and the difference between overlapping lines is between 10cm to 20cm so within specification at the depth.
	SSS	Fit-for-purpose	The low frequency (300 kHz) SSS data were mainly interpreted. The high-frequency data were used to aid the interpretation.
	SBP	Good	Penetration on the Sparker was an average of 50m. The penetration of the Chirp was usually between 1m and 15m. Greater signal attenuation was observed when thick layers of surficial sand were present.
	Magnetometer	Good	

Source: MMT (2019a)

The geotechnical survey included testing and sampling along the entire route using vibrocoring (VC) and cone penetrometer testing (CPT). A total of 58 VC (including 24 re-attempts) and 61 CPT (including 5 re-attempts) were undertaken in Irish waters.

Seabed samples were also collected using either a Hamon grab or a Day grab; selection depended on sediment type. A total of 17 sites were samples in Irish waters; 7 within the Proposed Development (Stations S00 to S06) and 10 in the Irish Offshore (Stations S07 to S16). Three samples were obtained at each station; two for faunal identification, and one for particle size analysis and chemical analysis.

Geophysical data were used to focus the environmental survey strategy and subsequent data interpretation. A description of the benthic survey is provided in Chapter 7.

6.2 Consultation

The steps taken to contact stakeholders for comments on the EIA scope is documented in Chapter 5. None of the stakeholders contacted raised any comments with respect to physical conditions and marine processes.

6.3 Existing Baseline

For the purposes of this EIAR, the physical environment has been divided into the following topics:

- Metocean conditions;
- Coastal processes;
- Bathymetry, geology, seabed sediments and features; and
- Water and sediment quality

The baseline description is provided to characterise the environment of the Proposed Development and to enable the identification of areas that may be geologically and/or bathymetrically sensitive to pressures from cable installation, maintenance, repair, operation and decommissioning.

6.3.1 Metocean conditions

6.3.1.1 Water levels & Currents

Water levels and currents in the region are driven by astronomical tides and occasional storm surges. The tides are semi-diurnal (two high and two low waters each day) and their range varies through the lunar cycle and seasonally, reaching a maximum (spring tide) every two weeks. The mean spring range is around 4m to 5m near the median line, decreasing to around 2m to 3m at the Hook Head Peninsula (DCCAE 2011). Peak tidal current velocities for the ebb and flood tide were taken from Hydrographic Department (1974) as 0.7m/s flood and 1.0m/s ebb. The general prevailing near surface currents are towards the south-west, parallel to the coastline (DCCAE 2011). Coastal waters are well mixed throughout the year, but further offshore, near the UK/Republic of Ireland median line stratification[1] occurs in summer and autumn due to deep water and weaker tides (DCCAE 2011).

Storm surges occur when deep depressions cause a temporary and localised increase in water levels. When combined with high tides, a storm tide occurs, which in this area can be in the order of 0.5m to 1m, however, there have been instances where levels have exceeded 2m during extreme conditions.

Tidal regimes are primarily meso-to macrotidal (spring tidal range is 2m to more than 4m), but also include microtidal areas (spring tidal range is below 2m) for south-east and central northern coasts of Ireland. This variation in the tidal regime is further influenced by major storm activity, as described above. Coasts,

[1] formation of layers in the water column based on water temperature and/or salinity

particularly those of the west coast of Ireland, are exposed to the full effects of eastward-moving cyclones and swell waves in the North Atlantic. The predicted changes in North Atlantic storminess as a result of global warming is likely to cause Ireland's coastal wetlands and other soft-sedimentary systems to be among the first in Europe to respond to storm-led sea level rise (SLR) (Devoy 2008).

6.3.1.2 Waves

Waves are principally caused by wind. Annual average wave height data has been collected by the Irish Marine Institute and covers the area of the Proposed Development and Irish Offshore. The average wave height ranges from 1.75m to 2m at the median line, decreasing to between 1m and 1.5m at the Hook Head Peninsula (Marine Institute 2015).

As well as waves generated in the immediate vicinity, there will also be swell waves, i.e. remnants of waves from distant storms, as the area is exposed to the Atlantic. Surge levels of between 1.25 and 0.75m are predicted on the eastern Irish coastline and towards the median line. As the Irish Sea is semi-enclosed, the associated currents are weak, arising both directly from wind drag at the sea surface and indirectly from sea surface gradients (DCCAE 2011). Compared to locally generated waves, swell waves have a longer oscillation period and a smoother profile. Wave motions follow a roughly circular trajectory, forward on a wave crest and backward on the following trough. These motions can extend well below the water surface (several tens of metres) so that they can mobilise seabed sediment or exert a force on seafloor cables and other structures.

Baginbun Beach is a small, relatively sheltered east-facing cove approximately 0.3km in length. It has a combination of habitats, including rocky cliffs to the south with rock pools and a concentric sandy beach stretching northward. A rocky reef and Baginbun headland offer some protection to the cove from long period Atlantic swell waves and dissipate storm energy, ensuring the sand remains within the cove. Short period, smaller wind waves will likely dominate this beach along with refracted energy around Baginbun Headland.

6.3.1.3 Wind

The southern Irish Sea enjoys mild maritime climates, although it can be unsettled with periods of strong winds and rough seas. Gales in the region are most frequent in the winter months and on some occasions can reach storm or hurricane strength. In January and July, the percentage frequency of winds with Beaufort force 7 (mean speed of 15.5m/s; range 13.9 - 17.1m/s) or over in the region is 20-25% and 2% respectively. Beaufort gale force 8 (mean 18.9m/s; range 17.2 - 20.7m/s) or over are reported on about 12% of occasions in December and less than 2% in July. The most common wind direction for these gales is from the south-west and north-west. Calm conditions (wind speeds <0.2m/s) are likely to occur less than approximately 2% of the time. The annual mean wind speed in the region ranges from 7.6 - 8.0m/s to 10.6 - 11.0m/s in open areas, decreasing to 5.1 - 5.5m/s in coastal areas (OSPAR 2000).

6.3.1.4 Temperature and Salinity

Along the Proposed Development, the mean sea surface temperature varies between 8-10°C in winter to 14-17°C in summer. Mean near-bottom water temperatures in the deeper waters are similar, averaging 10°C due to the warm Atlantic water entering from the southwest derived from the North Atlantic Drift Current, or Gulf Stream (DCCAE 2011).

Surface water salinity is fairly constant annually and with depth, however, some seasonality will be observed. A salinity of 34 to 35 is typical (Marine Irish Digital Atlas 2015).

6.3.2 Coastal processes

The Irish Sea is a tide-dominated shelf sea where strong tidal flows produce active sediment transport and erosion processes (DCENR 2015). Along the south coast of Ireland, the long-term sand movement runs parallel to the coast in an easterly direction towards St George's Channel. Sediment transport in the Celtic Sea is dominated by the net movement of material from St George's Channel and the Bristol Channel. From these channels, ebbing tidal currents carrying fine sediment fan out in a south-westerly direction across the Celtic Sea (DCCAE 2011).

Approximately 20% of Ireland's entire coastline is at risk of erosion. SLR, combined with increased storminess, is expected to exacerbate the problems, especially along the Atlantic coast. For example, in February 2002, a low-pressure system in the southern Irish Sea coincided with a spring tide, leading to an extreme water level of 2.9m above mean sea level. This storm surge led to widespread flooding in Dublin and Belfast with marked coastal erosion between Cork and Belfast (Europa 2014). Baginbun Beach is not considered to be at risk from erosion (see section on Baginbun Beach below)

A national study in 2004 (cited in European Commission undated) estimated that Wexford has the highest proportion of vulnerable coastline, with 40% of it requiring protection. The same review indicated that the Cork county has, with 149km, the longest stretch of coast needing protection.

Baginbun Beach, County Wexford

The landfall site at Baginbun Beach is located approximately 20km southwest of Waterford on the Hook Head Peninsula. It is a concentric beach orientated north to south with a maximum beach width of 75m at the central point, narrowing to the north and south. A thin veneer of sand (coarse sediment) approximately 1m deep lies on consolidated material and bedrock. The cove is sheltered by Baginbun headland, to the south, and a 300m fringing rock reef.

Figure 6-2 Aerial image of Baginbun Beach viewed from northeast to southwest

Low cliffs form the back of the beach. The age of the bedrock is believed to be of late Cambrian age (485 to 541 million years old) and comprises of repetitively interbedded fine-grained sandstone and siltstone with some black mudstone and para-conglomerates. The beds are of variable and random thicknesses usually from one to ten centimetres and no more than twenty, usually with continuous flat surfaces (Figure 6-3). The dip of the rock strata in this area is very steep (over 60 degrees), dipping to the northwest.

Sediment at this beach is likely to be sourced from a combination of glacial till and eroded material from the back of the beach that is trapped by the rock reef. It is also likely to be infrequently supplied by the Corock River to the north. The majority will stay within this cove as Baginbun Head prevents further southerly migration and traps the sediment unless exposed to easterly storm conditions.

Superficial deposits consist of beach sand and a possible thin layer of glacial till material.

Figure 6-3 Cliffs at Baginbun Beach (left image showing close-up of rock strata)

6.3.3 Bathymetry, geology, seabed sediments and features

6.3.3.1 Bathymetry

The Irish Sea is a fairly shallow basin, with depths ranging from 20-100m over considerable areas (DCENR 2015), increasing gradually to depths of 90-100m in the centre of St George's Channel. Maximum charted depths within St George's Channel, which is the deepest part of the Irish Offshore component of Greenlink, reach 130m. Within the Irish Offshore and Proposed Development, the depths range from 91-120m at the median line to 0-30m at the Irish coast. Bathymetry along the Proposed Development and Irish Offshore is shown in Figure 6-4 (Drawing P1975-BATH-001).

The cable route is generally characterised by flat or a gradually varying seabed with very gentle to gentle slopes.

Proposed Development (KP 159.4 to KP124.0)

The bathymetry in the Proposed Development is shown in Figure 6-5 (Drawing P1975-BATH-003). It is described here from the 12nm limit towards the landfall at Baginbun Beach.

Depths decrease from KP124 to KP130 with the seabed comprising ripples and numerous trawl marks with occasional boulders. The gentle gradient reaches 3.8° with depths up to 72m within the Proposed Development. From KP130 to KP138, the seabed rises to 57.3m with ripples and occasional boulders throughout. Seabed gradient is very gentle with a maximum value of 1.13°.

Between KP138 and KP148 the seabed is mostly smooth and relatively flat with occasional boulders. Seabed gradient is less than 1° and depth gently decreases to 45m. From KP148 to KP156 the depth continues to decrease reaching 32m in this section. Rocky outcrops were observed in the data, with occasional boulders and ripples throughout. The seabed continues to rise gently in the last 2km, with small ripples observed between rocky outcrops that flank the route. Very gentle to gentle gradients were observed, peaking at 3.6°. Depths reach 22.35m by KP156.

At KP156 the indicative cable centreline follows a channel between outcropping rocky areas on both sides. The channel is approximately 200m wide. Depths decrease from KP156.7 to KP157.3 where it becomes generally flat at KP157.7. The seabed comprises ripples throughout the centre of the channel with the rocky areas at the outer edges of the Proposed Development. Very gentle to gentle gradients are observed within the channel, peaking at 1.8° with depths ranging up to 16.7m.

There is little depth variation until KP158.106 where the depths marginally increase by 0.5m. The seabed is rippled until the indicative cable centreline turns at KP157.611 onto a smoother area of the seafloor. Very gentle gradients can be found here, with maximum values of 0.7°. Depths range by up to 13.8m.

A small rocky area within the sand channel is present at KP158.365 before the indicative cable centreline passes over a smooth seabed between KP158.5 until

KP159.070. From KP159.070 a rocky area is encountered which extends across the width of the Proposed Development until the low water mark. Very gentle to locally moderate gradients with a maximum value of 5.8° over the rocks can be observed.

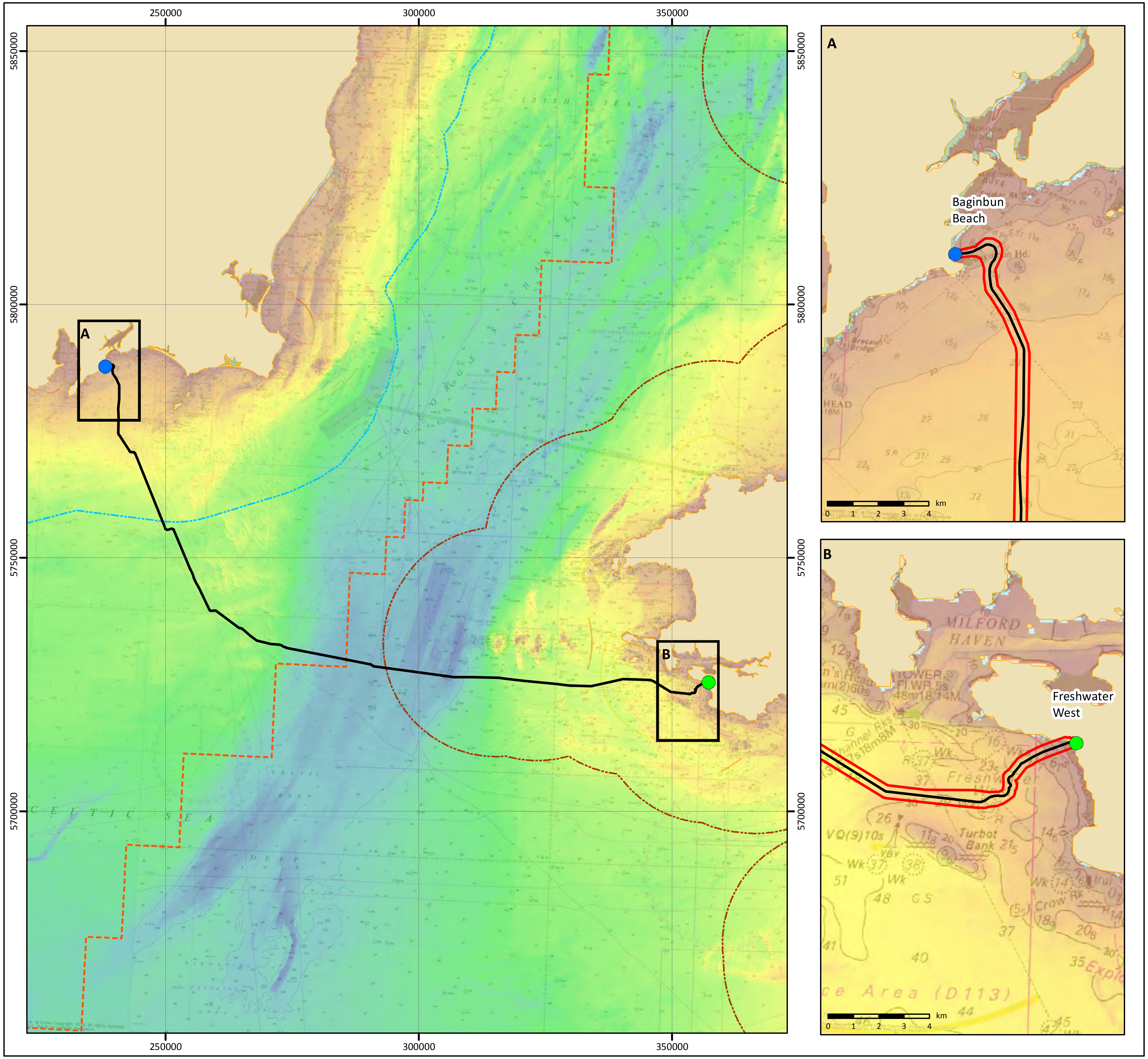
Irish Offshore (KP124.0 to KP73.2)

Starting at the Republic of Ireland / UK median line at KP73.2 the seabed gently increases in depth until KP75 where depths gradually decrease. The seabed is rippled throughout. Gentle to very gentle gradients are observed with a maximum value of 3.5°. Depths range up to 116m on this section of the route.

Depths continue to gradually decrease to KP85 reaching 112.14m. The seabed comprises ripples and occasional sand waves. Very gentle to gentle gradients are observed with local moderate slopes. Maximum gradients of 6° are seen within the sandwaves.

Between KP85 and KP95 the seabed rises gently to 88.9m. It is rippled with occasional sandwaves throughout. Very gentle seabed gradients with a maximum value of 2.9° are observed.

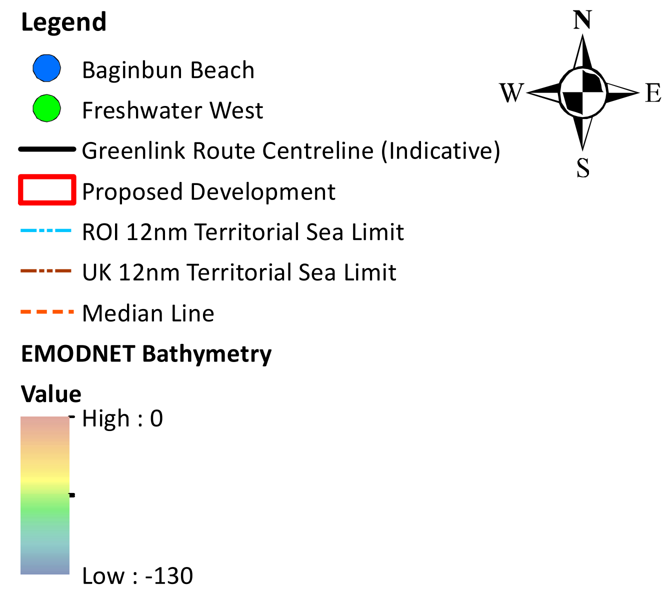
To KP124, the seabed continues to rise and fall gently at around 70m depth with ripples and sandwaves throughout, occasional trawl marks can also be observed. The gradients remain low, ranging between 1° and 3.5.

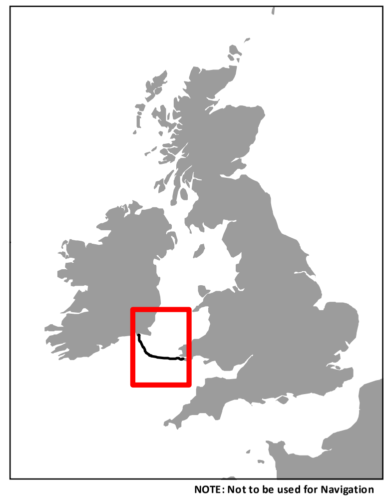


GREENLINK INTERCONNECTOR

BATHYMETRY

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





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File Reference	J:\P1975\Mxd\04_BATH\ P1975-BATH-001.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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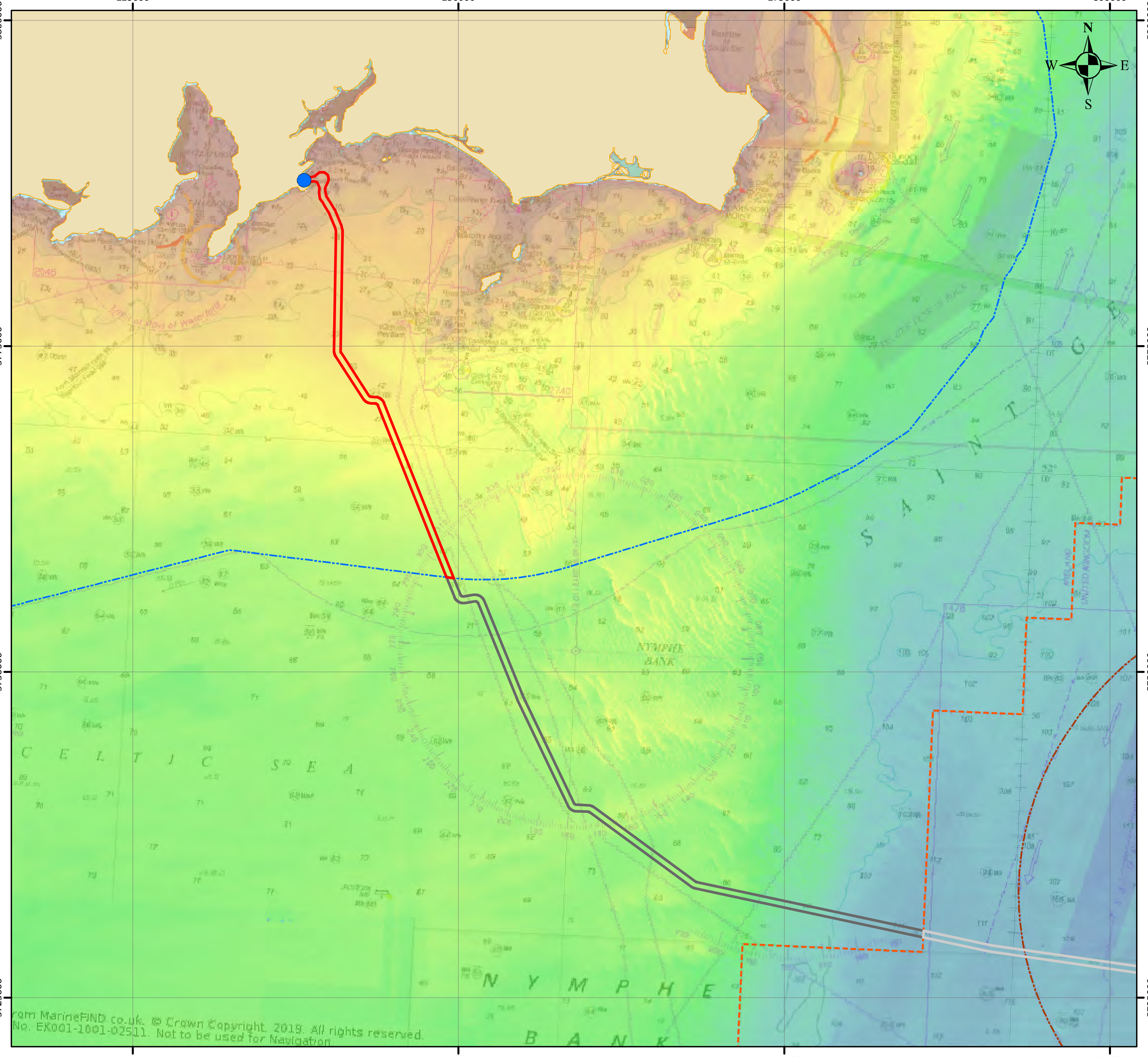
0 10 20 30 40 km



GREENLINK INTERCONNECTOR

BATHYMETRY

ROI Waters

Drawing No: P1975-BATH-003	A

Legend

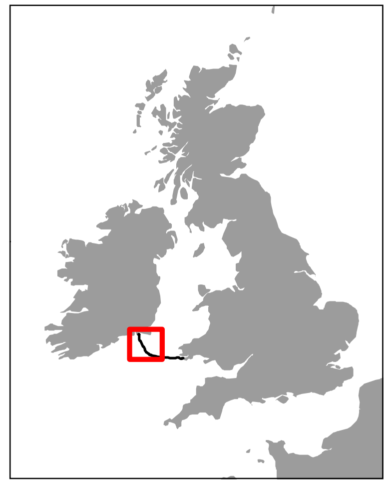
- Baginbun Beach
- Proposed Development
- Irish Offshore
- Wales Marine
- ROI 12nm Territorial Sea Limit
- UK 12nm Territorial Sea Limit
- Median Line

EMODNET Bathymetry

Value

High : 0

Low : -130



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Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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0 2.5 5 7.5 10 km

6.3.3.2 Underlying geology

The eastern and south-eastern regions of the Proposed Development are composed of unconsolidated Quaternary glaciogenic sediments and fewer rock exposures. Glacial and fluvial actions have also created major sedimentary areas.

The underlying geology is reported to consist of Palaeozoic rock (541 – 252.17 million years ago) overlain by Permian (252.17 – 298.9 million years ago), Mesozoic (252.17 – 66 million years ago) and Tertiary (66 – 2.58 million years ago) strata, of which overlying Quaternary sediments locally exceed 300m in depth (Tappin et al. 1994).

The geophysical survey suggests that the shallow geology along the route is characterised by a sequence of sand, channel infills, till and bedrock (from top to bottom). A surficial sand unit is present over almost the entire route as veneers over bedrock or till with varying depths of some decimetres to more than 10m in some infills or sand wave areas. It is generally greater than 2m thick and continuously present from KP73.91 to KP148.38. The lower boundary of the sand unit is usually characterised by a gravel layer. Thicker sediment cover is present within the basin of the St. George's Channel.

The till comprises mainly low to high strength, soft to firm clay with varying sand, silt and gravel content. A thick sequence of till is present from KP102.51 to KP130.52. The top of the till is highly undulating, and the incisions are filled with mixed channel infill sediments between KP104.1 and KP 144.4.

Bedrock is more than 5m below the seabed surface present over the majority of Proposed Development and Irish Offshore. The top of the bedrock is not resolved in the seismic data from KP103.35 to KP107.24 and KP114.61 and KP130.52; suggesting that the overlying sediments are thick in these areas. However, it is closer to the seabed between KP148.38 and KP155.48.

6.3.3.3 Seabed sediments and features

Seabed sediments off the southeast coast of Ireland predominantly consist of sandy gravel with nearshore areas of sand and outcropping bedrock. Seabed sediments for the region have been categorised by the British Geological Survey (BGS) and are illustrated in Figure 6-5 (Drawing P1975-SED-002). Sediment layers are patchy with areas of exposed bedrock close to the shore.

Bathymetry data reveals a large sandwave field to the northeast of the Proposed Development and Irish Offshore (adjacent to approximately KP80 – KP140); which Greenlink has been routed to avoid. The sandwaves have a wavelength of approximately 500m and an estimated wave height of 20m.

The majority of the surficial geology in the Irish Offshore is characterised by sand with mega ripples and occasional sand waves. The sand is occasionally interrupted by areas of gravelly sand/sandy gravel. The mega ripples become less significant with increasing KP and are no longer present from KP139.27. From KP148.30, within the Hook Head Special Area of Conservation (SAC), the surficial geology becomes more varied, with areas of gravel and abundant outcropping bedrock. In this area, boulder fields are also present.

Figures 6-7, 6-8 and 6-9 (Drawings P1975-SURV-005 to P1975-SURV-007) show the seabed conditions from KP158 to KP146; the area of the Proposed Development that lies within the Hook Head SAC.

Proposed Development (KP159.4 to KP124.0)

The surficial sediments consists of mainly gravelly sand to sandy gravel up to KP157.72 where the dominating sediment becomes silt. Mega ripples are present along the route to KP157.604. These features are also observed between KP157.7 – 158.3, which principally consists of silt interrupted by areas comprising silt and sand. The surficial geology consists of mainly sand interrupted by areas of silt and sand.

Two grab samples were collected in Block 2 (nearshore Ireland), one on flat, probably sandy sediment between rippled bedforms (depth of approximately 21.1m) and the second located on a relatively flat patch of sediment with rippled sediments, and potential areas of coarse sediment, nearby potential gravel (depth of approximately 27.3m).

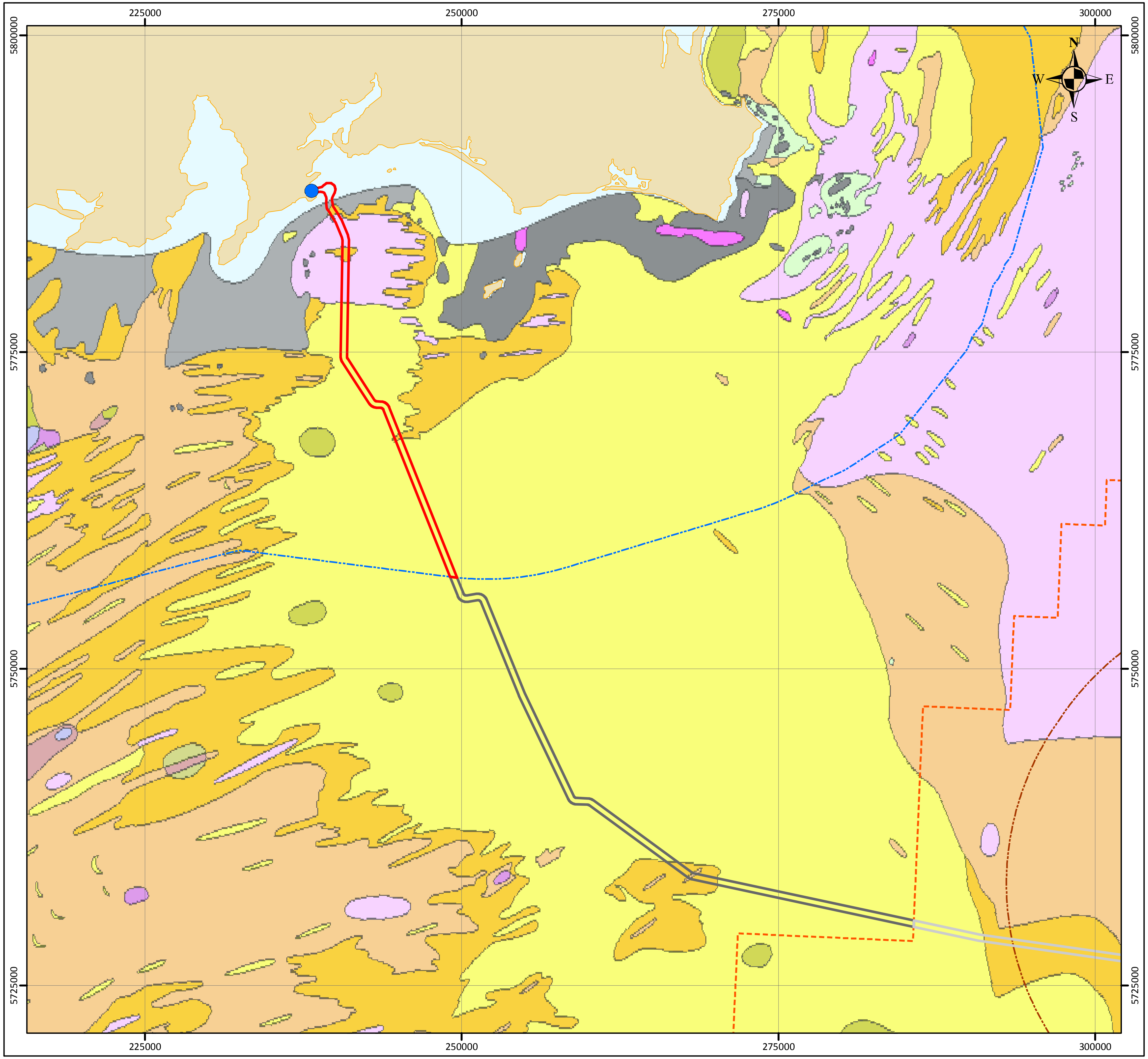
In Block 1 (at the coast along the centreline), one grab sample was taken on a flat, probably sandy sediment. Here, rippled bedforms, coarser sediments with bedrock outcrops nearby, approximately 180m to the nearest outcropping reef feature at a depth of 13.4m, were present.

The results of the particle size analysis show that the sediment at these sites consists mainly of sand, with the exception of the three shallowest sites (Stations S00, S01 and S02). Site S00 principally consists of mud (clay and silt; 70%), site S01 consists mainly of sand (60%) and site S02 consists mainly of gravel (75%).

The results of the particle size analysis show that the sediment at the remainder of the sample sites (S03 to S16) mainly consists of sand (91±6%) with smaller fractions of gravel (3±2%) and mud (6±6%). This suggests well-sorted sand samples with minor fractions of fines and coarse materials.

Irish offshore waters (KP124.0 to KP73.2)

The offshore route passes through consistent sand and sandy gravels. Mega ripple areas are present throughout, commonly associated with gravel sediments. A few sand wave crests are present. Trawl scars indicating fishing activity is abundant in the initial parts of the section.



GREENLINK INTERCONNECTOR
SEABED SEDIMENTS
BGS Data - ROI Waters

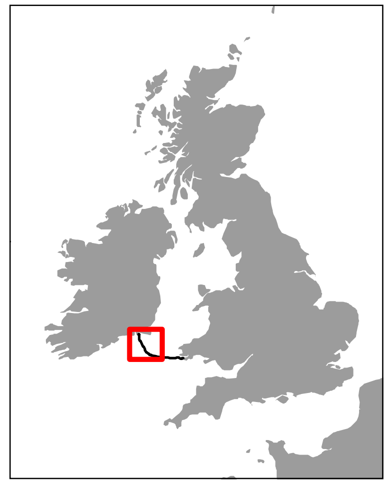
Drawing No: P1975-SED-002	A

Legend

- Baginbun Beach
- Proposed Development
- Irish Offshore
- Wales Marine
- ROI 12nm Territorial Sea Limit
- UK 12nm Territorial Sea Limit
- Median Line

BGS Seabed Sediment

- Gravel
- Gravelly Sand
- Muddy Gravel
- Muddy Sandy Gravel
- Muddy Sand
- Slightly Gravelly Muddy Sand
- Slightly Gravelly Sand
- Sand
- Gravelly Muddy Sand
- Sandy Gravel
- Diamicton
- Rock or Diamicton
- Undifferentiated Rock



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Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Greenlink

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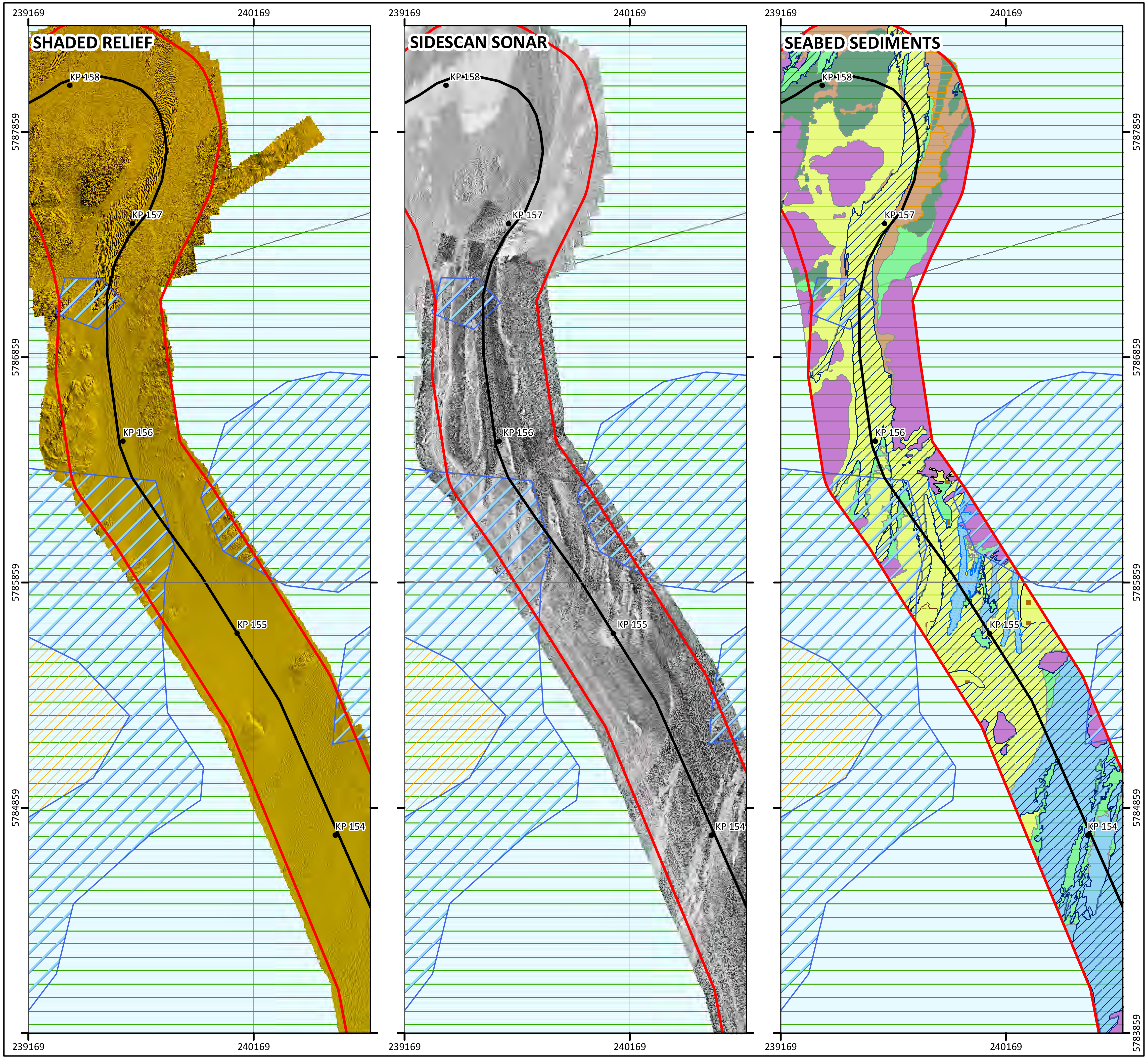
intertek

0 2.5 5 7.5 10 km



GREENLINK INTERCONNECTOR

SURVEY DATA

Seabed Features within Hook Head SAC KP154 to KP158

Drawing No: P1975-SURV-005 | **A**

Legend

- KPs
- Greenlink Route Centreline (Indicative)
- Proposed Development
- SAC

Habitat Type (NPWS)

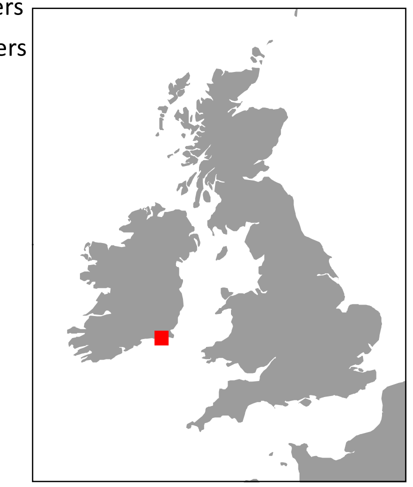
- Echinoderm and Sponge Dom Community
- Laminaria Dominated Community

Seabed Classification

- BEDROCK
- GRAVEL
- Gravelly SAND to Sandy GRAVEL
- SAND
- SILT
- SILT and SAND

Seabed Features

- Mega Ripples
- Numerous Boulders
- Occasional Boulders
- Ripples
- Sand Waves



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Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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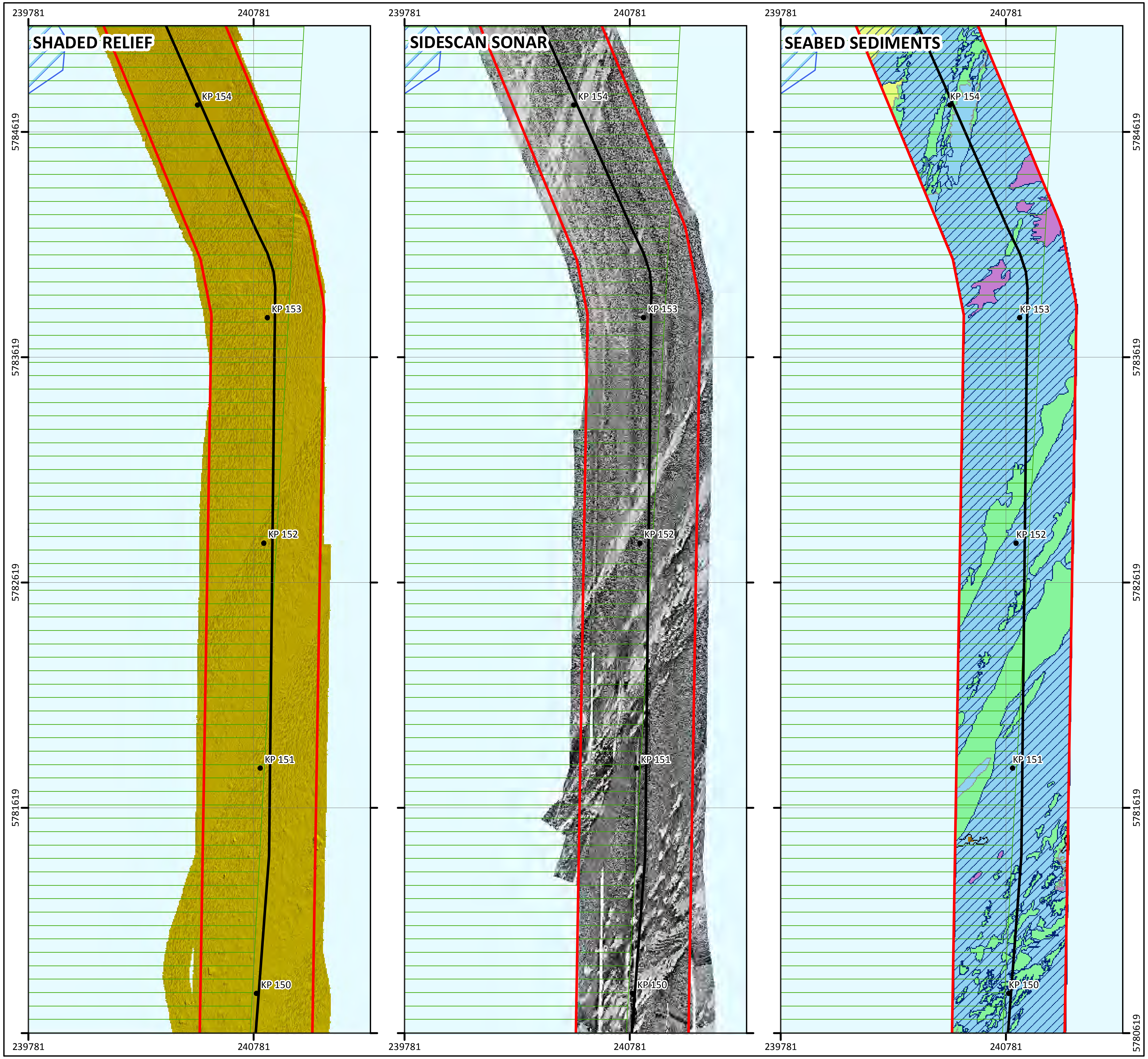
0 0.25 0.5 0.75 1 km



GREENLINK INTERCONNECTOR

SURVEY DATA

Seabed Features within Hook Head SAC

KP150 to KP154

Drawing No: P1975-SURV-006 | **A**

Legend

- KPs
- Greenlink Route Centreline (Indicative)
- Proposed Development
- SAC

Habitat Type (NPWS)

- Echinoderm and Sponge Dom Community

Seabed Classification

- BEDROCK
- GRAVEL
- Gravelly SAND to Sandy GRAVEL
- SAND

Seabed Features

- Mega Ripples
- Numerous Boulders
- Occasional Boulders

N E S W

NOTE: Not to be used for Navigation

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Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Greenlink

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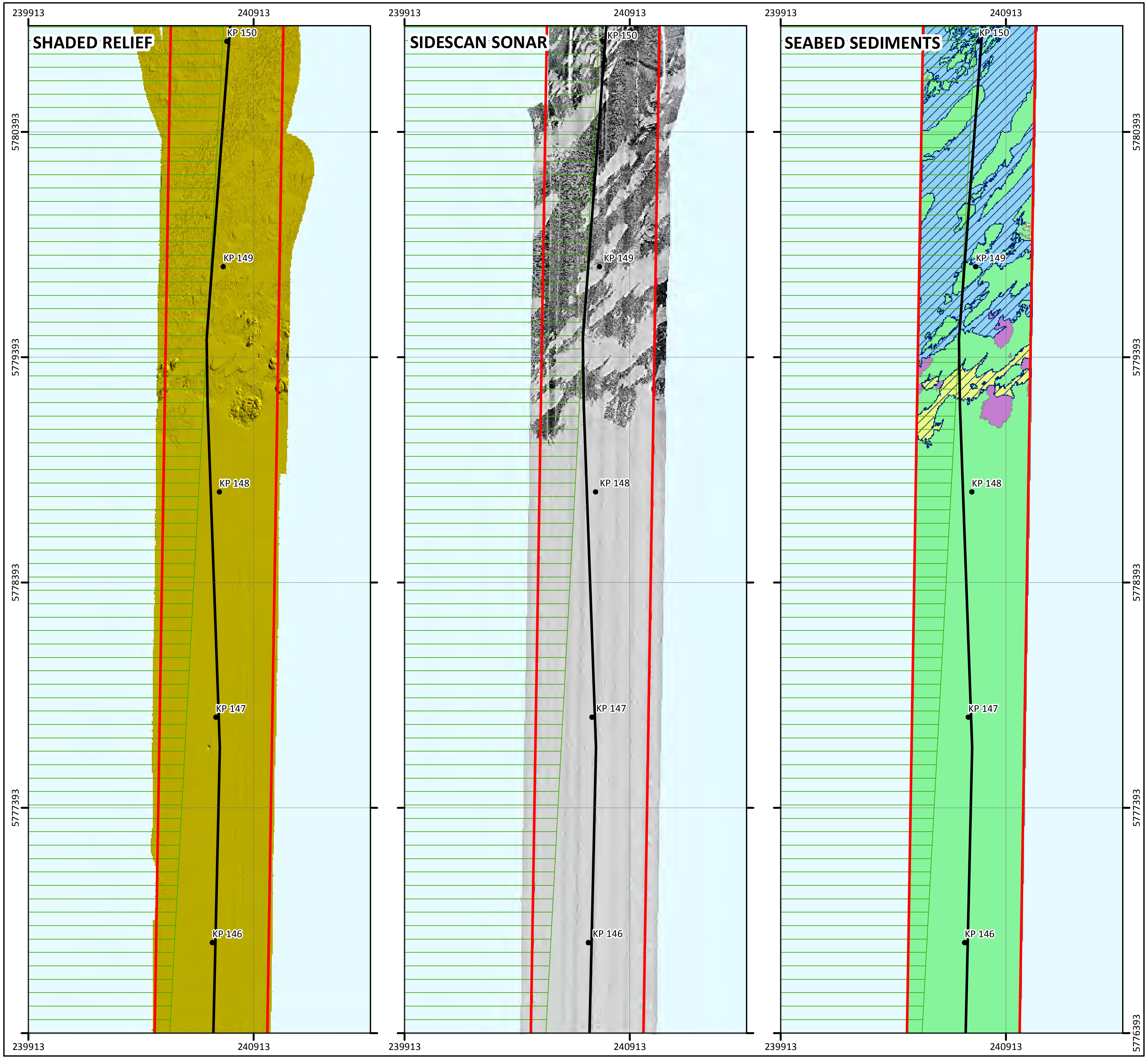

GREENLINK INTERCONNECTOR
SURVEY DATA
Seabed Features within Hook Head SAC
KP146 to KP150

Drawing No: P1975-SURV-007 | **A**

Legend

- KPs
- Greenlink Route Centreline (Indicative)
- Proposed Development
- SAC

Seabed Classification

- BEDROCK
- GRAVEL
- Gravelly SAND to Sandy GRAVEL
- SAND

Seabed Features

- Mega Ripples

NOTE: Not to be used for Navigation

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Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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0 0.25 0.5 0.75 1 km

6.3.4 Water and sediment quality

Water and sediment quality at any particular location on the Irish continental shelf is the result of a combination of source, transport and removal mechanisms for the individual chemical species under consideration. There are many routes by which substances with the potential to affect water quality enter the Celtic Sea, both through natural processes and as a result of anthropogenic activity, with a general downward trend in anthropogenic inputs over the past few decades (UKMMAS 2010).

6.3.4.1 Water quality

Water quality monitoring is undertaken in coastal waters by the respective local authorities as part of the requirements of the EU Water Framework Directive (WFD). River Basin Management Plans (RBMP) are being developed as a requirement of the WFD and report on the "ecological status" of surface and ground water in coastal waters (within 1nm) and "chemical status" of surface and ground waters in territorial waters (out to 12nm). The Proposed Development is within the jurisdiction of Wexford Country Council.

Bathing Waters: Water quality is monitored at Bathing Waters designated under the Bathing Water Directive (2006/7/EC) and is classified as Excellent (guideline standards met), Good (mandatory standards have been met) and Poor (minimum mandatory standard has not been met). The closest designated bathing waters to the Proposed Development are the Grange Beach (approximately 2.5km north of Baginbun Beach), Cullenstown Beach (approximately 8km north-west of Baginbun Beach) and Kilmore Quay (approximately 18km west of Baginbun Beach). All three bathing waters are currently classified as having Excellent bathing water quality (EPA 2018). Although Baginbun Beach is used for bathing, it has not currently been classified as a bathing water under the Bathing Waters Directive. The status of the coastal water body the Proposed Development crosses is yet to be determined according to EPA (2019).

Shellfish Waters: Water quality is monitored for shellfish waters designated under the Shellfish Waters Directive 79/923/EEC. Baginbun Beach is located approximately 3km from the Bannow Bay shellfish water (Marine Institute 2015).

6.3.4.2 Suspended sediments

Suspended sediments in water column arises as a result of biological activity, inputs from land and re-suspension of sediments. The suspended particulate matter (SPM) is made up of organic and inorganic fractions.

The organic fraction is predominantly the result of biological activity in the water column, and is primarily composed of planktonic material, including bacteria. This will not be influenced by any activities associated with cable laying and will not be discussed further in this Chapter.

Inorganic SPM results from inputs from rivers (derived both from erosion in the river catchments and from chemical reactions in the estuarine zone), fallout from the atmosphere and coastal erosion combined with resuspension of existing sediments and chemical reactions in the water column. As a result inorganic SPM loads vary widely, generally increasing with proximity to the coastline (UKMAAS 2010). They are also highly dependent on energy inputs (e.g. storms).

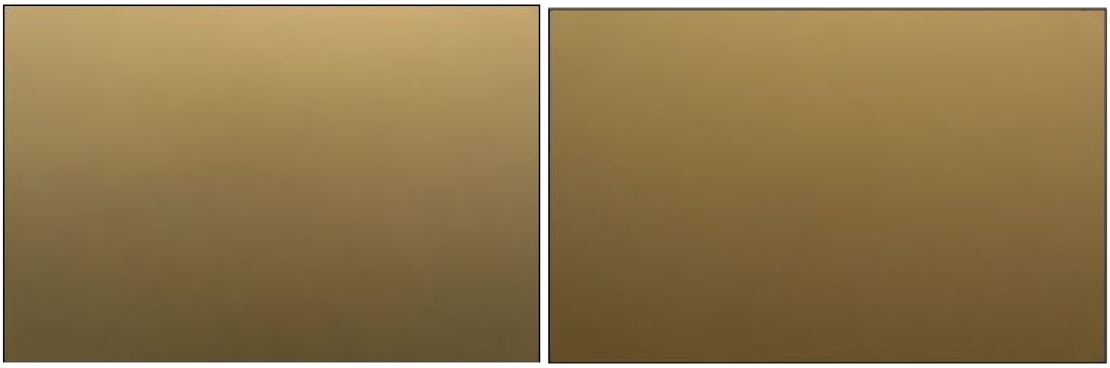
SPM is highly variable, both spatially and temporally, depending on proximity to terrestrial sources, water depth, current regimes and weather conditions (UKMMAS 2010). Available measurements of SPM, whether from vessels or by satellite imagery, are largely restricted to near-surface data obtained under non-storm / cloud free conditions and are summarised as follows:

- SPM are bottom-current dependent. As a result, they tend to be greater during spring tides than during neaps and can increase to very high levels during storm events (UKMMAS 2010).
- Measurements commissioned by the Waterford Port Company at a disposal site in the mouth of the River Barrow indicated SPM concentrations were low; between 5mg/l at neap tide and 19 mg/l on spring tide during June 1999 (Delft 2000).
- The Co.Wexford coastline experiences seasonal fluctuations in turbidity, related to storm conditions. This is evident from photographs taken during the benthic survey (October 2018) showing high suspended sediment loads in the water column (Figure 6-10); potentially greater than 100mg/l and up to 1000mg/l, although this was not measured and is based on comparison of the image with samples showing known concentrations of SPM.
- Satellite imagery data given in Defra (2010) supports the seasonality showing the Irish Sea is subject to high sediment loads for most of the year except summer. Data indicating monthly averaged SPM concentrations reach approximately 10mg/l off Co.Wexford during January reducing to values in the order of 1-2 mg/l is presented in Rivier et al (2012)[2].
- CEFAS (2016) indicates average SPM for the period 1998 – 2015 off the Co.Wexford coast is approximately 5-10mg/l, with values dropping to <5mg/l during June, July and August.

As an indication of naturally occurring SPM loads resulting from sediment resuspension, values of the order of 1000mg/l have been measured within the surf zone of sandy beaches (Voulgaris and Collins 2000), while surface inorganic SPM loads in water depths of over 70m in the central English Channel exceed 6mg/l during the winter (Rivier et al 2012).

[2] A limitation of this data is that the paper focuses on the English Channel and the Co.Wexford coastline is at the very edge of images.

Figure 6-10 Photographs taken at S00 (approximately KP157.8 water depth 13.4m) (right) and S03 (approximately KP151.4 water depth 27.2m) (left) showing high levels of turbidity



Source: MMT (2019)

6.3.4.3 Sediment quality

Sediment contamination may result from natural and anthropogenic inputs that are harmful to biota. Generally, dissolved contaminants in the sediments of the Celtic Sea and Irish coast are low or below the level of detection for current analytical tools.

Sediment samples taken during the cable route survey were tested for metal and polycyclic aromatic hydrocarbons (PAH) concentrations.

Metal concentrations were low across all grab sample sites and rarely exceeded any threshold values with the exception of Arsenic (As). At grab sample sites S07, S10 and S12 in the Irish Offshore, concentrations exceeded the Canadian Council of Ministers of the Environment (CCME) interim marine sediment quality guidelines (ISQG) of 7.24 ug/g. The values were 9.3, 8.0 and 16.3 ug/g, respectively. Arsenic is a natural component of sweater and rocks and given the lack of variability between samples it is expected that the values are of a natural origin rather than anthropogenic contamination.

Concentrations of PAHs varied greatly between grab samples sites. Grab sample sites S00 (nearest to landfall) and S15 (furthest offshore) contained markedly higher concentrations of PAHs, while grab sample sites S03 and S11 had markedly low concentrations. Threshold values were not exceeded at any of the grab sample sites.

6.3.5 Natural evolution of the baseline

Future climatic changes, such as changing seasonal atmospheric pressure patterns that form over the north-eastern Atlantic, bring the potential for an increase in storm intensity in the region. An increase in wave heights has also been observed, with the monthly significant wave height increasing by up to 0.6m between 1988 and 2002 in the north-east Atlantic (Marine Institute 2009). Such effects, along with rising sea levels and in increase in sea temperatures and acidity could lead to loss of habitat along the coastal regions of Ireland (DCCAE 2015). Recent trends have also indicated a slight reduction in annual rainfall in to the south and east of Ireland, with increases being noted to the north and west. In order to combat these trends, further long-term monitoring of climatic trends and co-operation with the international scientific community has been recommended to better understand the threats these impacts may pose to Ireland's coastal and marine environment (Marine Institute 2009).

There are no current forecasts of any geological or bathymetrical change within the near future, with any changes to bathymetry being of anthropogenic origin and relatively minor. The Marine Strategy Framework Directive requires EU member states to ensure their coastal and offshore waters meet Good Environmental Standards by 2020. This relates to aspects such as water and sediment quality. A programme of measures has been undertaken by the Irish government to meet these targets, with these standards then intended to be maintained into the future (DCCAE 2015).

6.4 Potential Pressure Identification and Zone of Influence

A scoping exercise undertaken to inform the content of the EIAR has excluded the following pressures from further consideration in this topic Chapter. An explanation for the exclusion is provided in Chapter 5, Table 5-2.

- Changes in suspended solids (water clarity): specifically, in relation to discharges from project vessels.
- Temperature changes (local).

The pressures listed in Table 6-2 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 6-2.

Table 6-2 Pressure identification and zone of influence – physical conditions and marine processes

Project phase	Activity	Pressure	Receptor	Zone of influence
Installation Operation Decommissioning	Cable burial Cable protection Cable removal	Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Sediments	15m
Installation Operation Decommissioning	Cable burial Cable removal	Changes in suspended solids (water clarity)	Water quality	100m*

Project phase	Activity	Pressure	Receptor	Zone of influence
Operation	Cable protection	Water flow (tidal changes) local	Coastal processes	Baginbun landfall
Operation	Cable protection	Physical change (to another seabed type)	Sediments	10m radius of crossing locations
	Cable repair and maintenance			10m x 1km (5 discrete occasions for cable repair)
* Defined in Section 6.6.3.				

6.5 Embedded Mitigation

The project description in Chapter 4 provides the design. 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 physical conditions and marine processes is provided in Table 6-3 below. When undertaking the EIA, it has been assumed that these measures will be implemented; either as a matter of best practice or to ensure compliance with statute and consents.

Table 6-3 Embedded mitigation

ID	Embedded mitigation
EM13	HDD will be used for the cable landfalls to avoid disturbance of sensitive habitats (e.g. intertidal reef habitat) 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 which reduces the seabed footprint of installation activities and the electromagnetic field generated during operation, thus minimising any potential compass deviation effects.
EM17	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to the seabed.
EM24	A cable burial plan will be produced which outlines proposed method statements and cable protection measures for approval by the Foreshore Unit and discussion with fisheries stakeholders.
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.

6.6 Significance Assessment

6.6.1 Summary of assessment

Table 6-4 presents the impact assessment conducted on the Proposed Development. Sections 6.6.2 to 6.6.5 provide justification for the conclusions. Where there is potential for residual effects, this is discussed further in Section 6.8. Where the assessment concluded the effects are significant, Project Specific Mitigation has been proposed and is described in Section 6.7.

Table 6-4 Impact assessment summary – physical conditions and marine processes

Section	Determination of Potential Effect					Impact Assessment			Consideration of Mitigation	Residual Effect Assessment		
	Project Phase	Aspect	Potential pressure	Embedded Mitigation (Table 6-3)	Receptor	Magnitude	Sensitivity	Significance	Project Specific Mitigation (Table 6-6)	Magnitude	Sensitivity	Significance of Residual Effect
6.6.2	Installation Operation (Repair & Maintenance) Decommissioning	Cable burial	Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	EM13, EM14, EM15	Bedrock	Medium	High	Significant	PS2, PS3	-	-	No Effect
		Cable burial Cable protection Cable removal		EM13, EM14, EM15, EM17	Subtidal sands	Low	Low	Slight	-	-	-	-
6.6.3	Installation Operation (Repair & Maintenance) Decommissioning	Cable burial Cable protection Cable removal	Changes in suspended solids (water clarity)	EM15	Water quality	Negligible	Negligible	Imperceptible	-	-	-	-
6.6.4	Operation	Cable protection	Water flow (tidal changes) local	EM13, EM15, EM24, EM29	Coastal processes	Low	Low	Slight	-	-	-	-
6.6.5	Operation	Cable protection at crossings or during repair	Physical change (to another seabed type)	EM15, EM24, EM26, EM29	Sediments	Low	Low	Slight	-	-	-	-
		Cable protection at the two HDD exits			Sediments Coastal processes	Low	Medium	Slight	PS1	-	-	-

6.6.2 Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion

6.6.2.1 Installation

Subtidal sands
Sediments will be disturbed during seabed preparation (e.g. pre-lay grapnel run), cable burial (jetting and / or ploughing) and to a lesser extent anchor placement (if required). Cable trenches will either be naturally or manually backfilled (with trenching tools) returning the seabed to its former state and the bathymetry to the baseline condition.

Sediments within the Proposed Development and Irish Offshore are predominately sand with small fractions of gravel and silt. A shallow depression may be observed directly over the cable if jetting is used, as finer fractions of sediment suspended during the burial process are dispersed by currents. However, the depression will be a temporary feature with local sediment transport filling it in. The cables will be bundled together into one trench (embedded mitigation EM15), which will reduce the footprint of effects.

External cable protection will be used at four locations in the Irish Offshore to facilitate cable crossings. Placement of rock protection will alter the nature of the sediment, replacing mobile sediments with solid substrate, over a small area. There is the potential that scour will develop around the external cable protection, but this will be localised (expected to be within 10m of the crossing).

The magnitude of the effect has been assessed as low for the following reasons:

- BGS data shows the sediments within the Proposed Development cover larger areas of the Celtic Sea and in this context the narrow zone of disturbance (15m) is very small and localised;
- The cable burial activities will not alter sediment characteristics, bathymetry or seabed features; and
- The activity will be a one-off event that will not be repeated.

The sensitivity of the receptor has been assessed as low as sediments have a high capacity to return to baseline conditions following disturbance. The overall significance of the effect has been assessed as Slight and is Not Significant.

Bedrock
An area of outcropping bedrock has been identified on the approach to the intertidal area. This extends across the width of the Proposed Development and extends for approximately 200m. Although the preference is to use HDD for the landfall (embedded mitigation EM13), the exact location of the exit point has not been determined. As a worst-case the EIA process has assumed that the HDD could come up in this area of bedrock. Cable installation in bedrock would require cutting and the use of external cable protection. Although the spatial extent of the effect

would be very localised approximately 1m wide trench x 200m long, the change to the feature would be permanent. This results in an assessment of low magnitude and high sensitivity. The overall significance of the effect has been assessed as Significant.

For this reason an engineering solution was investigated to avoid the negative environmental effects. Review of the Greenlink geophysical data has been undertaken to determine where there is a sufficiently deep sediment unit to allow the HDD ducts to exit and the cables to be trenched directly into the seabed post-lay. Data suggests that burial in sediment is achievable past the 9m water depth contour. Based on the geological conditions at Baginbun Beach, a target area for the HDD exit has been prescribed and will be imposed on the Installation Contractor. Presented as the orange hatched box in Figure 4-19 (Drawing P1975-INST-002), the area starts at the 9m water depth contour. The length of HDD proposed (between 700m – 1km) is feasible and has been proven on other engineering projects. This solution is the project that has been taken forward for assessment as it avoids the fringing bedrock at Baginbun Beach.

Project Specific Mitigation has been proposed to remove the pathway of effect so that there is no residual effect. This is presented in Section 6.7.

6.6.2.2 Operation (including maintenance and repair)

No seabed disturbance will occur from the operating cables. Effects during any unforeseen repair and maintenance works will be of a smaller magnitude when compared to cable installation. The significance of the effect remains:

- Slight and is Not Significant for subtidal sands; and
- Significant for bedrock.

6.6.2.3 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 sediments 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 as:

- Slight and is Not Significant for subtidal sands; and
- Significant for bedrock.

6.6.2.4 Change in suspended solids (water clarity)

Seabed preparation and cable burial (ploughing and/or jetting) will briefly change SPM levels (increasing turbidity). An increase in SPM has the potential to indirectly affect biological receptors by reducing light levels or as sediment is re-deposited on surrounding habitats.

Within the Proposed Development, SPM concentrations vary seasonally from measured values of 5mg/l to 19mg/l during the summer potentially increasing to in excess of 100mg/l following storms.

The extent of suspension, dispersion and re-deposition is to a large extent a function of the sediment being disturbed as follows:

- Sand and gravel disturbed during the cable burial operations will settle back to the seabed very rapidly and the footprint is unlikely to extend any great distance from the cable route.
- Silts, clay and chalk particles will remain in suspension for a greater period of time 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 small.

Each metre of trench will result in a displacement of 1.5m3 of sediment, with between 80% (jetting) and 95% (ploughing) returned to the trench – the remainder being released into the water column. Calculations presented in Table 6-5 show that gravel will settle out of suspension rapidly (14 seconds) within 2m of the trench. Sand will settle out in 2 minutes within 19m of the trench but silt particles due to their slower terminal velocity have the potential to be carried by currents a greater distance, up to 5.3km before settling out. In addition, silt particles will remain suspended for longer, approximately 9.8 hours, essentially behaving as dissolved matter. Calculations assume a release point 5m above the seabed with an average current speed of 0.7m/s.

Table 6-5 also shows the indicative median layer depth of sediment deposition for each of the fractions. The calculations take into consideration the particle size analysis and present figures for the worst-case volumes present of each fraction.

Table 6-5 Sediment analysis along the Proposed Development

Particle type	Fraction settling velocity (ms^{-1})	Settling time	Median settling distance (m)	Max proportion of sediment (%)	Volume released (m^3)	Median depth of layer (mm)
Silt	0.0001	9.8 hours	5317	70	0.21	0.039
Sand	0.028	2 minutes	18.6	100	0.3	16.12
Gravel	0.251	14 seconds	2.09	75	0.225	107.74

Dilution calculations indicate that the average SPM concentration will reach 300mg/l within 100m of the trench, but will rapidly dissipate with distance and time (minutes rather than hours).

Near the coast, between KP157 and 158, where a major component of the sediment is silt, a plume of 5km could be briefly generated from the trench - similar to suspended sediment concentrations during a storm. This will cloud the water, but as sediments are not contaminated it will not have a detrimental effect on the environment, and water clarity will quickly return as the installation moves on and tidal currents dissipate the suspended sediments.

Whilst jetting is considered to have the least impact 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).

In conclusion, the installation activities will increase the levels of SPM in the water column. The magnitude of the increase will be dependent on the seabed conditions. However, calculations indicate the concentrations will be within the range of natural variability expected for the region, will be limited in extent and brief in nature. The magnitude of the effect has been assessed as negligible. The sensitivity of the receptor has been assessed as negligible as the level of change is reversible and there will be no effect on the baseline character. The overall significance of the effect is Imperceptible and is Not Significant.

6.6.3 Water flow (tidal current) changes – local

External cable protection will be required at four crossing locations in Irish Offshore. The EIA has also assessed the contingency that a small quantity of external cable protection is used at the HDD exit points. External protection is likely to in the form of two rock berms, both 5.2m wide by 20m long with a height of 0.7m (overall seabed footprint of 208m^2 [0.000208km^2]). If required, they would be installed in water depths greater than 9m; a minimum of 400m from the low water mark.

The presence of external cable protection in the offshore region may cause very localised changes in water flows around the crossing location. 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 Irish Offshore area are relatively low, particularly near the seabed due to frictional effect, high scour is unlikely to be a significant issue.

In the nearshore, sediment transport pathways to the beach are from the north to the south. The fringing acts as a barrier reducing the transport of sediment from the nearshore to the beach. Therefore, it is unlikely that the deposition of external cable protection past the 9m contour will affect coastal processes on the beach. In addition, given that the external cable protection will be lower than the surrounding outcropping reef it will not have a noticeable effect on waves.

The magnitude of the effect has been assessed as low as although the structures will be permanent features, the spatial extents of effects will be very localised, with effects unlikely on Baginbun Beach. The sensitivity of the receptor has been assessed as medium as there will be a localised change in sediment type which changes the character of the baseline, albeit on a very small scale. The overall significance of the effect has been assessed as Slight and is Not Significant.

6.6.4 Physical change (to another seabed type)

Where external cable protection is required, e.g. at the crossing locations in Irish Offshore, and if necessary at the two HDD exit points within the Proposed Development, and during cable repair, there will be a localised change in seabed sediment type. The preference is to lay the cables bundled in one trench (embedded mitigation EM15), which will reduce the potential spatial footprint of the change. At all locations where external cable protection is required surficial sediments are sand.

External cable protection will consist of rock in the size range of 2-22cm. This will represent a significant coarsening of the sediment at that location. Approximately 4,244m^2 of seabed will be affected, at six locations (if the protection is also required at the HDD exit points). In the unlikely event that a cable repair is required and the new cable sections cannot be buried into the seabed an additional 50,000m^2 could be effected. Sand covers large areas of the Celtic Sea, Proposed Development and Irish Offshore.

A Qualifying Interest of the Hook Head SAC is the habitat large shallow inlets and bays. The sand substrate between 3m and 15m water depth is part of the feature. The Natura 2000 form for the site (NATURA 2000 2018) records that the Qualifying Interest covers an area of 52.44km^2 (5243.8404 hectares). The footprint of the two deposits of external cable protection within this habitat will cover 208m^2; equivalent to 0.0004% of the Qualifying Interest. This is a negligible reduction which will not adversely affect the conservation targets for the Qualifying Interest. This conclusion is supported by NPWS (2011) that “licensing of activities likely to cause continuous disturbance of each community type should not exceed an approximate area of 15%”.

The magnitude of the effect has been assessed as low as although the structures will be a permanent feature, the spatial extent of the change in seabed type will be very localised, with effects unlikely on Baginbun Beach. The sensitivity of the receptor has been assessed as medium as there will be a localised change in sediment type which changes the character of the baseline, albeit on a very small scale. The overall significance of the effect has been assessed as Slight and is Not Significant.

In recognition that the HDD exit points are within an Annex I habitat, Project Specific Mitigation has been proposed in relation to the HDD exit points.

This potential effect has also been assessed within the Greenlink Marine Natura Impact Statement. Section 5 (Appropriate Assessment Screening) concluded significant effects are likely and that an Appropriate Assessment (AA) is required. Information to support the AA is provided in Section 6 (Stage 2 Appropriate Assessment Natura Impact Statement) which concludes the Proposed Development will not have an adverse effect on the integrity of the Hook Head SAC, either alone or in combination with other plans or projects.

6.7 Project Specific Mitigation

In addition to the embedded mitigation discussed in Section 6.5, Table 6-6 presents measures that Greenlink is committed to adopting.

Table 6-6 Project-specific mitigation physical conditions and marine processes

ID	Project Specific Mitigation
PS1	The preference is to bury the HDD duct exits and all cables in sediment to the required depth of lowering. To achieve this the Installation Contractor should seek to engineer the HDD to exit in thick sediment in order that the ducts can be trenched back down to beneath the seabed level. If the required depth of burial cannot be achieved in sediment, then some external protection will be required. Taking into consideration the exact HDD exit points, the footprint of external protection should be the minimum required for burial. To achieve this, consideration should be given to undertaking part sediment burial, and part external protection; use of concrete mattresses (i.e. to reduce berm height), or other engineering solutions that reduce the footprint of external cable protection (both vertically and horizontally). If there is no technically feasible alternative the exact position, nature of and final defined size of external cable protection will be communicated to the Foreshore Unit, NPWS and Irish Maritime Administration and local fishermen.
PS2	Exclusion zones have been established around Annex I bedrock reef features; shown on Figure 7-18, Drawing P1975-INST-008). No intrusive works (e.g. cable installation, deposit of external cable protection material) will be undertaken within these exclusion zones.
PS3	There will be no intrusive works undertaken on Baginbun Beach between mean high water springs and the low water mark.

6.8 Residual Effect

The assessment presented in Table 6-4 identified that two pressures could potentially have significant effects on the receptor physical conditions and marine processes. The significance of these effects was re-assessed taking into consideration the Project Specific Mitigation outlined in Section 6.7 to determine if a significant residual effect remains.

6.8.1 Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion

The assessment identified that Bedrock is highly sensitive to the pressure penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion. Activities that involve intrusive seabed works have been assessed as having a Significant effect on the receptor. The Proposed Development has been optimised to avoid the majority of the bedrock, by following a sand channel. However, areas of Bedrock have been confirmed in the nearshore area extending from the intertidal zone. Project Specific Mitigation in the form of exclusion zones (PS2) have been established around the habitat within the Proposed Development. GIL will ensure that the Installation Contractor adheres to these exclusions by ensuring the HDD exit points and final cable trenches avoid the bedrock. A target area for the HDD has been prescribed in area where review of survey data suggests that cable burial is achievable. This in turn means that installation will avoid works on the beach (PS3). Implementation of the exclusion zones will result in the pressure pathway to the receptor being removed and the subsequent residual effect has been assessed as **No effect.**

6.8.2 Physical change (to another seabed type)

The assessment identified that the use of external cable protection at the two HDD exit points will have an effect that is Slight and is Not Significant. This was due to the small size of the footprint in the context of the large areas of sand in the region, and the fact that the two berms are unlikely to have an effect on coastal processes. However, as the external cable protection deposits would be within the Hook Head SAC and within a habitat identified as a Qualifying Interest, Project Specific Mitigation has been proposed (PS1). This requires the Installation Contractor to investigate alternatives to the use of external cable protection and to consider ways to minimise the footprint of the protection should no technically feasible alternatives be available. However, as it is unknown whether the footprint can be reduced, the assessment has concluded that the residual effect remains Slight and is **Not Significant.**

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7. Benthic and Intertidal Ecology

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

The Proposed Development refers to the Irish Marine components of Greenlink from mean high-water springs (MHWS) at the Irish landfall at Baginbun Beach, Co. Wexford to the 12nm limit. 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.

This chapter also provides information on the Irish Offshore components of Greenlink from the 12nm limit to the Republic of Ireland/UK median line.

The Campile Estuary component of Greenlink lies along the onshore cable route. Horizontal directional drilling (HDD) will be used to cross the River Campile. The bores will be at a depth of >10m below the river bed. As the bores under the estuary cross the Foreshore, they will be included within the Foreshore Licence application, and therefore the significance of any effects on the estuary ecology has been assessed in this chapter. The compounds from which the HDD will initiate and terminate will be either side of the estuary, setback above MHWS, and are outside the scope of this EIAR. A separate EIAR will be prepared for the Irish Onshore components of Greenlink, which will include the HDD compounds.

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 H;
- Greenlink Interconnector Cable Landfall Locations (Wales and Ireland) – Intertidal Walkover Survey Report 2018 (MarineSpace 2018) – provided as Technical Appendix I;
- Ecological Assessment of estuarine habitats at Campile estuary and terrestrial ecology in proximity to Baginbun Beach for a proposed electricity interconnector between Ireland and Wales (Dixon.Brosnan 2019);
- 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 Baginbun Beach is not readily available. Therefore, GIL commissioned MarineSpace to undertake a phase 1 intertidal walkover survey of the Baginbun Beach landfall to inform the baseline description and assessment.

Conducted on the 12 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 10cm 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 ~ 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 I.

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

The benthic survey corridor was 500m wide. 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).

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

A total of 17 sites were sampled in Irish waters; 7 within the Proposed Development (Stations S00 to S06) and 10 in the Irish Offshore (Stations S07 to S16) (Figure 7-1).

Prior to grab sampling, seabed still images were collected using a SeaSpyder drop-down video (DDV) system. These 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.

Three video transects were performed within the nearshore area of the Proposed Development to investigate areas of potential interest (DDV_T01, DDV_T02, DDV_T03) (Figure 7-1). However, no habitats or associated fauna was recorded due to very poor visibility from suspended sediment in the water column (mobilised by recent storm conditions). DDV_T02 did show kelp on bedrock. No transects were undertaken in the Irish Offshore.

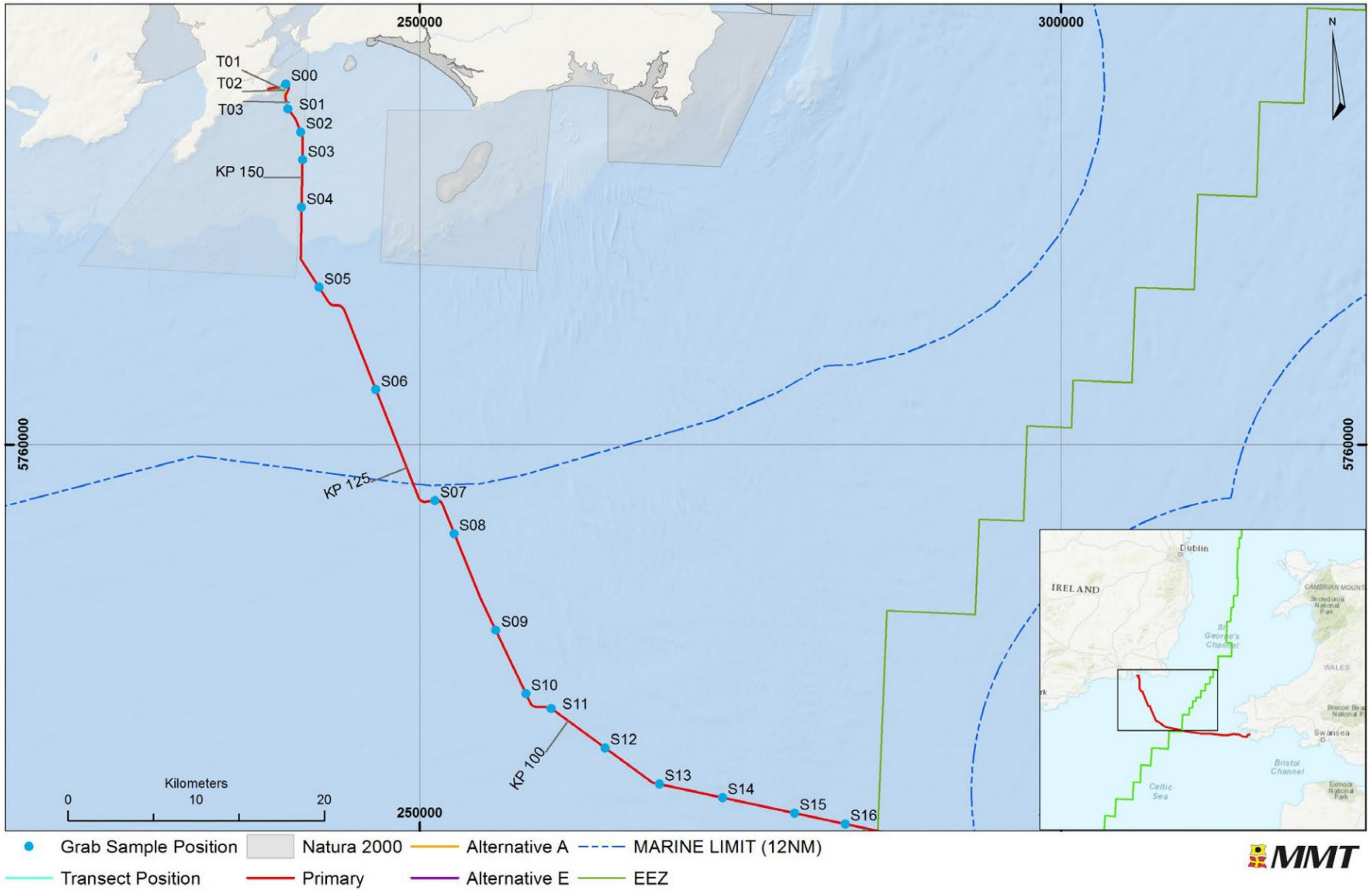
Underwater visibility was generally good, although very poor conditions were experienced in the nearshore area i.e. at transects DDV_T01, DDV_T02, DDV_T03.

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 H.

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 – intertidal, benthic and estuarine ecology

Stakeholder	Summary of Consultation Response	How response has been addressed
Foreshore Unit	A description of the biological environment over which the activity would impact, including the terrestrial flora and fauna, must be included	A description of the environmental baseline is included in Section 7.3. Information has been taken and summarised from the baseline surveys provided as Technical Appendices H and I. Effects on terrestrial fauna and flora above MHWS will be assessed in the Irish Onshore EIAR.
Foreshore Unit	The Foreshore Unit commented that in their opinion burial in a sand channel within the SAC would only have an ethereal impact, with pre-impact conditions reached within 6 months; and would therefore be preferable to the use of external cable protection.	Foreshore Unit opinion has been taken into consideration when conducting the assessment presented in Section 7.6.

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.

Seabed conditions along the Proposed Development were identified as typical of the southeast coast of Ireland, which predominantly consist of sandy gravel with nearshore areas of sand (JNCC 2004). The British Geological Survey (BGS) has categorised these sediments as patchy with areas of exposed bedrock close to the shore.

The Proposed Development crosses the Hook Head Special Area of Conservation (SAC) from KP159.267 at the Baginbun Beach landfall to KP151.258. The SAC comprises marine subtidal reefs to the south and east of the Hook Head Peninsula and sea cliffs from Hook Head to Baginbun and Ingard Point. The substrate around the Hook Head Peninsula gives rise to a range of benthic fauna. This is partly due to the strong tides and water currents which bring new supplies of food and nutrients.

An exposed to moderately exposed reef community complex occurs around Hook Head. Subtidally the reefs are aligned in a north-east/south-west orientation and are typically strewn with boulders, cobbles and patches of sand and gravel. There are also a number of isolated reefs that project from a sand plain. The reefs present a high species richness with Laminaria dominated communities in shallower waters. The deeper waters consist of Echinoderm and sponge dominated communities characterised by cushion sponges, branching sponges and the rose coral *Pentapora foliacea*. The rare red algae *Schizymenia dubyi* also occurs (NPWS 2016).

Habitat maps of the Hook Head SAC were obtained from NPWS and combined with bathymetry data from INFOMAR were used to select the route for the Proposed Development (see Chapter 3).

Further offshore, sediments are more sandy and homogenous (MMT 2019).

A total of 12 habitats were identified by the benthic survey in Irish waters, most of which were classified as sandy habitats.

7.3.2 Baginbun Beach intertidal ecology and habitats

The intertidal zone at Baginbun Beach contains a complex mosaic of littoral rock platforms and sand filled gullies supporting a variety of biotopes. Figure 7-2 shows the Beach as seen from the air; the images were taken during the Greenlink drone survey to establish the topography.

The habitat map produced by the intertidal Phase 1 walkover survey is provided as Figure 7-4.

To the south, the upper shore is dominated by barren littoral coarse sand (A2.221) with a narrow overlying strandline biotope constituted by decomposing seaweed supporting sandhopper (*Talitrid amphipods*) communities (A2.211). Fingers of sandy sediment extend down the shore filling tide swept gullies formed by fucoid dominated rocky outcrops (A1.214) (visible in Figure 7-2). These extend from the mid to the lower shore. Aggregations of *Sabellaria alveolata* tubes were noted along the rocky outcrops (Figure 7-3). To the north of the survey area, the band of barren upper shore sand is narrower and was fringed by barnacle dominated littoral rock (A1.112 / A1.113) quickly grading into fucoid dominated mid-shore rocky outcrops (A1.313 / A1.3141) that extended into a rocky platform dominated by *Fucus serratus* (A1.214) and *Laminaria digitata* along the sublittoral fringe.

A summary of biotopes found at Baginbun Beach is provided in Table 7-2.

Figure 7-2 Aerial images of Baginbun Beach September 2018

Source: MMT

Table 7-2 Key intertidal biotopes

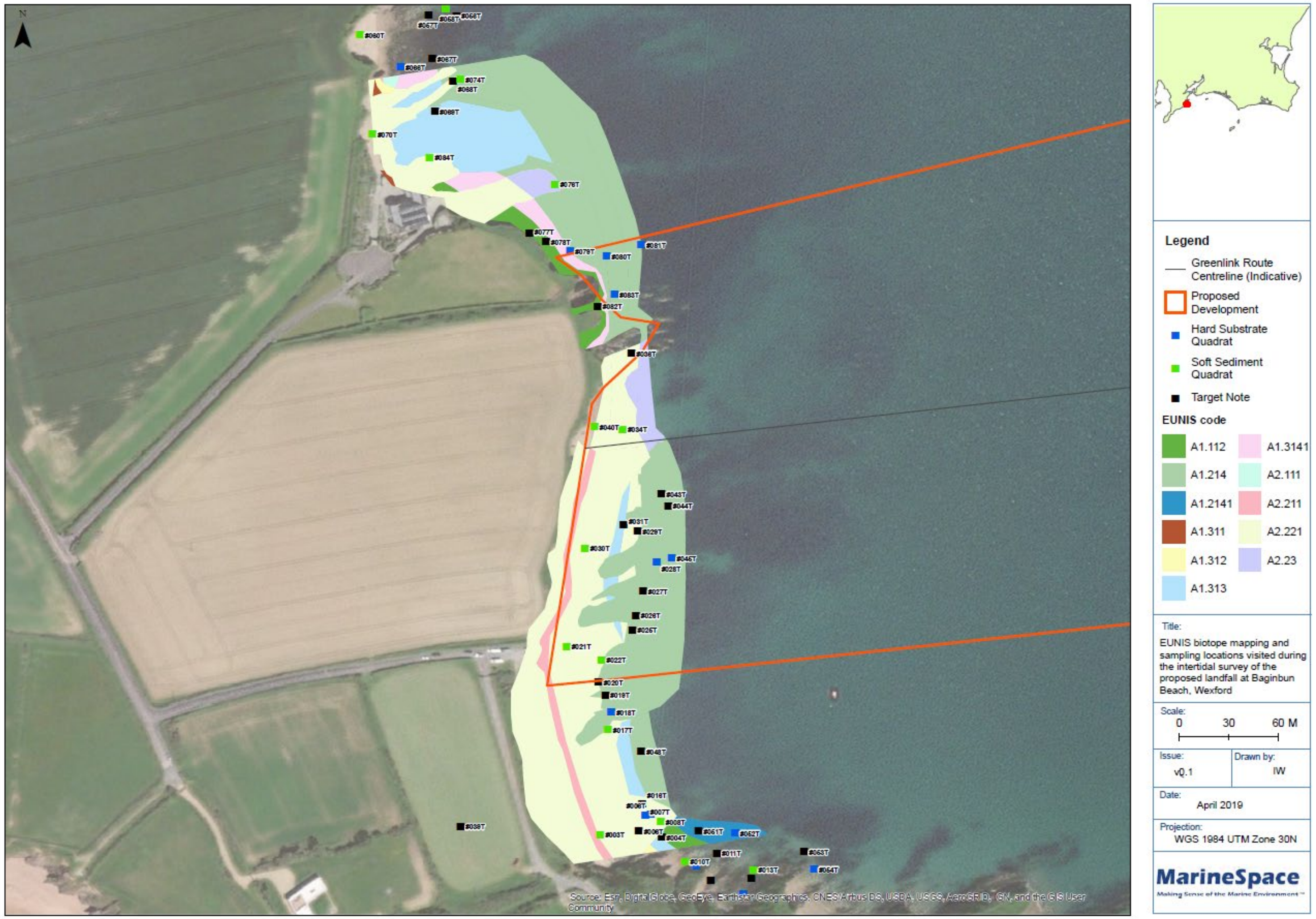
Habitat	EUNIS Code	EUNIS Description
A1 - Littoral Rock and other hard substrata	A1.113	*Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock
	A1.214	*Fucus serratus* on moderately exposed lower eulittoral rock
	A1.2141	*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock
	A1.311	*Pelvetia canaliculata* on sheltered littoral fringe rock
	A1.312	*Fucus spiralis* on sheltered upper eulittoral rock
	A1.313	*Fucus vesiculosus* on moderately exposed to sheltered mid eulittoral rock
	A1.3141	*Ascophyllum nodosum* on full salinity mid eulittoral rock
	A1.421	Green seaweeds (*Enteromorpha* spp. and *Cladophora* spp.) in shallow upper shore rockpools
	A1.412	Fucoids and kelp in deep eulittoral rockpools
	A1.413	Seaweeds in sediment-floored eulittoral rockpools
A2 - Littoral sediment	A2.111	Barren littoral shingle
	A2.211	Talitrids on the upper shore and strandline
	A2.221	Barren littoral coarse sand
	A2.23	Polychaete/amphipod-dominated fine sand shores

Figure 7-3 Photographs of biotope features at Baginbun Beach

Left: Shallow upper shore rock pool feature. Right: *S. alveolata* tube aggregation in a gully on the mid-shore.

Source: MarineSpace (2018)

Figure 7-4 EUNIS biotope mapping and sampling locations at Baginbun Beach



7.3.3 Subtidal ecology and habitats

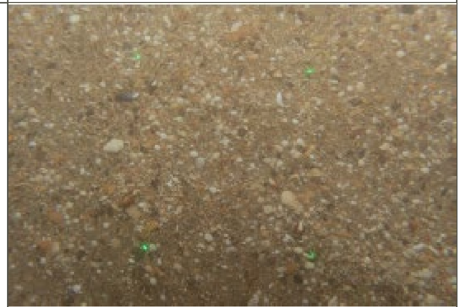
Review of the geophysical data, ground-truthed by video and still photography, and infaunal grab sample analysis identified 12 habitats within the survey corridor as described in Table 7-3. These are mapped and presented in Figure 7-5 to Figure 7-11 below (Drawings P1975-HAB-003 Sheet 12 to Sheet 06).

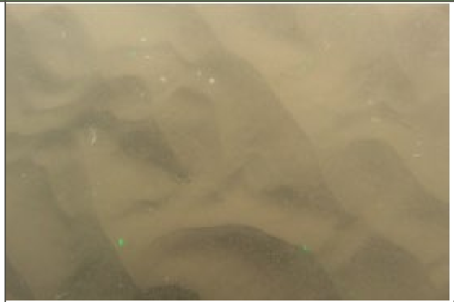
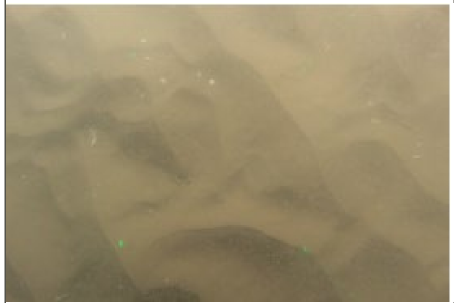
No *Sabellaria spinulosa* were identified in any of the grab samples in Irish waters.

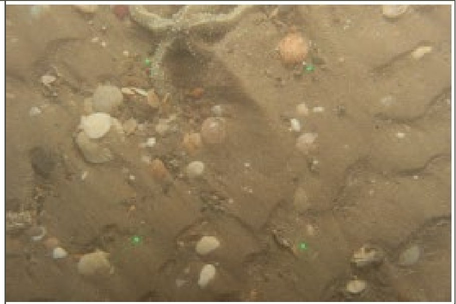
Table 7-3 Habitats present within the Proposed Development and Irish Offshore

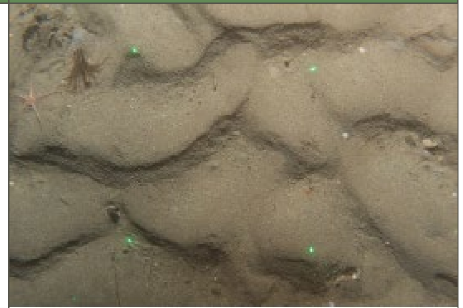
Indicative KPs	Associated Sample Station(s)	EUNIS Habitat code	JNCC Equivalent Habitat	Infaunal analyses from grab samples	Indicative habitat image
Proposed Development					
Landfall	T01 S00	A3.2 - Atlantic and Mediterranean moderate energy infralittoral rock	IR.MIR - Moderate energy infralittoral rock	S00 - The infaunal composition was characterized by molluscs *A. alba*, *F. fabula*, *Spisula subtruncata* and polychaetes *M. johnstoni* and *Nephtys hombergii*.	Interpreted from side scan sonar (SSS) data
Landfall KP 159-158 KP 153 - 149	T03-T01, S01 S03, S04	A5.252 - *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	SS.SSa.CFiSa.ApriBatPo - *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	S01, KP 155.639,- The infaunal analysis showed a small sample with regards to abundance and diversity which was primarily characterized by crustaceans and polychaetes. S03, KP 151.395 - The infaunal was characterised by polychaetes *O. borealis*, and *Spiophanes bombyx*, *L. cingulate*, amphipods *B. elegans*, *Urothoe elegans* and molluscs *A. prismatica* and *T. ovata*. S04, KP 147.691 characterised by molluscs Fabulina fabula, A. prismatica, N. nitidosa, Gari fervensis, polychaetes Magelona johnstoni, Magelona filiformis, N. cirrosa, amphipods Bathyporeia tenuipes, B. elegans and echinoderms E. pusillus and A. filiformis.	

Indicative KPs	Associated Sample Station(s)	EUNIS Habitat code	JNCC Equivalent Habitat	Infaunal analyses from grab samples	Indicative habitat image
KP159	S01, T01	A3.11 - Kelp with cushion fauna and/or foliose red seaweeds	IR.HIR.KFaR - Kelp with cushion fauna and/or foliose red seaweeds	S01, KP 155.639,- The infaunal analysis showed a small sample with regards to abundance and diversity which was primarily characterized by crustaceans and polychaetes.	
KP 159-158	T03-T01, S01	A5.24 - Infralittoral muddy sand	SS.SSa.IMuSa - Infralittoral muddy sand		
KP158-156	TO3-T01, S01	A5.44 - Circalittoral mixed sediments	SS.SMx.CMx - Circalittoral mixed sediments		Interpreted from SSS data

Indicative KPs	Associated Sample Station(s)	EUNIS Habitat code	JNCC Equivalent Habitat	Infaunal analyses from grab samples	Indicative habitat image
KP 156 - 154	T03, S01	A5.25 - Circalittoral fine sand	SS.SSa.CFiSa - Circalittoral fine sand		
KP 153-149	S02, S03, S04	A5.14 Circalittoral coarse sediment	SS.SCS.CCS - Circalittoral coarse sediment	S02, KP.153.593 - Infaunal composition was characterised by polychaetes *Pista mediterranea*, *Psamathe fusca*, echinoderms *Amphipholis squamata*, holothurian *Thyone fusus*, molluscs *Gari telinella* and *Clausinella fasciata*. S03, KP 151.395 - The infaunal was characterised by polychaetes *O. borealis*, and *Spiophanes bombyx*, *L. cingulate*, amphipods *B. elegans*, *Urothoe elegans* and molluscs *A. prismatica* and *T. ovata*. S04, KP 147.691 characterised by molluscs Fabulina fabula, A. prismatica, N. nitidosa, Gari fervensis, polychaetes Magelona johnstoni, Magelona filiformis, N. cirrosa, amphipods Bathyporeia tenuipes, B. elegans and echinoderms E. pusillus and A. filiformis.	

Indicative KPs	Associated Sample Station(s)	EUNIS Habitat code	JNCC Equivalent Habitat	Infaunal analyses from grab samples	Indicative habitat image
KP 147 - 126	S05-S04	A5.242 - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	SS.SSa.IMuSa.FfabMag - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	S05, S04, KP 131.546, KP 141.046 and KP 147.691 - characterised by molluscs Fabulina fabula, A. prismatica, N. nitidosa, Gari fervensis, polychaetes Magelona johnstoni, Magelona filiformis, N. cirrosa, amphipods Bathyporeia tenuipes, B. elegans and echinoderms E. pusillus and A. filiformis.	
Irish Offshore (KP74 - KP124)					
KP126 - 118	S06 - S07	A5.242 - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	SS.SSa.IMuSa.FfabMag - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	S07, S06, KP 121.090, - characterised by molluscs Fabulina fabula, A. prismatica, N. nitidosa, Gari fervensis, polychaetes Magelona johnstoni, Magelona filiformis, N. cirrosa, amphipods Bathyporeia tenuipes, B. elegans and echinoderms E. pusillus and A. filiformis.	

Indicative KPs	Associated Sample Station(s)	EUNIS Habitat code	JNCC Equivalent Habitat	Infaunal analyses from grab samples	Indicative habitat image
KP 118 -105 KP 75-71	S10-S08 S16	A5.251 - Echinocyamus pusillus, Ophelia borealis and Abra prismatica in circalittoral fine sand	SS.SSa.CFiSa.EpusOborApri- Echinocyamus pusillus, Ophelia borealis and Abra prismatica in circalittoral fine sand	S08, KP117.806 - No residue was acquired for analysis of infauna S09 and S10, KP 109.684 and 104.203 - The infaunal composition was similar at both locations, although less diverse and abundant at S09 than compared to S10, and was characterised by echinoderm *E. pusillus*, polychaetes *O. borealis*, and *Spiophanes bombyx*, amphipod *B. elegans* and molluscs *A. prismatica*, *T. flexuosa* and *K. bidentata*. S16, KP 76.476 - The infaunal composition was characterized by molluscs *Abra prismatica, A. alba, Phaxas pellucidus*, cumaceans *Eudorellopsis deformis*, numerous polychaetes, *B. elegans* and echinoderms *A. filiformis* and *E. pusillus*	
KP 99 - 75	S16-S12	A5.252 - *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	SS.SSa.CFiSa.ApriBatPo - *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	S16, S15, S14, S12, KP 76.476, KP 80.529, KP 86.263, KP 96.422 - The infaunal composition at these locations was characterized by molluscs *Abra prismatica, A. alba, Phaxas pellucidus*, cumaceans *Eudorellopsis deformis*, numerous polychaetes, *B. elegans* and echinoderms *A. filiformis* and *E. pusillus*. S13, KP 91.300 - the infaunal composition was characterised polychaetes *Spiophanes kroyeri, Owenia* sp., *Goniada maculata*, echinoderms *A. filiformis* and molluscs *Corbula gibba* and *Nucula hanleyi*.	

Indicative KPs	Associated Sample Station(s)	EUNIS Habitat code	JNCC Equivalent Habitat	Infaunal analyses from grab samples	Indicative habitat image
KP93, 92, 90 KP 105-100	S13 S11 S10	A5.272 - *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	SS.SSa.OSa.OfusAfil - *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	S13, KP 91.300 - the infaunal composition was characterised polychaetes *Spiophanes kroyeri*, *Owenia* sp., *Goniada maculata*, echinoderms *A. filiformis* and molluscs *Corbula gibba* and *Nucula hanleyi*. S10, KP104.203 - The infaunal composition was similar at both locations, although less diverse and abundant at S09 than compared to S10, and was characterised by echinoderm *E. pusillus*, polychaetes *O. borealis*, and *Spiophanes bombyx*, amphipod *B. elegans* and molluscs *A. prismatica*, *T. flexuosa* and *K. bidentata*. S11, KP 101.624 - infaunal composition was characterized by polychaetes *Owenia sp.*, *O. borealis*, *Lagis koreni*, molluscs *Nucula nitidosa*, *C. gibba*, *Thyasira flexuosa*, echinoderms *A. filiformis* and *E. pusillus*	

GREENLINK INTERCONNECTOR

BENTHIC HABITATS
Survey Data - Sheet 12

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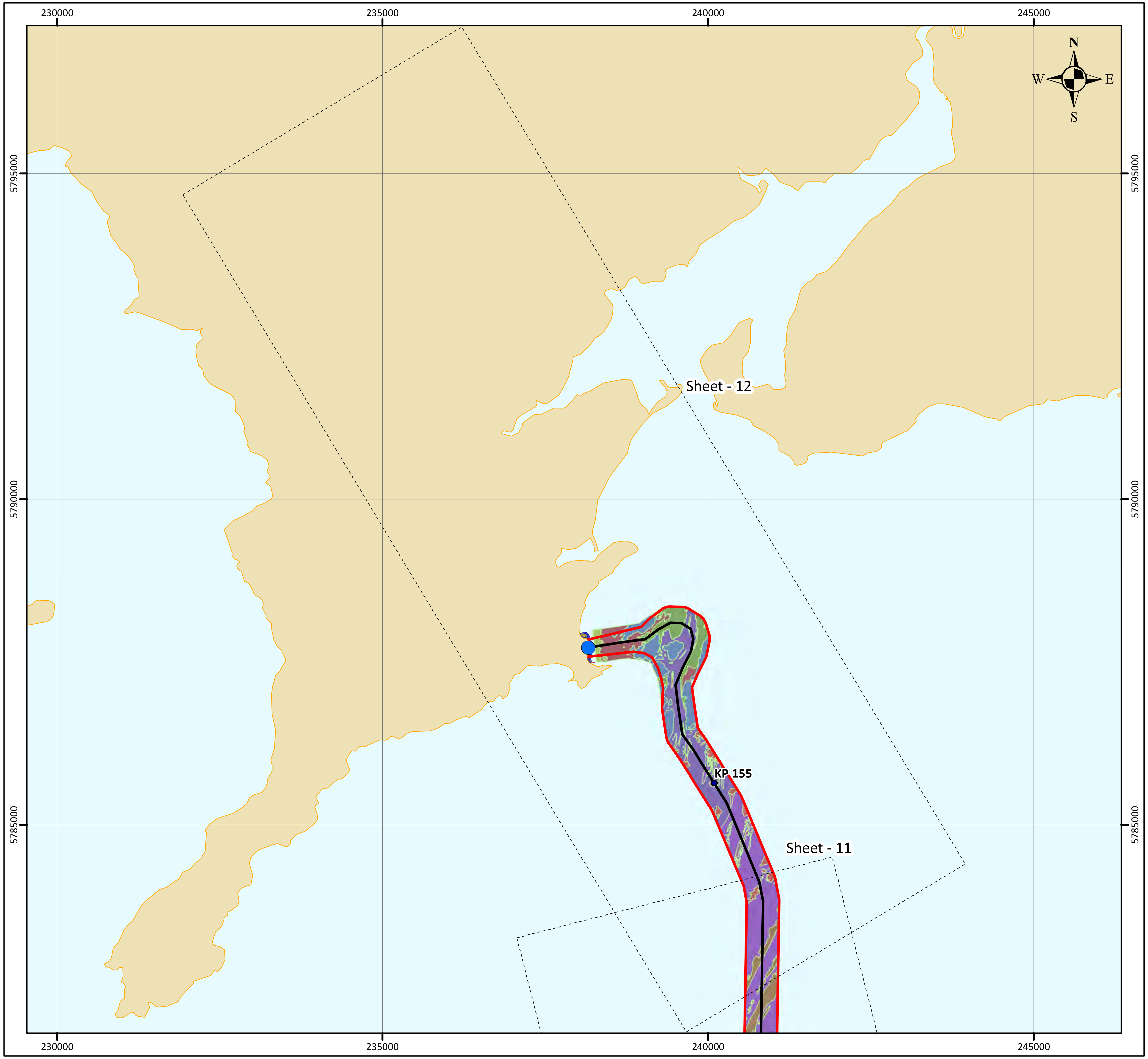

Legend

- Baginbun Beach
- Greenlink Route Centreline (Indicative)
- Proposed Development

MMT Survey
EUNIS Classification

- A3.11
- A3.2
- A4.1
- A5.14
- A5.23
- A5.24
- A5.25
- A5.252
- A5.43
- A5.44

MarineSpace Survey
EUNIS Classification

- A1.112
- A1.113
- A1.214
- A1.2141
- A1.311
- A1.312
- A1.313
- A1.3141
- A2.111
- A2.211
- A2.221
- A2.23

NOTE: Not to be used for Navigation

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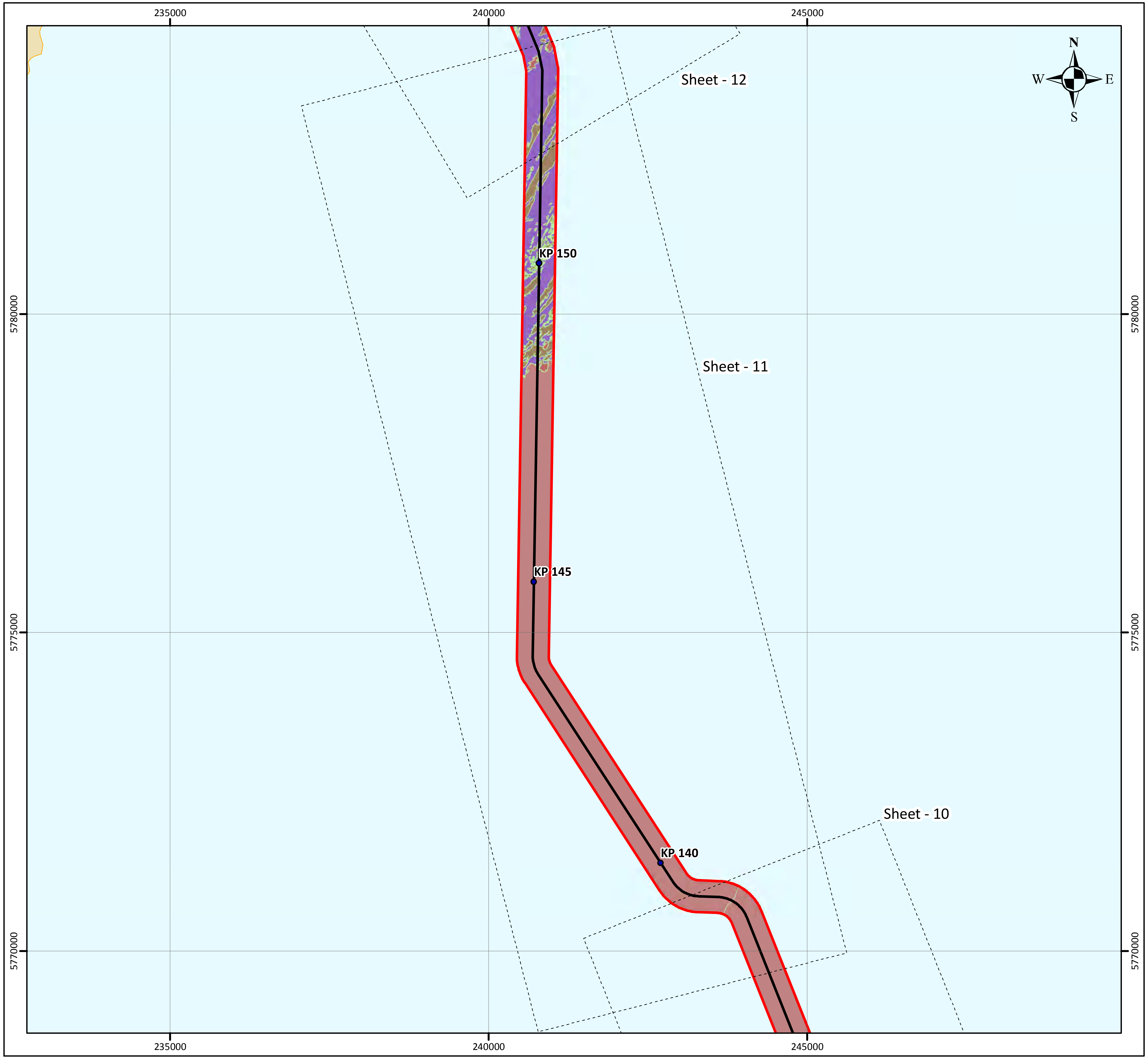
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; OSOD; OSI; MMT; Greenlink
File Reference	J:\P1975\Mxd\06_HAB\ P1975-HAB-003.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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 11

Drawing No: P1975-HAB-003	A

Legend

- Greenlink Route Centreline (Indicative)
- Proposed Development

MMT Survey

EUNIS Classification

- A4.1
- A5.14
- A5.242
- A5.25
- A5.252
- A5.44

NOTE: Not to be used for Navigation

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Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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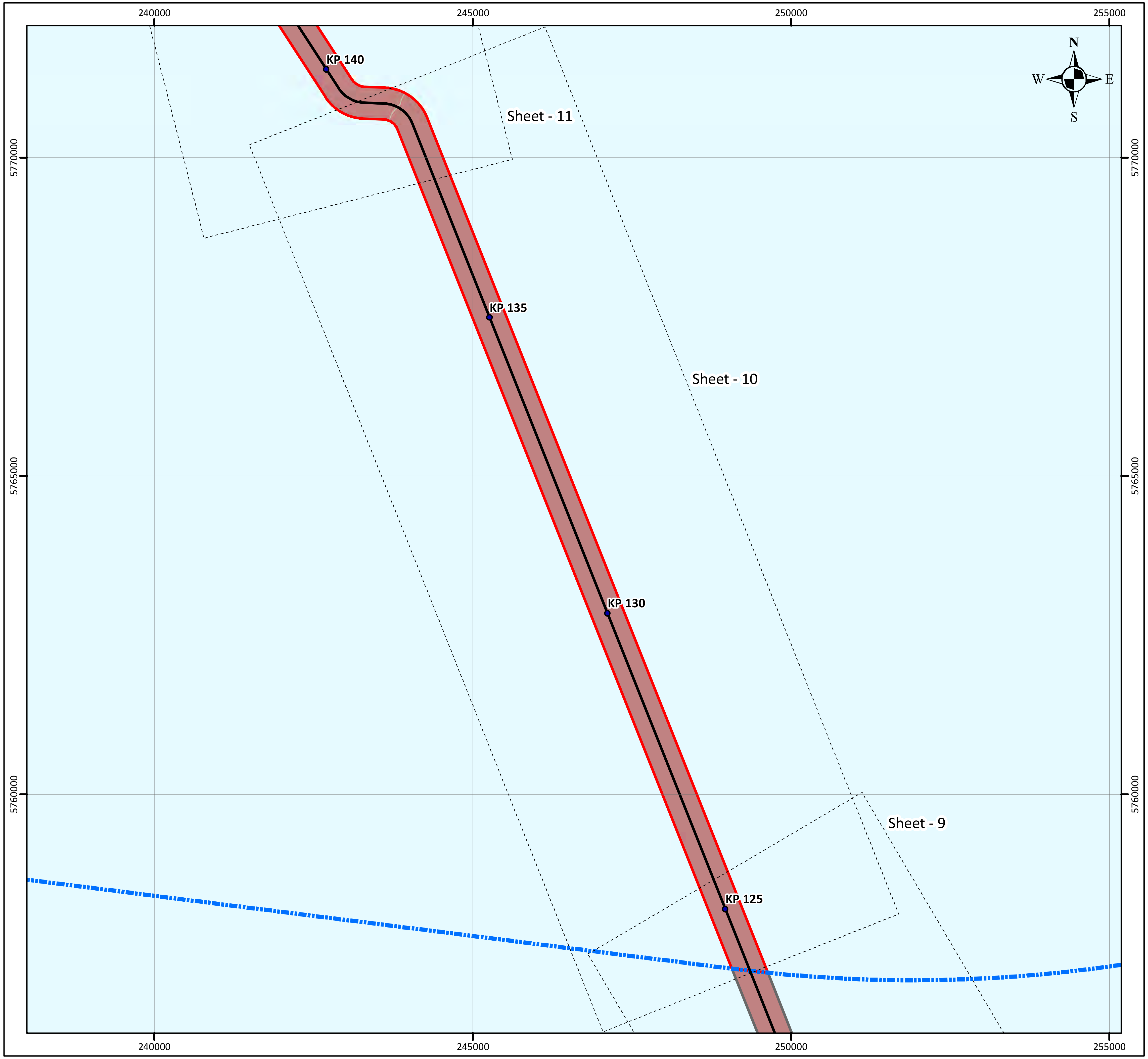
0 0.5 1 1.5 2 km



GREENLINK INTERCONNECTOR

BENTHIC HABITATS

Survey Data - Sheet 10

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

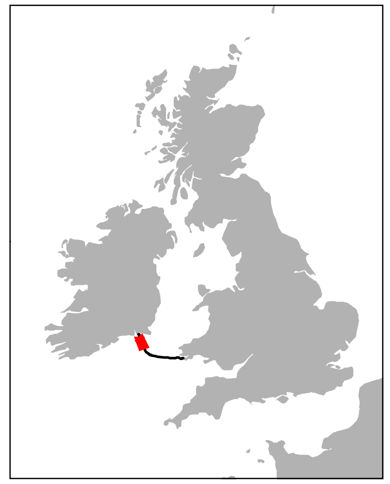
Legend

- Greenlink Route Centreline (Indicative)
- Proposed Development
- Irish Offshore
- ROI 12nm Territorial Sea Limit

MMT Survey

EUNIS Classification

- A5.242



NOTE: Not to be used for Navigation

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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

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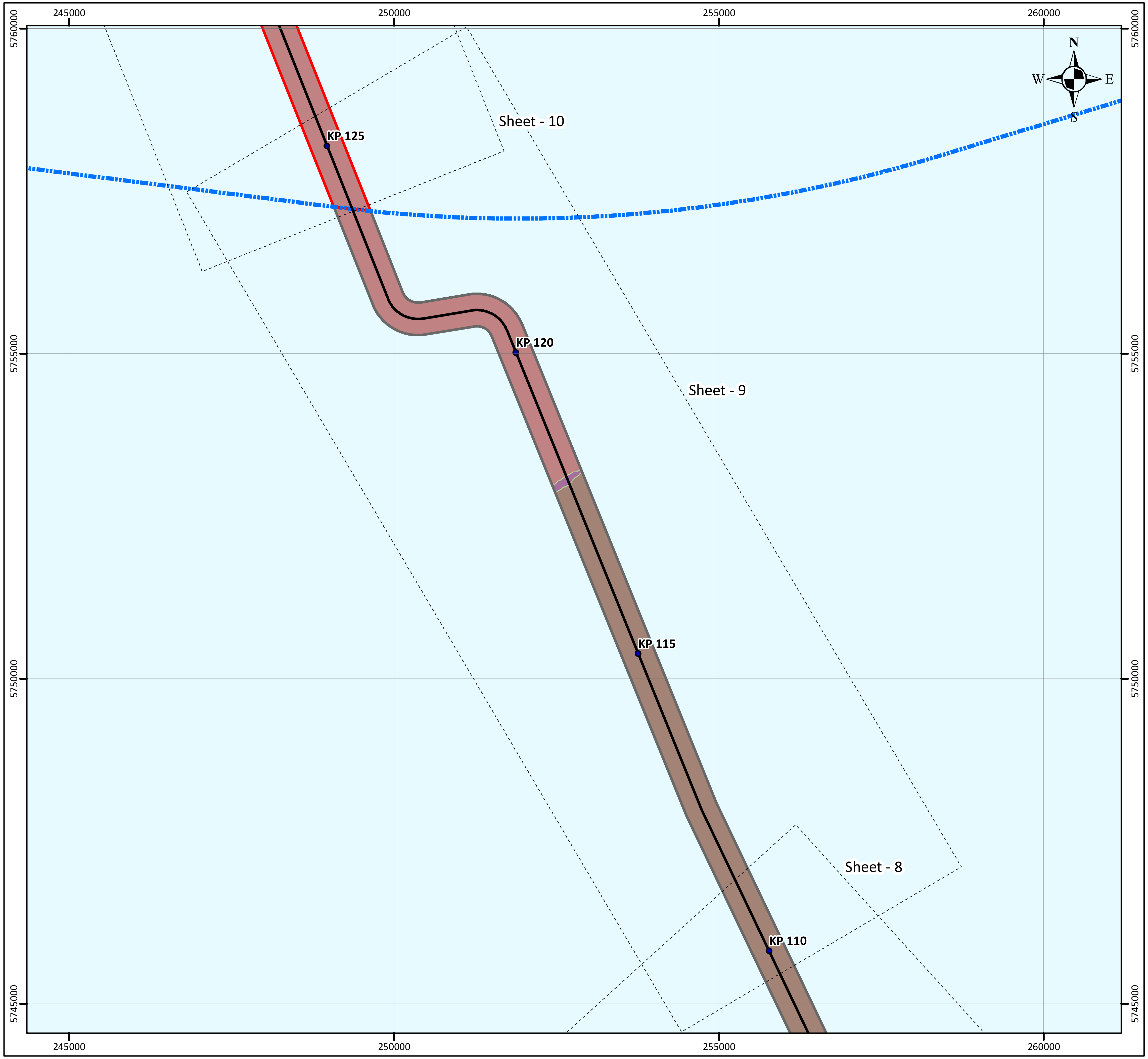
0 0.5 1 1.5 2 km



GREENLINK INTERCONNECTOR

BENTHIC HABITATS
Survey Data - Sheet 9

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

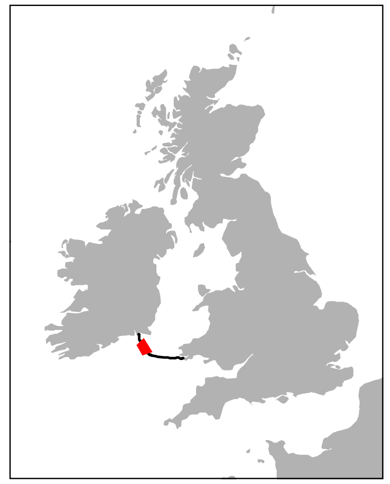
Legend

- Greenlink Route Centreline (Indicative)
- Proposed Development
- Irish Offshore
- ROI 12nm Territorial Sea Limit

MMT Survey

EUNIS Classification

- A5.242
- A5.25
- A5.251



Date	Monday, April 8, 2019 12:40:35
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
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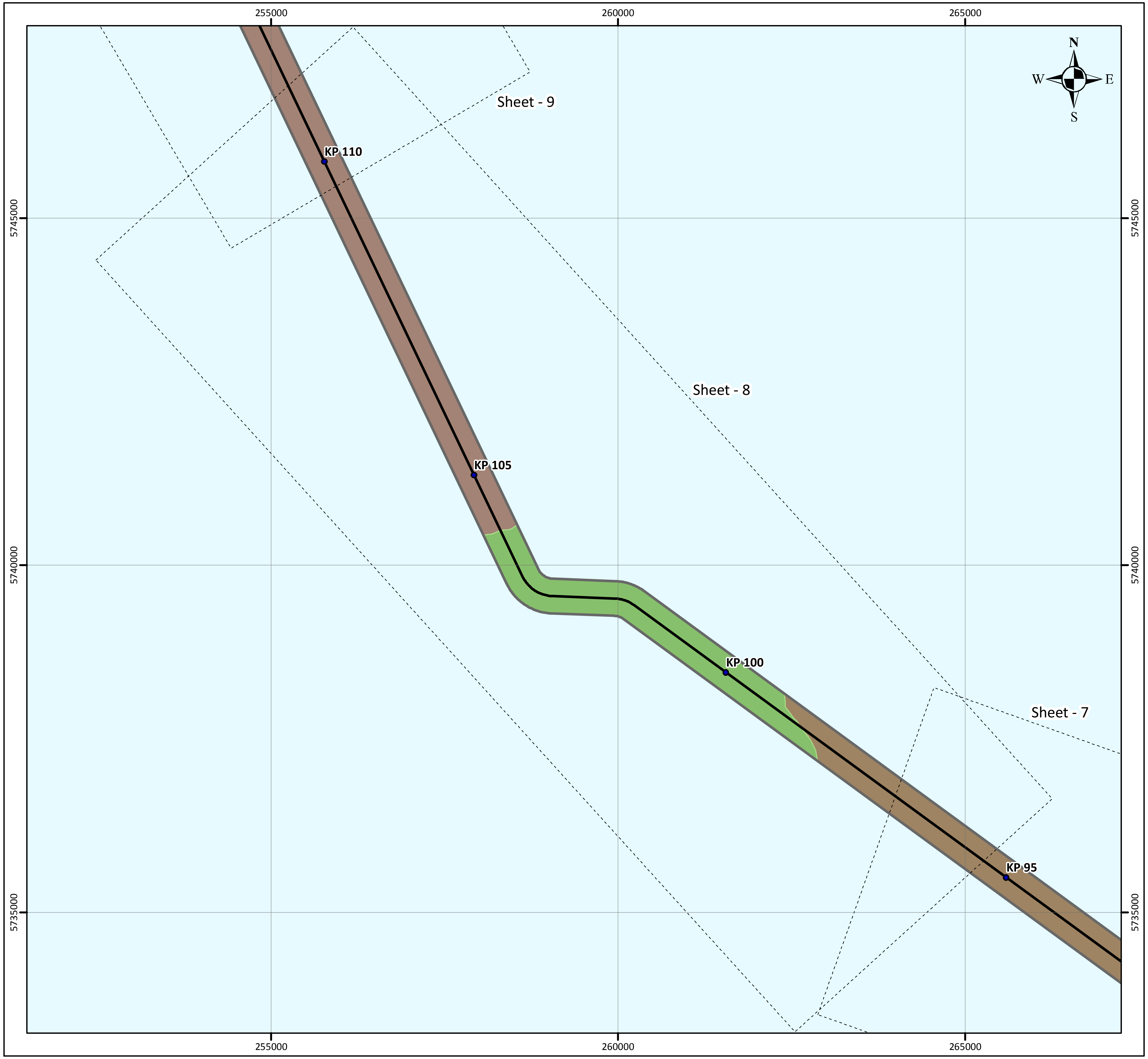
File Reference	J:\P1975\Mxd\06_HAB\ P1975-HAB-003.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Co-financed by the European Union
Connecting Europe Facility

0 0.5 1 1.5 2 km



GREENLINK INTERCONNECTOR

BENTHIC HABITATS
Survey Data - Sheet 8

Drawing No: P1975-HAB-003	A

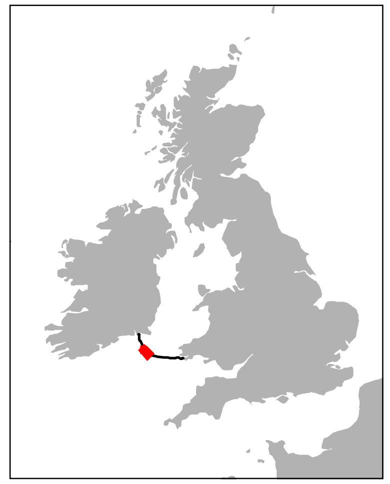
Legend

- Greenlink Route Centreline (Indicative)
- Irish Offshore

MMT Survey

EUNIS Classification

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



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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

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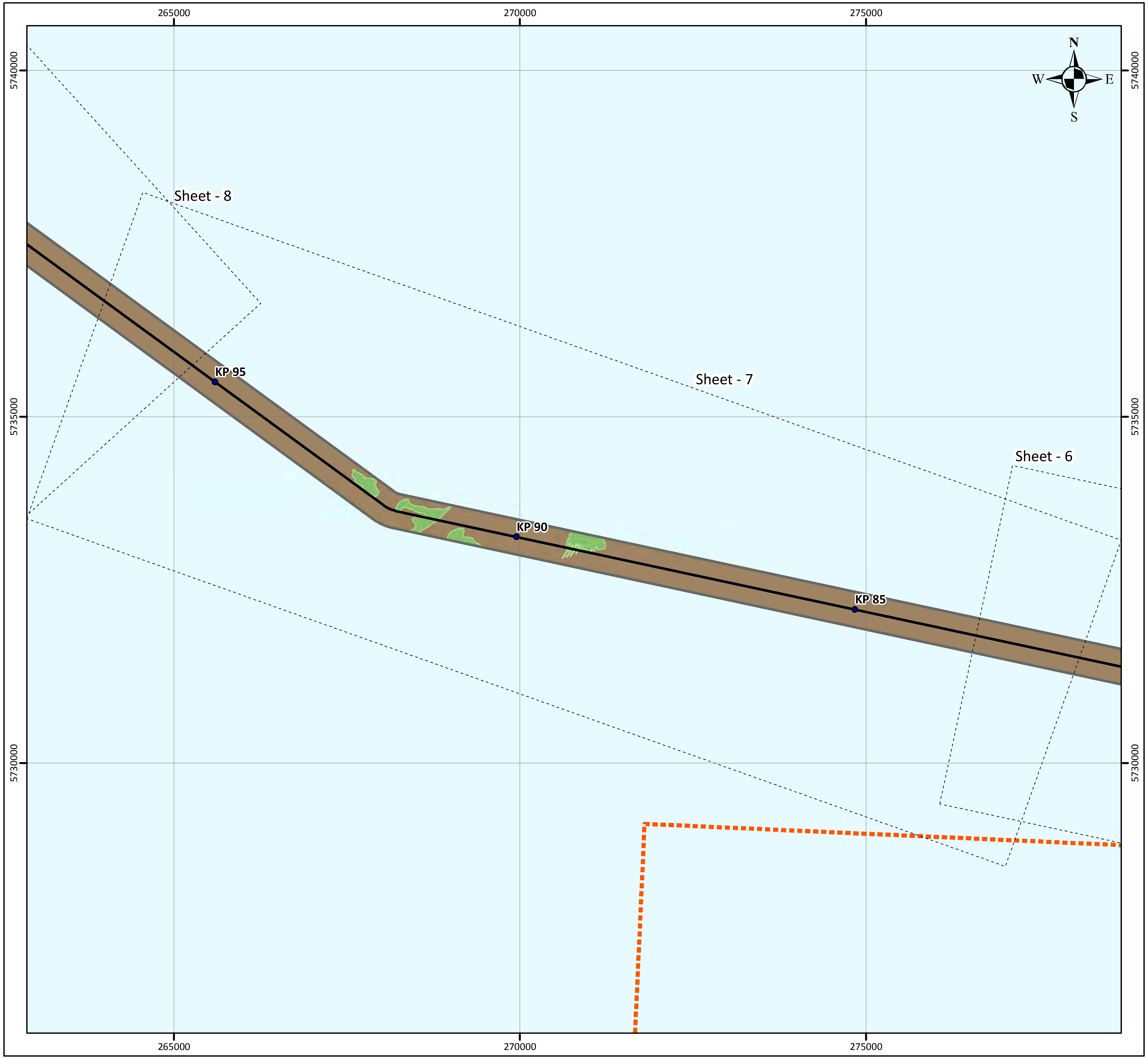
0 0.5 1 1.5 2 km



GREENLINK INTERCONNECTOR

BENTHIC HABITATS
Survey Data - Sheet 7

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

Legend

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

MMT Survey

EUNIS Classification

- A5.252
- A5.272

Date	Monday, April 8, 2019 12:40:35
Projection	WGS_1984_UTM_Zone_30N
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Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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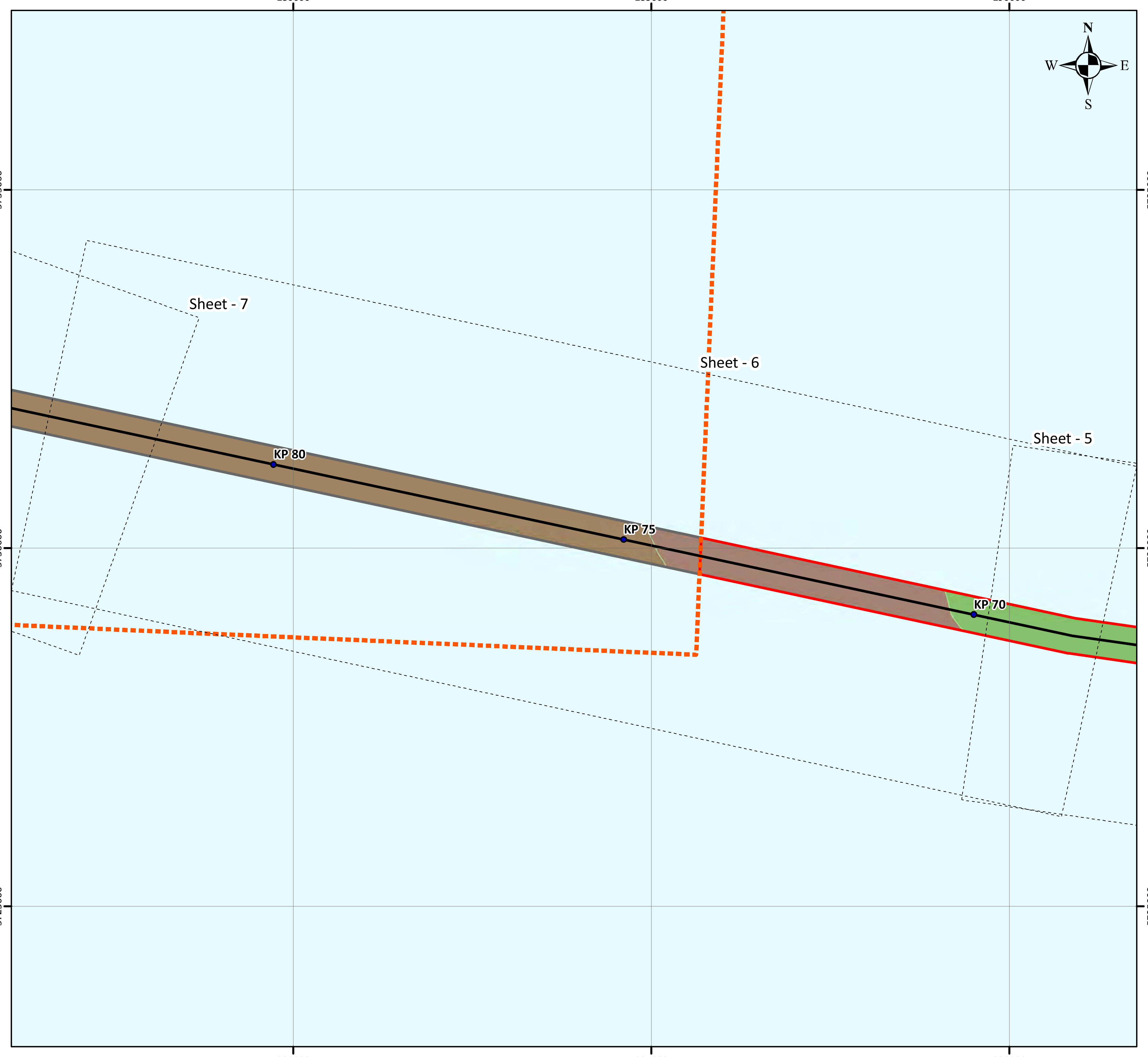
0 0.5 1 1.5 2 km



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

Date	Monday, April 8, 2019 12:40:35
Projection	WGS_1984_UTM_Zone_30N
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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

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0 0.5 1 1.5 2 km

7.3.4 Campile Estuary ecology and habitats

The Campile River at Dunbrody Bridge is tidal, with regular fluctuations in salinity and turbidity, and in the rate and direction of water flow. This section of the Campile River is part of the River Barrow and River Nore SAC. The shoreline habitat is classified as upper salt marsh habitat that has developed along the Campile River Channel (Figure 7-12). This upper section of the river is subject to less frequent and less prolonged inundation by the sea and, as a result, is not as saline in character as lower sections of the river.

Figure 7-12 Photographs 1 and 2 showing the proposed crossing area of the Campile River, with associated habitats, west of Dunbrody Bridge and north of the railway line.

The river channel has been considerably modified over time with the development of embankments along the southern bank of the river to the west of Dunbrody Bridge. The river channel embankments were created on both sides of the river banks to allow for the reclamation of intertidal habitats and thus to create farmland.

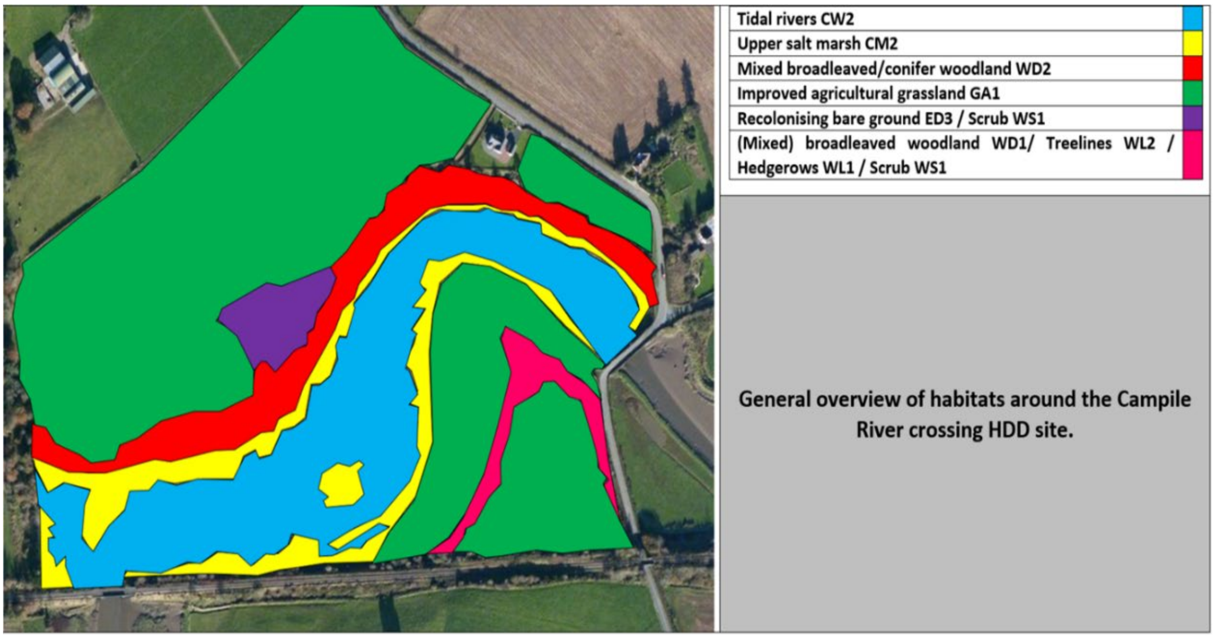
The embankment along the southern bank of the river to the west of Dunbrody Bridge separates the Campile River from an area of improved, heavily grazed agricultural grassland. The embankment itself, while showing some signs of grazing, is dominated by a mix of species including Sea Couch (*Elytrigia atherica*), False Oat-grass (*Arrhenatherum elatius*), Nettle (*Urtica dioica*), Bindweed (*Calystegia spp.*) and patches of Bramble (*Rubus spp.)*.

The section of the Campile River to the west of the Dunbrody Bridge is dominated by mudflat habitat which is exposed during periods of low tide. However, found scattered within these areas of consolidated mud and along the river bank are areas of upper salt marsh habitat. Floral composition varies. Common Cord-grass (*Spartina anglica*) has become abundant in places which can cause habitat loss and degradation. Other species noted include Sea Couch, Sea Club-rush (*Bolboschoenus maritimus*), Creeping Bent (*Agrostis stolonifera*), Sea Aster (*Aster tripolium*), Orache (*Atriplex spp.*) and Sea Plantain (*Plantago maritima*). There is some evidence of grazing by cattle within this habitat.

Situated to the north of this section of the Campile River, is a band of mixed broadleaved/conifer woodland. Species noted include Ash (*Fraxinus excelsior*), Oak (*Quercus spp.*), Birch (*Betula spp.*), Scots Pine (*Pinus sylvestris*), Sycamore (*Acer pseudoplatanus*) and Hawthorn (*Crataegus monogyna*). The high-risk invasive species Rhododendron (*Rhododendron ponticum*) was recorded growing within the understory of the woodland habitat at various locations.

Figure 7-13 presents the habitats identified at the Campile Estuary.

Figure 7-13 General overview of habitats west of Dunbrody Bridge



7.3.5 Protected species and species of conservation importance

7.3.5.1 Intertidal

Aggregations of honeycomb worm (*Sabellaria alveolata*) tubes and rockpools were ubiquitous across the site. Significant portions of the lower shore fucoid (brown seaweed) dominated rock found in the southern end of the survey area was colonised by low lying veneers of *S. alveolata* tube aggregations. Discrete clumps were also noted on the vertical faces of the sand-filled gullies formed by the rocky outcrops along the majority of the survey area. Given their low-lying nature (< 2 cm) and limited extent, these aggregations were not thought to be representative of the larger reef structures that are afforded protection as Annex I biogenic reef habitats under the EC Habitats Directive. However, the rock outcrops themselves do fall under the category of Annex I bedrock reef.

7.3.5.2 Subtidal

The cable route survey identified the following EC Habitats Directive listed Annex I habitats within the Proposed Development:

- Bedrock reef (1170)
- Large shallow inlets and bays (1160)

Both habitats are designating features of the Hook Head SAC; in which the Proposed Development lies between the landfall at Baginbun Beach, KP 159.267 to KP151.258.

Large shallow inlets and bays (1160):

Large shallow inlets and bays are habitat complexes which comprise an interdependent mosaic of subtidal and intertidal habitats. Several of these habitat types (1140 Mudflats and sandflats not covered by sea water at low tide, 1110 Sandbanks which are slightly covered by sea water all the time and 1170 Reefs) are listed as Annex I habitats in their own right.

Large shallow inlets and bays are large indentations of the coast, generally more sheltered from wave action than the open coast. They are relatively shallow (with water less than 30m over most of the area), and in contrast to 1130 estuaries, generally have much lower freshwater influence (JNCC 2019).

Figures 7-15 and 7-16 (P1975-HAB-004 Sheet 11 and Sheet 12) show areas along the Proposed Development which are classified as part of the habitat 'large shallow inlets and bays'.

Bedrock reef (1170):

The EC Habitats Directive habitat 1170 Reefs is described as "*Submarine, or exposed at low tide, rocky substrates and biogenic concretions, which arise from the sea floor in the sublittoral zone but may extend into the littoral zone where there is an uninterrupted zonation of plant and animal communities. These reefs generally support a zonation of benthic communities of algae and animals species including concretions, encrustations and corallogenic concretions.*" (European Commission 2013)

The sub-type 'bedrock reef' occurs where the bedrock arises from the surrounding seabed creating a habitat that is colonised by many different marine animals and plants (JNCC 2014); it is a type of rocky reef. Rocky reefs can be very variable in terms of both their structure and the communities that they support. They provide a home to many species such as corals, sponges and sea squirts as well as giving shelter to fish and crustaceans such as lobsters and crabs.

Bedrock outcrops were identified in the geophysical data within the Proposed Development. These outcrops had been identified during route development and the indicative cable centreline follows a sand channel between the Bedrock reef.

Photo transects were performed across the corridor at three locations (DDV_T01 at KP158.318, DDV_T02 at KP156.911 and DDV_T03 at KP 156.136) to try to visualise the bedrock reef. However, due to poor visibility from suspended sediments, no habitats or associated fauna was recorded from transects DDV_T01 and DDV_T03. Transect DDV_T02 showed kelp on bedrock (Figure 7-14). All outcropping bedrock shallower than 20m, was classified to A3.11 - kelp with cushion fauna and/or foliose red seaweeds.

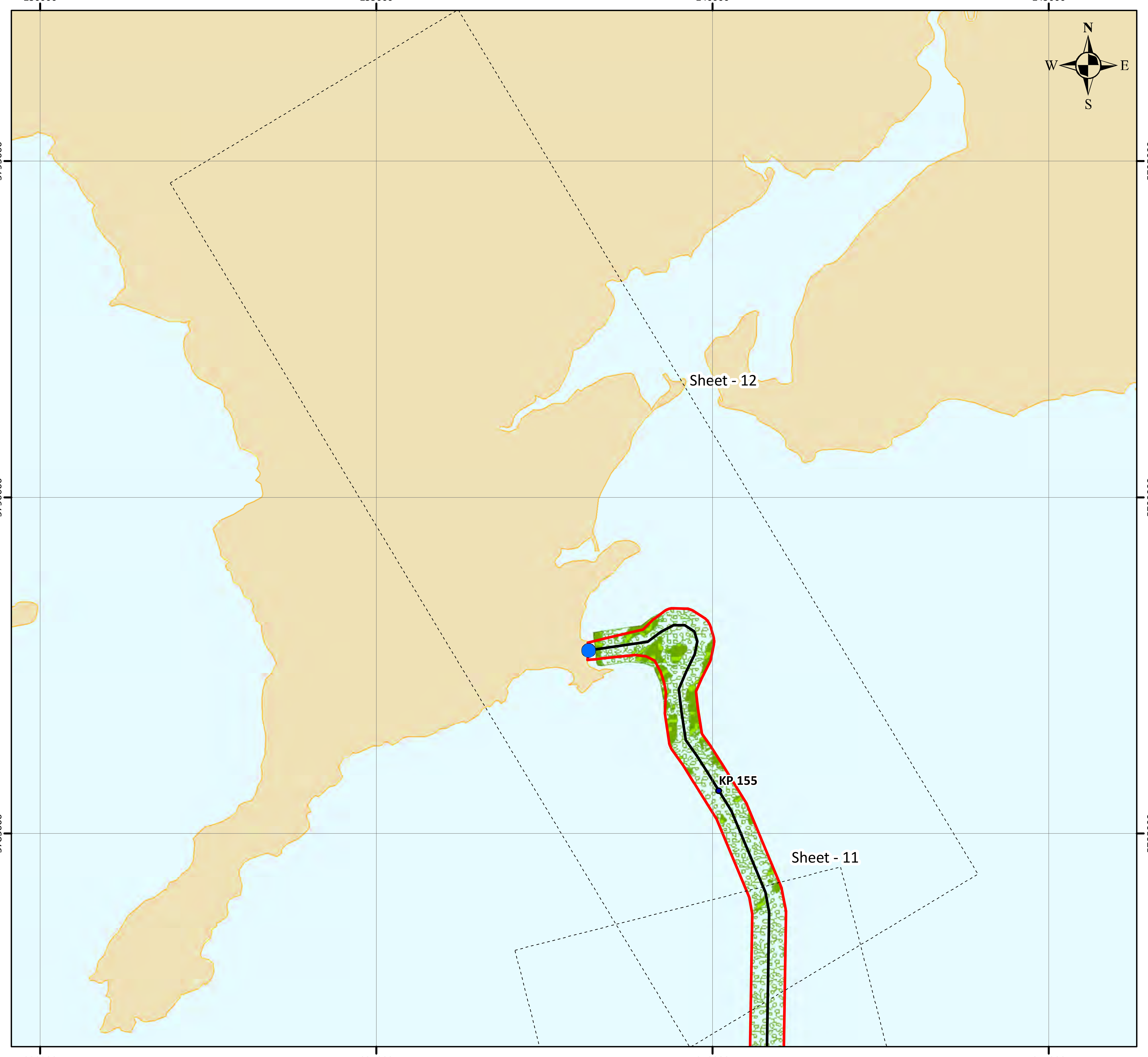
The reef habitats found in Hook Head SAC are bedrock and stony reefs of three community types: exposed to moderately exposed intertidal reef community complex, echinoderm and sponge dominated community complex, and laminaria dominated community (NPWS 2014). None of the invertebrate species listed in the Natura 2000 standard data form for Hook Head were identified in the grab samples (MMT 2019).

Areas of Laminaria sp. was identified on outcropping bedrock within the Irish EEZ.

Figure 7-15 and 7-16 (P1975-HAB-004 Sheet 12 and Sheet 11) shows areas within the Proposed Development classified as bedrock reef.

The extent of Annex I Reef habitat within the Proposed Development has been calculated as 5.33km^2; of which 4.16km^2 is within the Hook Head SAC. However, it is evident from INFOMAR bathymetry data and NPWS habitat maps for Hook Head SAC that exposed bedrock covers a greater extent, in the wider region. The extent of Reef protected by the Hook Head SAC, as measured from the NPWS habitat maps, is 105.34km^2. When compared, the habitat maps and Greenlink cable route survey data generally showed a good level of alignment; although as the Greenlink cable route survey is of a higher resolution, local small scale differences were identified.

Figure 7-14 Photograph from DDV_T02_001 showing Annex I (1170) – Bedrock reefs with the habitat A3.11 – Kelp with cushion fauna and/or foliose red seaweeds



GREENLINK INTERCONNECTOR

ANNEX I HABITATS

Survey Data - Sheet 12

Drawing No: P1975-HAB-004	A

Legend

Landfall

- Baginbun Beach
- Greenlink Route Centreline (Indicative)
- Proposed Development

Annex I Habitat Classification

- Large Shallow Inlets/Bay
- Bedrock Reef

NOTE: Not to be used for Navigation

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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

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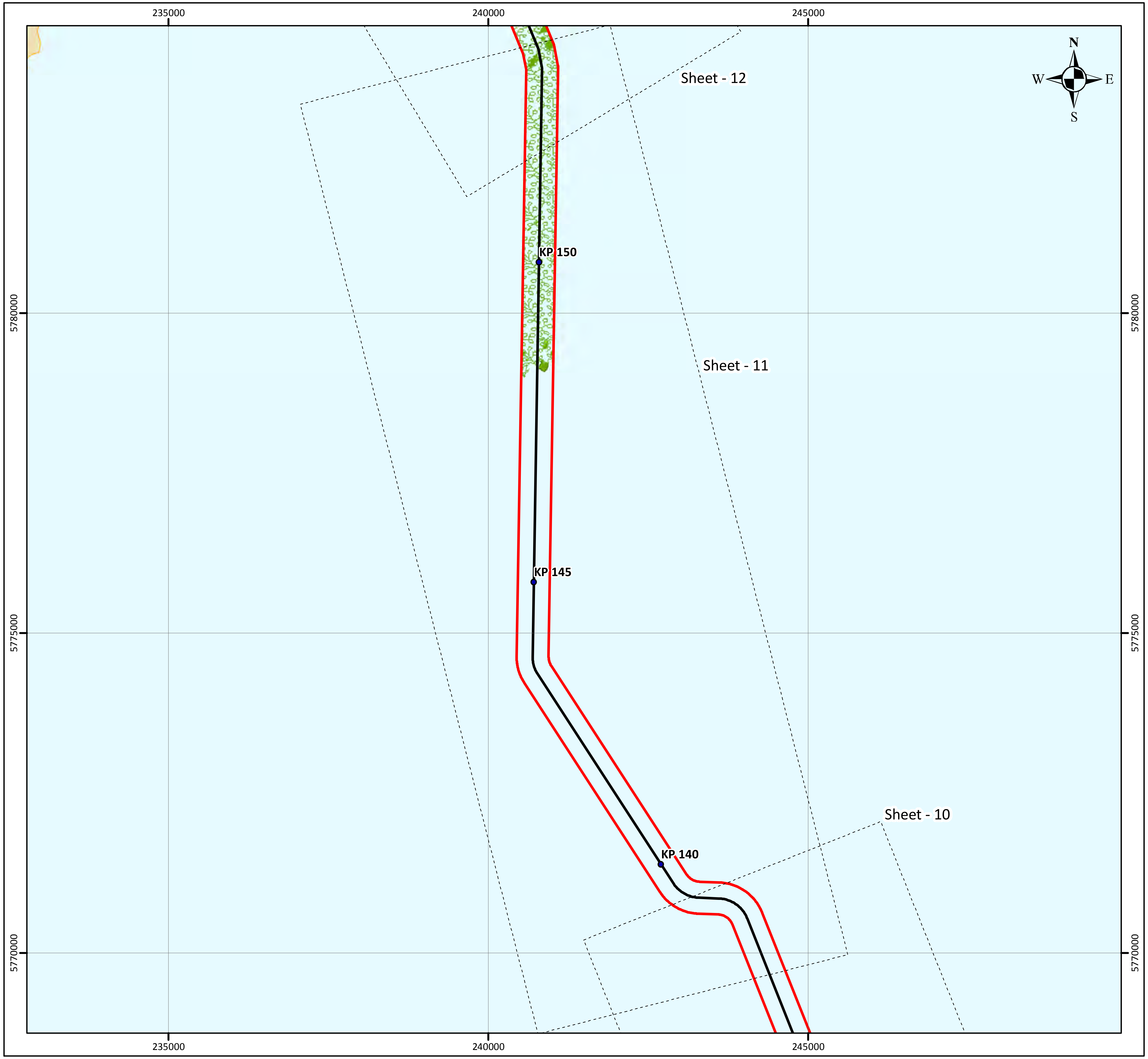
GREENLINK INTERCONNECTOR

ANNEX I HABITATS
Survey Data - Sheet 11

Drawing No: P1975-HAB-004	A

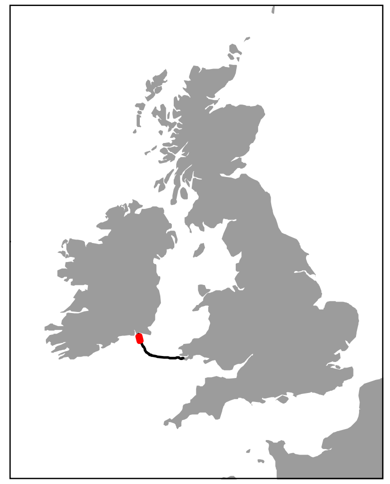


Legend

- Greenlink Route Centreline (Indicative)
- Proposed Development

Annex I Habitat Classification

- Large Shallow Inlets/Bay
- Bedrock Reef



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7.3.5.3 Campile Estuary

Annex I habitats currently listed as qualifying interest features for the River Barrow and River Nore SAC include H1310 Salicornia and other annuals colonizing mud and sand; H1330 Atlantic salt meadow (*Glauco-Puccinellietalia maritimae*); and H1410 Mediterranean salt meadows (*Juncetalia maritimi*).

The upper saltmarsh (CM2) identified in Figure 7-13 is part of the Dunbrody Abbey saltmarsh, one of four Saltmarsh inventory sites found in the River Barrow estuary. The Dunbrody Saltmarsh has been mapped as covering 0.425km^2 (41.465 hectares). Of this area Spartina swards cover approximately 0.01km^2 (1.208 hectares) and other saltmarsh (CM2) covers approximately 0.039 km^2 (3.928 hectares) (NPWS 2011a).

7.3.6 Natural evolution of the baseline

It is expected that in the short-term benthic habitats and communities will be subject to typical natural influences and anthropogenic pressures that will alter their range and composition such as storm events and hydroclimatic variability (DCCAE 2015). Longer term climate change impacts such as the increase in ocean temperatures have the potential to cause species at the southern limit of their range to shift their distribution northwards to remain in cooler waters. An increase in the pH of the seas as a result of climate change could result in a reduction in bivalve species such as horse mussels, with increasing acidity producing an increased metabolic cost for shell formation (Ventura 2018). Some estimates predict that horse mussel beds will have declined significantly by 2050, with complete population loss occurring by 2100 (MCCIP 2050).

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;
- Temperature changes – local;
- Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion (change to seabed features) – intertidal species only; and
- Introduction or spread of non-indigenous species.

The pressures listed in Table 7-4 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 7-4.

Table 7-4 Pressure identification and zone of influence – intertidal, benthic and estuarine ecology

Project Phase	Project Activity	Aspect	Potential Pressure	Receptor	Zone of Influence
Installation	Campile Estuary	Campile Estuary HDD underneath the riverbed	Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Estuarine species and habitats	No effect
Installation	Cable burial	Pre lay grapnel run Cable trenching (ploughing and jet trenching)		Subtidal species and habitats	15m
Operation	Cable repair and maintenance				
Decommissioning	Cable removal				
Installation	Cable burial	Cable trenching (ploughing and jet trenching)	Siltation rate changes, including smothering (depth of vertical sediment overburden)	Subtidal species and habitats	40m*
		External cable protection			
Installation	HDD exit points	External cable protection	Physical change (to another seabed type)	Subtidal species and habitats	208m²
	Irish Offshore third-party asset crossings				4 discrete locations in Irish Offshore each covering 1009m². Overall 4036m²
Operation	Operation of cables	Emission of EMF	Electromagnetic changes	Estuarine species	Distance at which EMF attenuates to background levels 12m at HDD exit point for unbundled cables 2m for remainder of route where cables are bundled
				Subtidal species	
* Discussed in Section 7.6.3					

7.5 *Embedded Mitigation*

The project description, Chapter 4, provides the design. This includes mitigation measures which form part of the design and are therefore an inherent part of the Proposed Development and Campile Estuary and comprise embedded or primary mitigation. The embedded mitigation relevant to intertidal, benthic and estuarine ecology is provided in Table 7-5 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 7-5 Embedded mitigation

ID	Embedded mitigation
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. intertidal reef habitat) 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 which reduces the seabed footprint of installation activities and the electromagnetic field generated during operation, thus minimising any potential compass deviation effects.
EM17	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed.

7.6 Significance Assessment

7.6.1 Summary of assessment

Table 7-6 presents the summary of the impact assessment conducted on the Proposed Development and Campile Estuary. Sections 7.6.2 to 7.6.5 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 potential for residual effects this is discussed further in Section 7.8.

Table 7-6 Impact assessment summary – intertidal, benthic and estuarine ecology

Determination of potential effect						Impact assessment			Consideration of mitigation	Residual effect assessment		
Section	Project Phase	Aspect	Embedded mitigation	Potential Pressure	Receptor	Magnitude	Sensitivity	Significance	Project Specific Mitigation	Magnitude	Sensitivity	Significance of Residual Effect
7.6.2	Campile Estuary (Installation)	HDD under the riverbed	-	Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Estuarine species	-	-	No effect	-	-	-	-
	Installation Operation (Repair & Maintenance) Decommissioning	Pre lay grapnel run. Cable trenching (ploughing and jet trenching) Cable removal	EM13, EM14, EM15, EM17		Habitats A5.24, A5.242, A5.25, A5.251, A5.252, A5.44	Low	Low	Slight	-	-	-	-
					Annex I reef habitat (A3.11)	Medium	High	Significant	PS2, PS3	-	-	No effect
					A5.272, A5.14	Low	Medium	Slight	-	-	-	-
7.6.3	Installation Operation (Repair & Maintenance) Decommissioning	Pre lay grapnel run. Cable trenching (ploughing and jet trenching) Cable removal	EM14, EM15, EM17	Siltation rate changes, including smothering (depth of vertical sediment overburden)	Subtidal species and habitats	Negligible	Low	Imperceptible	-	-	-	-
7.6.4	Installation	External cable protection	EM15	Permanent change (to another seabed type)	Subtidal habitats	Low	Medium	Slight	PS4	Low	Medium	Slight
7.6.5	Operation	Emission of EMF	-	Electromagnetic changes	Estuarine species	-	-	No effect	-	-	-	-
			EM15		Benthic species	Low	Low	Slight	-	-	-	-

7.6.2 Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion (change to seabed features)

7.6.2.1 Installation

Intertidal species and habitats

The design being assessed includes no intrusive works within the intertidal area i.e. between MHWS and LWM; embedded mitigation EM16. Therefore, there will be **No Effect** on intertidal species or habitats.

Subtidal species and habitats

The seabed within the direct zone of influence of the installation (15m – equivalent to the widest footprint of a cable trenching machine) will be temporarily disturbed by seabed preparation and cable laying operations e.g. pre-lay grapnel run, jet-trenching or plough trenching. The cable trench within this footprint will be 1m. Habitats and species within the zone of influence will either be smothered by temporarily displaced sediments (i.e. before sediment is returned to the trench),or compacted by the installation machines.

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 or cable installation machinery. This is more likely to affect 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.

Most habitats in the Proposed Development comprise of sandy habitats with an infaunal community. Using information provided on the Marine Life Information Network (MarLIN), Table 7-7 presents an assessment of the sensitivity of habitats to the pressure.

Table 7-7 Sensitivity of habitats to the pressure 'Penetration and/or disturbance of the substrate below the seabed'

EUNIS habitat code	Resistance	Resilience	Sensitivity	Confidence *			
				Q	A	C	Overall
A3.11 - Kelp with cushion fauna and/or foliose red seaweeds	Low	Medium	Medium	H	H	H	High
A5.14 Circalittoral coarse sediment	Medium	Medium	Medium	L	L	L	Low
A5.24 - Infralittoral muddy sand	Medium	High	Low	M	M	M	Medium
A5.242 - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	Medium	High	Low	H	H	M	High - medium

EUNIS habitat code	Resistance	Resilience	Sensitivity	Confidence *			
				Q	A	C	Overall
A5.25 - Circalittoral fine sand	Medium	High	Low	H	H	M	High - medium
A5.251 - Echinocyamus pusillus, Ophelia borealis and Abra prismatica in circalittoral fine sand	Medium	High	Low	H	H	M	High - medium
A5.252 - *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	Medium	High	Low	H	H	M	High - medium
A5.272 - *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand	Low	Medium	Medium	H	M	M	Medium - high
A5.44 - Circalittoral mixed sediments	Low	Low	High	H	H	M	High - medium
Notes * specific to sensitivity Italics & grey = Assessment based on sublevel habitat assessments Q = Quality of Evidence; A = Applicability of Evidence; C = Degree of concordance (agreement between studies); L = Low; M = Medium; H = High							

The discussion below has been split into two sections; assessment of the effects on subtidal habitats (including Annex I habitat 'Large shallow inlets and bays') ; and an assessment of effects on Habitat A3.11 (including Annex I 'Bedrock reef'). The Annex I habitat 'Large shallow inlets and bays' are habitat complexes which comprise an interdependent mosaic of subtidal and intertidal habitats. Therefore, the assessment undertaken on subtidal habitats is directly applicable to this habitat type.

Subtidal habitats (including Annex I habitat 'Large shallow inlets and bays')

Table 7-7 identifies that the majority of habitats present within the Proposed Development and Irish Offshore have been classified as having low to medium sensitivity to the pressure; with the exception of 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 within the Hook Head SAC between KP156 and KP158. It was sampled by one grab sample (S01). The grab sample consisted mainly of sand (60%) and was classified as gravelly muddy sand. The infaunal analysis showed a small sample with regards to abundance and diversity which was primarily characterised by crustaceans and polychaetes.

The species identified in the grab included the polychaetes *Sclerocheilus*, *Scolelepis korsuni*, *Parexogone hebes*, *Magelona johnstoni*, and *Heteroclymene robusta*; and the echinoderm *Echinocyamus pusillus*. The low abundance and diversity from the grab, suggests that the sensitivity category of high is over conservative for the habitat identified. Given the species identified, which are not as sensitive to abrasion as *Modiolus modiolus* and *Cerianthus lloydii*, and the low abundance and diversity confirmed by the grab sample, the sensitivity has been assessed as low in the EIA.

The sandy habitats identified in the Proposed Development are 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 and gastropods are likely to take longer than polychaetes to re-colonise areas but even considering this it is unlikely to exceed months (MarLIN 2016).

The zone of influence of the installation (15m wide) represents a very small area when compared to the area encompassed by the Proposed Development and the extent of habitats in the wider region. Embedded mitigation, EM15 supports this by ensuring that the cables share a trench, reducing the seabed footprint of installation. The temporary disturbance 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. Habitats will be disturbed twice by two separate activities; cable route clearance and cable installation. The latter activity, cable installation will be the more significant of the two and will be a one-off event that will not be repeated. Taking this into consideration, the magnitude of the effect has been assessed as low for all habitats.

The overall significance of the effect on all subtidal habitats identified with the Proposed Development and Irish Offshore has been assessed as **Slight** and is **Not Significant**.

Habitat A3.11 (including Annex I Bedrock Reef)

Areas defined as EUNIS habitat A3.11 have also been classified as ‘Annex I Bedrock Reef’. The extent of EUNIS habitat A3.11 and therefore Annex I Reef habitat within the Proposed Development has been calculated as 5.33km^2; of which 4.16km^2 is within the Hook Head SAC.

MarLIN does not provide a sensitivity assessment specifically for habitat ‘A3.11 - Kelp with cushion fauna and/or foliose red seaweeds’ for the pressure penetration and/or disturbance. The assessment presented in Table 7-6 is based on habitat ‘A3.113 - *Laminaria hyperborea* forest with a faunal cushion (sponges and polyclinids) and foliose red seaweeds on very exposed infralittoral rock’ and the pressure abrasion. The supporting evidence for the assessment, based on studies following commercial *Laminaria hyperborea* trawling, suggests that beds of mature *Laminaria hyperborea* can regenerate from disturbance within a period of 1-6 years and the associated community within 7-10 years (Stamp and Hiscock 2015). As a *Laminaria* dominated community is a qualifying feature of the Hook Head SAC, this assessment is thought to be appropriate for the habitat A3.11 found within the Proposed Development.

Bedrock reef is a qualifying feature of the Hook Head 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 medium to high in recognition that the habitat is a key contributor to the overall biodiversity of the SAC.

The conservation objectives for the site state that "*Those communities that are key contributors to overall biodiversity at a site by virtue of their structure and/or function (keystone communities) should be afforded the highest degree of protection and any significant anthropogenic disturbance should be avoided*" (NPWS 2011b).

The presence and location of the Annex I habitat offshore was taken into consideration during the design (routeing) of the Proposed Development. INFOMAR bathymetry data and NPWS habitat maps were used to identify a suitable cable route through the Hook Head SAC that avoids crossing the Annex I habitat (embedded mitigation EM14). Route engineering was undertaken during the marine survey to investigate options to further avoid outcropping rock features. This has led to the selection of the final route, shown as the indicative centreline within the Proposed Development. The design being assessed is therefore an installation corridor that avoids crossing the Annex I bedrock reef habitat offshore. The channel between the mapped Annex I habitat features is sufficiently wide to allow installation within the sandy sediments.

Bedrock reef has also been identified in the nearshore area; extending out from the intertidal zone. The intention is to HDD under the beach to an exit point in the nearshore area. During the EIA process consideration was given to whether it would be feasible for the HDD to exit within this fringing Bedrock Reef (which reduces the length of the HDD).

GIL have consulted with NPWS throughout the design of the Proposed Development regarding routeing a cable through the Hook Head SAC. NPWS have been clear from the start that the use of external cable protection on Qualifying Interest Reef habitat has the potential to have a likely significant effect on the habitat. Although there is scope that external cable protection will be colonised by a similar reef habitat, potentially reducing the significance of the effect, other factors were taken into consideration when considering the environmental implications of the HDD exit points. These included:

- Cable trenching in outcropping rock would require cutting, which would have a narrow (1m wide) but permanent effect on the habitat. The magnitude of the effect was assessed as medium, which combined with the high sensitivity classification for the habitat (as discussed above) results in an effect that is **Significant.**
- In order to protect the cables in a rock cut trench, external cable protection would be required. A rock berm just below the low water mark on the fringing reef would modify wave patterns, which in turn will affect sediment transport along the beach.
- There would be a local scour concern with respect to the feature (current and wave driven).
- A rock berm would have a significant visual effect on the landscape values of the beach. As a popular public beach, with historic connections, a negative change in the recreational value of the beach would be considered significant.

The EIA process concluded that the significance of the effects on the habitat were likely to be Significant and that there was potential for significant effects on other receptors that an engineering alternative should be investigated. It was therefore recommended that trenching across the fringing Bedrock Reef should be excluded from the project description.

The design taken forward in the project description is that cable trenching will not be undertaken on any of the Bedrock reef habitat within the Proposed Development. This removes the pressure-receptor pathway and there will be **No Effect** on the habitat.

Project Specific Mitigation, presented in Section 7.7, has been proposed to ensure it is clear that this EIAR commits to no intrusive works on Annex I Bedrock Reef Habitat.

This potential effect is also discussed within the Greenlink Natura Impact Statement (NIS). The NIS concluded that the Proposed Development will not adversely affect the integrity of the Hook Head SAC either alone or in combination with other plans and projects.

Estuarine species and habitats

The works associated with drilling the boreholes under the Campile Estuary will be set-back above MHWS. The boreholes will be >10m below the riverbed. Therefore, there will be **No Effect** on estuarine species or habitats.

The compound for the HDD site will be located in common agricultural habitats of low ecological value. The effect on this habitat has been assessed in the Irish Onshore EIAR which concluded no significant effect.

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 a smaller magnitude when compared to cable installation. The assessment considered five discrete cable repairs during operation and concluded that the significance of the effect remains:

- **No effect** on estuarine habitats;
- **Slight** and is **Not Significant** for all subtidal habitats; and
- **Significant** for Annex I Bedrock Reef habitat.

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

- **No Effect** on estuarine habitats;
- **Slight** and is **Not Significant** for all subtidal habitats; and
- **Significant** for Annex I Bedrock Reef habitat.

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. Jet trenching will cause a greater level of sediment suspension compared to the use of ploughing equipment.

The extent of suspension, dispersion and re-deposition is to a large extent a function of the type of sediment being disturbed as follows:

- Sand and gravel disturbed during the cable burial operations will settle back to the seabed very rapidly and the footprint is unlikely to extend any great distance from the cable route.
- Silts, clay and chalk particles will remain in suspension for a greater period of time 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 small.

Chapter 6 concluded that gravel will settle out of suspension rapidly (14 seconds), within 2m of the trench. Sand will settle out in 2 minutes within 19m of the trench but silt particles will be carried by currents up to 5.3km before settling out of suspension. Sand will form a thin layer on average 16mm thick over the 19m distance. However, as the silt particles are finer and travel further distances before settling the average thickness of deposition form the silt fraction will be less than 1mm thick. The zone of influence has therefore been based on the sand fraction and estimated as 40m wide, centred on the trench, to take account of tidal oscillation.

Dilution calculations indicate that the average suspended sediment concentration will reach 300mg/l within 100m of the trench; but will rapidly dissipate with distance and time.

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 brittle stars 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.

The magnitude of the effect will depend on the percentage of silt fraction and background levels (OSPAR 2012), whilst the sensitivity of receptors depends on a number of factors including the ambient levels of suspended particulate matter (SPM) and the degree of variation throughout the year. If the natural levels of SPM and the seasonal variation are high, then the significance of the effect is likely to be less (BERR 2008).

Chapter 6 provides available measurements of SPM for the Co.Wexford coastline as ranging between 5mg/l to 19mg/l. The Co.Wexford coastline experiences seasonal fluctuations in turbidity, related to storm conditions. This is evident from photographs taken during the benthic survey (October 2018) showing high suspended sediment loads in the water column; potentially greater than 100mg/l and up to 1000mg/l, although this was not measured and is based on comparison of the image with samples showing known concentrations of SPM.

The subtidal habitats identified within the Proposed Development are widely occurring and general sensitivity to smothering is low (MarLIN 2019). With respect to the Annex I Bedrock reef habitat, MarLIN (2019) classified a similar habitat (A3.113) as not sensitive and highly resilient to light changes in SPM concentrations. Subtidal habitats within the area experience these conditions annually as evident from the cable route survey photographs suggesting that an increase in SPM and subsequent deposition is unlikely to significantly effect habitats.

Increases in SPM concentrations will be brief (restricted to the immediate period when cable burial is taking place) and localised. Increases in SPM associated with the cable route clearance will be of a lower magnitude than those associated with cable burial. They will also be separated temporally. A brief change in water clarity, with associated deposition of suspended sediments will be experienced, but it is predicted that the change will be within the normal environmental variation experienced after storm conditions.

Based on the discussion above the magnitude of the effect has been assessed as negligible. No activities within the Proposed Development will culminate in a manner that causes the magnitude of the effect to increase. The sensitivity of subtidal habitats, including Annex I Bedrock reef has been assessed as low. The overall significance of the effect has been assessed as **Imperceptible** and is **Not Significant**.

The potential effect of this pressure on the Hook Head SAC has also been assessed within the Greenlink Marine NIS. The NIS 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)

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 the significance of the effect remains **Imperceptible** 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 as **Imperceptible** and is **Not Significant**.

7.6.4 Physical change (to another seabed type) – subtidal

7.6.4.1 Installation

The design being assessed is that as a contingency a very small quantity of external cable protection (20m x 5.2m by 0.7m high) will be used at both HDD exit points to protect the cables before they can be bundled together and trenched. The HDD exits points lie in the habitat A5.23 Infralittoral fine sand. External cable protection would consist of rock in the size range 2-22cm, which would represent a significant coarsening of the sediment, and a localised change in seabed type.

A Qualifying Interest of the Hook Head SAC is the habitat large shallow inlets and bays. The sand substrate between 3m and 15m water depth is part of the feature. The Natura 2000 form for the site (NATURA 2000 2018) records that the Qualifying Interest covers an area of 52.44km^2 (5243.8404 hectares). The footprint of the external cable protection within this habitat will cover 208m^2; equivalent to 0.0004% of the Qualifying Interest. This is a negligible reduction which will not adversely affect the conservation targets for the Qualifying Interest. This conclusion is supported by NPWS (2011) that "licensing of activities likely to cause continuous disturbance of each community type should not exceed an approximate area of 15%.".

External cable protection will also be used at crossing locations in the Irish Offshore. Where external cable protection is used the seabed habitat within the footprint of the berm will be lost and replaced with potentially harder substrate, changing the seabed type.

Within the Irish Offshore four third-party asset crossings are required with an estimated seabed footprint of 0.004km^2 (Section 4.7.4, Table 4-5). This footprint has been reduced through the implementation of embedded mitigation EM15, whereby the Greenlink cables will be bundled together.

The crossing locations lie outside of any protected sites. Table 4-5 identifies the crossings are located in the following EUNIS habitats:

- A5.272 - *Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand: ESAT 1 crossing
- A5.242 - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand: SOLAS crossing; and
- A5.252 - *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand: Pan European Crossing 1 and Hibernia Seg D crossing.

The MarLIN sensitivity assessment concludes that for all three habitats the sensitivity to the pressure 'physical change (to another seabed type)' is high. This is based on the fact that *"The biotope is characterised by the sedimentary habitat (JNCC 2015), so a change to an artificial or rock substratum would alter the character of the biotope leading to reclassification and the loss of the sedimentary community including the characterizing bivalves, polychaetes and echinoderms that live buried within the sediment"* (Tillin 2016).

The EUSeaMap (EMODNet 2019) indicates that the habitats identified by the cable crossing survey are common within the Irish Sea and cover large areas of seabed. The sensitivity of the habitats has therefore been reduced to medium in the EIA as the habitats are not internationally, nationally or locally important and are not within a protected site.

Material used for rock berms is typically coarse gravel to cobbles. Therefore, external protection will result in a localised site-specific coarsening of sediments.

Post-construction monitoring of offshore windfarms has provided useful insight into the effects of a habitat change from sandy sediments to hard substrate. 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 areas 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. 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 (Pidduck et al 2017).

The colonisation of the hard substrate will be dependent on the passive transport of adult organisms or the availability of larvae from the surrounding region. However, in the examples provided above, the rock was introduced into areas of soft substrate and colonisation of the rock protection material has occurred. It can therefore be assumed that the external cable protection at the crossing locations will inevitably support the settlement of non-local hard bottom fauna that may not be representative of the surrounding benthos. Evidence suggests that effects on the local fauna in soft sediment areas will in most cases be very localised but long-term.

The external cable protection at the two HDD exit points, if required, will be within close proximity to existing Reef habitat; Reef is a maximum of 300m away from any potential HDD exit points. Colonisation of the external cable protection in these areas is more certain. This is supported by the cable route survey which shows the areas of bedrock separated from the main reef e.g. within the sediment channel, also support reef community.

The reef habitat in the area is classed as EUNIS habitat A3.11 – Kelp with cushion fauna and/or foliose red seaweeds. A study looking into the colonization of a newly created rocky shore in the Moray Firth found that limpets and barnacles were observed after 3-4 years (MarLIN 2019). A study by Hawkins & Southward (1992) (referenced in MarLIN 2019) found that, after the Torrey Canyon oil spill, it took between 10 and 15 years for the Fucus sp. to return to 'normal' levels of spatial and variation in cover on moderately exposed shores. This suggests colonisation would occur in the medium-term.

The external cable protection deposits could be viewed as 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 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.

Whilst the use of external cable protection will lead to a slight reduction in the area of sand habitat it will also lead to a slight increase in reef habitat; with a potentially higher diversity of species.

Taking the above discussion into consideration, the magnitude of the effect has been assessed as low, given the small, localised zone of influence of the pressure in the context of the available habitat within the region.

The overall significance of the effect has been assessed as **Slight** and is **Not Significant**.

This potential effect has also been assessed within the Greenlink Marine NIS. Stage 1 Screening concluded a potential for significant effects on the Hook Head SAC and that Appropriate Assessment was required. The NIS concluded that the Proposed Development will not adversely affect the integrity of the Hook Head SAC either alone or in combination with other plans and projects.

As the HDD exit points lie within a Qualifying Interest habitat of the Hook Head SAC Project Specific Mitigation has been proposed in Section 7.8.

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 the significance of the effect remains **Slight** and is **Not Significant**.

7.6.5 Electromagnetic changes

7.6.5.1 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 bundled 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.

For a short distance in water depths of between 9m and 15m the cables will not be bundled as they exit the HDD point. In this area the iE fields will be slightly higher, up to 128.7µV/m at the seabed reducing to 63.7µV/m at 10m from the cable and natural background levels at 12m.

Estuarine species

The cables will be buried 10m below the river bed in HDD boreholes. As there will be no detectable change to background geomagnetic fields noticeable at distances greater than 2m from the cable, there is no pathway for an effect on estuarine species. The assessment concluded there will be **No Effect** on estuarine species.

Subtidal species

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 where cables are bundled, and within 12m where unbundled cables exit the HDD ducts.

Potential effects will largely be negated by cable bundling and 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 **Slight** and is **Not Significant.**

7.7 Project Specific Mitigation

In addition to the embedded mitigation outlined in Table 7-5, Table 7-8 presents measures that GIL is committed to adopting.

Table 7-8 Project specific mitigation – intertidal, benthic and estuarine ecology

ID	Project Specific Mitigation
PS2	Exclusion zones have been established around Annex I bedrock reef features; shown on Figure 7-18, Drawing P1975-INST-008). No intrusive works (e.g. cable installation, deposit of external cable protection material) will be undertaken within these exclusion zones.
PS3	There will be no intrusive works undertaken on Baginbun Beach between mean high water springs and the low water mark.
PS4	If the contingency external cable protection is used at the two HDD exits, then an environmental monitoring plan will be established to monitor colonisation of the external cable protection. The monitoring programme will be developed in consultation with NPWS. It is proposed that this be conducted using drop-down video transects. A control transect should be established on the adjacent Annex I reef to establish a baseline for community diversity. The length of the external cable protection will also be surveyed. 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 confirm (or otherwise) the conclusion that the deposition of the external protection material adds to the Reef habitat within the Hook head SAC.

7.8 Residual Effect

The assessment presented in Section 7.6 identified that one potential pressure could have a significant effect. The significance of the effect was therefore re-assessed taking into consideration the Project Specific Mitigation outlined in Section 7.7 to determine if a residual effect remains.

7.8.1 Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion

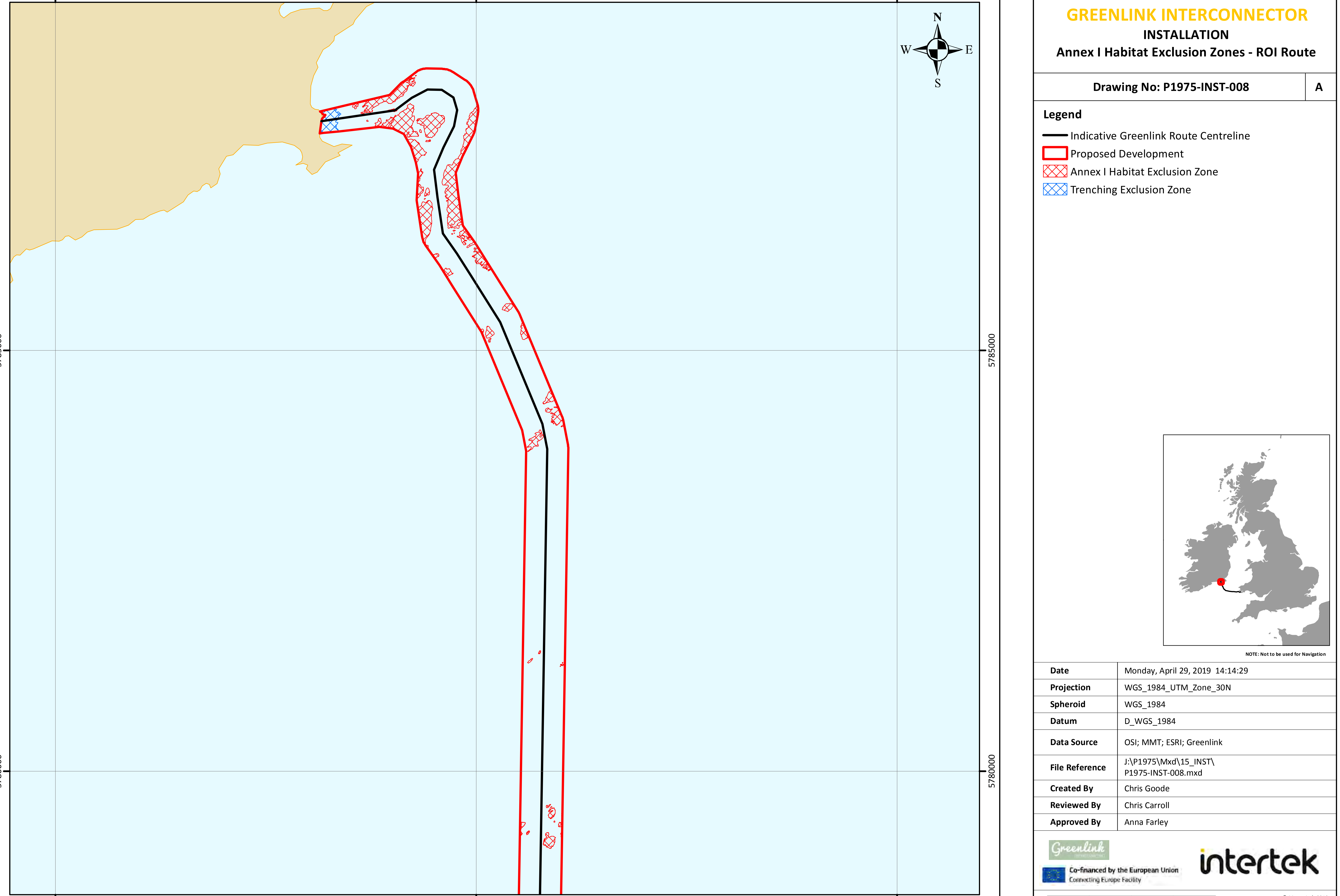
The assessment identified that Annex I Bedrock Reef (habitat A3.11) is highly sensitive to the pressure penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion. Activities that involve intrusive seabed works have been assessed as having a Significant effect on the habitat. The Proposed Development has been optimised to avoid the majority of the Annex I

Bedrock Reef habitat, by following a sand channel and prescribing an HDD exit points that exit within a sediment unit avoiding the Annex I Bedrock Reef in the nearshore area. Project Specific Mitigation in the form of exclusion zones (PS2) have been established around the habitat within the Proposed Development. GIL will ensure that the Installation Contractor adheres to these exclusions by ensuring the HDD exit points and final cable trench avoids the habitat. Implementation of the exclusion zones will result in the pressure pathway to the habitat being removed and the subsequent residual effect has been assessed as **No effect**.

7.8.2 Physical change (to another seabed type)

The EIA concluded that the pressure will not have a significant effect on the habitats present in the Proposed Development. However, as there is a contingency to use a small quantity of external cable protection at the HDD exit points, within the Hook Head SAC, Project Specific Mitigation PS3 has been proposed. PS3 seeks to reduce the footprint of the effect by requiring the Installation Contractor to seek alternative means of achieving the required depth of burial before the use of external cable protection. However, as it is not known whether alternatives will be available, the residual effect remains **Slight** and is **Not Significant**.

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 (PS4). 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 Hook Head SAC. Validating the conclusions of the Greenlink Marine NIS will support the decision making for future applications.



Contains Ordnance Survey Ireland data © OSi 2014

GREENLINK INTERCONNECTOR

INSTALLATION

Annex I Habitat Exclusion Zones - ROI Route

Drawing No: P1975-INST-008	A

Legend

- Indicative Greenlink Route Centreline
- Proposed Development
- Annex I Habitat Exclusion Zone
- Trenching Exclusion Zone

Date	Monday, April 29, 2019 14:14:29
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	OSI; MMT; ESRI; Greenlink
File Reference	J:\P1975\Mxd\15_INST\ P1975-INST-008.mxd
Created By	Chris Goode
Reviewed By	Chris Carroll
Approved By	Anna Farley

Greenlink

Co-financed by the European Union
Connecting Europe Facility

intertek

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8. Fish and Shellfish

This Chapter describes the existing baseline environment for fish and shellfish, 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 refers to the Irish Marine components of Greenlink from mean high-water springs (MHWS) at the Irish landfall at Baginbun Beach, Co. Wexford to the 12nm limit. 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, remediation and maintenance activities); and
- Decommissioning.

This chapter also provides information on the Irish Offshore components of Greenlink from the 12nm limit to the Republic of Ireland/UK median line.

8.1 Data Sources

Baseline conditions have been established by undertaking a desktop review of published information and through consultation with relevant bodies. The data sources used to inform the baseline description and assessment include but are not limited to the following:

- Marine survey reports (MMT 2019);
- Fisheries Ecosystems Advisory Services (FEAS) (Marine Institute 2018);
- Cefas Sensitivity Maps (Coull et al. 1998, Ellis et al. 2012);
- Offshore Energy Strategic Environmental Assessment 3 (DECC 2016);
- Technical Appendix C - Noise Assessment;
- Technical Appendix D – Herring Spawning and Sandeel Assessment; and
- Other data sources are referenced in the text and listed at the end of the Chapter.

8.2 Consultation

Table 8-1 summarises the relevant consultation responses on fish and shellfish. The steps taken to contact stakeholders for comments on the EIA scope is documented in Chapter 5.

Table 8-1 Consultation responses – fish and shellfish

Stakeholder	Summary of Consultation Response	How response has been addressed
Irish Fisheries	Noted that Sprat and Herring are major fisheries in the Estuary	An assessment of impacts to herring has been conducted and can be seen in Technical Appendix D. In addition, this is discussed in section 8.6.1
NPWS	Noted that a Sprat and juvenile Herring run usually occurs in January, with associated cetacean activity (Fin and Humpback Whale)	Please see Section 8.2.3

8.3 Existing Baseline

8.3.1 General Overview

Ireland's Marine Atlas provides information on fish assemblages along the Irish coast in the Irish and Celtic Sea. The variable seabed conditions across the south-eastern coast of Ireland supports a wide variety of fish species with distinct assemblages associated with particular seabed conditions.

8.3.2 Spawning and nursery grounds

Fisheries sensitivity maps (Coull et al. 1998, Ellis et al. 2012) provide information on spawning (the location where eggs are laid) and nursery areas (the location where juveniles are common) for fish-stocks in the region. Ellis et al. (2012) has identified data gaps in understanding the extent of spawning and nursery grounds in the Irish and Celtic Sea and acknowledges that further work may be required in this region to provide a similar understanding comparable to the North Sea (Ellis et al. 2012).

Data available for the region indicates that the Proposed Development and Irish Offshore passes within, or close to the spawning grounds for seven commercially important fish species (see Table 8-2 sub-heading spawning period; Figure 8-1 Drawing P1975-FISH-003; Figure 8-2 Drawing P1975-FISH-004). The waters of the area also act as a nursery for ten commercially important fish species (see Table 8-2 sub-heading nursery period; Figure 8-1 Drawing P1975-FISH-003; Figure 8-2 Drawing P1975-FISH-004).

Table 8-2 Summary of spawning and nursery periods for the main commercial species

Species	Spawning period	Nursery period	Spawning aquatic zone
Atlantic Cod (*Gadus morhua*)	January – April FEAS*	January – June FEAS*	Demersal
Mackerel (*Scomber scrombrus*)	-	February – August FEAS*	Pelagic
Lemon Sole (*Microstomus kitt*)	April to September	April- November	Demersal
Nephrops	Gravid females and juveniles can be found all year round		
Whiting (*Merlangius merlangus*)	FEAS*	February to August FEAS*	Demersal
Plaice	January – March (peak spawning January and February)	-	Demersal
Sprat (*Sprattus sprattus*)	May to August (Peak May to June)	-	Pelagic
Herring (*Clupea harengus*)	Offshore - January – April Coastal September - February	-	Demersal
Anglerfish (*Lophius piscatorius*)	-	January - August	Demersal
Blue Whiting (*Micromesistius poutassou*)	-	April to August	Pelagic
Ling (*Molva molva*)	-	February - July	Pelagic
European hake (*Merluccius merluccius*)	-	January - August FEAS*	Demersal
Sandeels (*Ammodytidae*)	-	November to April	Demersal

Source: Coull et al. (1998), Ellis et al. (2012) and Marine Institute 2018. * Indicated as an area of spawning and nursery grounds by Fisheries Ecosystems Advisory Services (FEAS) (Marine Institute 2018).

The spawning and nursery areas through which the Proposed Development and Irish Offshore passes are widespread, covering a large area of the Celtic Sea and Irish Sea (see Figure 8-1 Drawing P1975-FISH-003 and Figure 8-2 Drawing P1975-FISH-004). Some species spawn within the water column and have extensive spawning grounds. Tidal currents carry pelagic spawned, fertilised eggs and tiny juvenile fish species (both pelagic and demersal) within the plankton to nursery areas. Some species deposit their eggs in a certain habitat type and therefore have more restricted spawning areas. Nursery grounds are areas where juvenile fish occur at higher densities, have reduced rates of predation and have faster growth rates than other habitats, which result in nursery grounds providing a greater contribution to adult recruitment (Ellis et al. 2012). Once grown, most fish leave their nursery grounds.

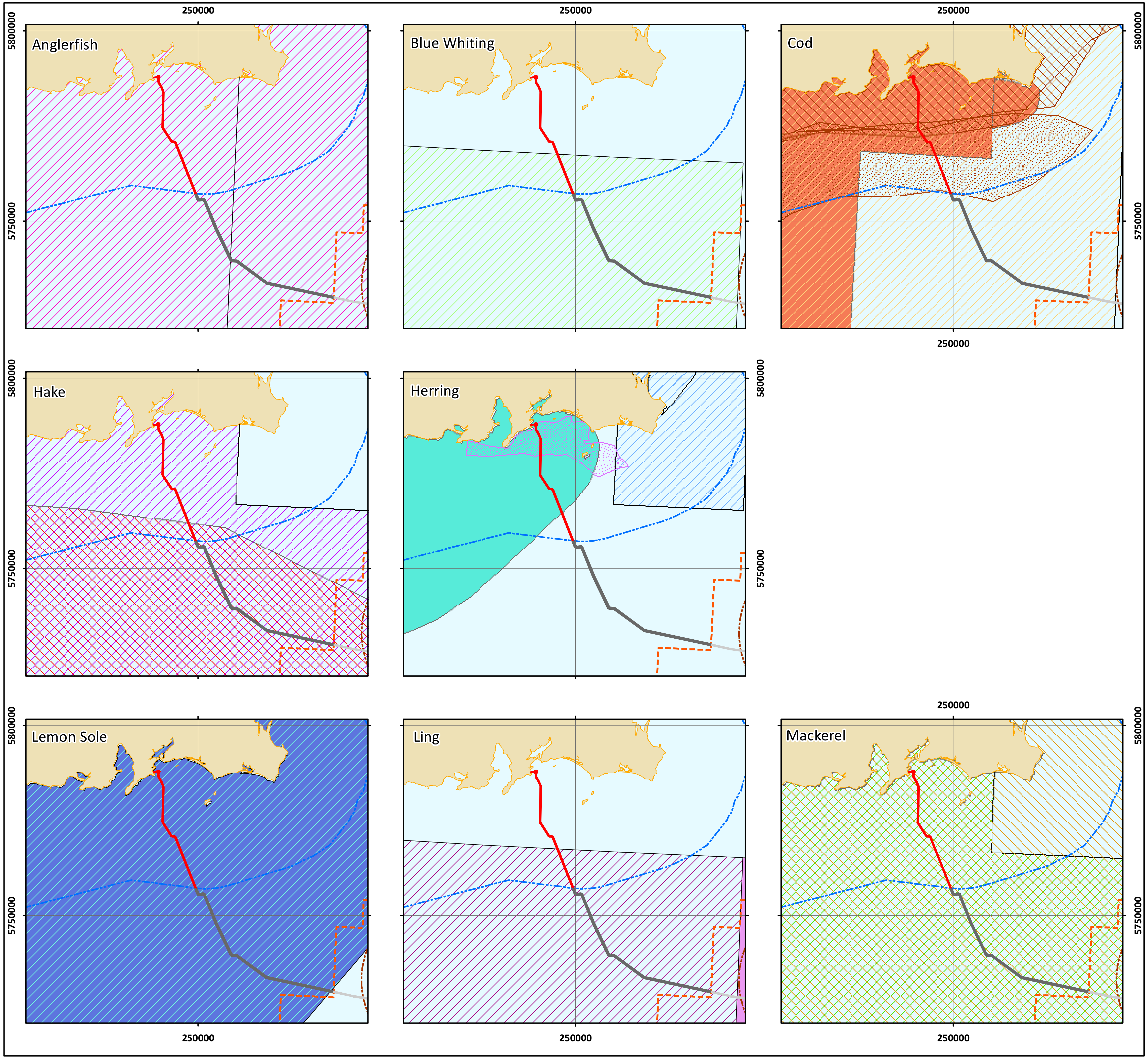
The species most likely to be affected by the Proposed Development are those with demersal (bottom dwelling) life stages, e.g. species which lay their eggs on specific seabed types, such as cod and sole, larval or juvenile ages, or species that live in contact with the seabed e.g. sandeel. Sandeel are of particular importance in the area as they are an important component to food webs.

Some species produce a vast amount of eggs at one time meaning that they have a short population doubling time e.g. sprat which can double their population in less than 15 months (DECC 2009). Therefore, providing an important food source for foraging mobile species. As pelagic spawners, sprat spawning and nursery areas are widely distributed through the Celtic and Irish Seas (Figure 8-2, Drawing P1975-FISH-004).

The wider region has been identified as a high intensity spawning ground for plaice and sprat and low intensity spawning ground for cod, lemon sole and herring and a low intensity nursery ground for cod, mackerel, lemon sole, whiting, anglerfish, blue whiting, ling, European hake and sandeel (Coull et al. 1998 and Ellis et.al. 2012).

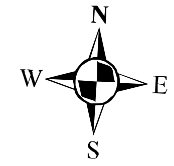
In addition, the National Parks & Wildlife Service (NPWS) has identified that a juvenile herring and sprat run occurs in the area in January. Fin and humpback whale follow this seasonal movement of sprat and herring as they congregate inshore to spawn between Slea Head, Co. Kerry and the Hook Head peninsula, Co. Wexford (Irish Times 2013; Ryan *et al*. 2015).

The overall likelihood of presence of juveniles within the first year of their life in the vicinity of the Proposed Development has been determined to be low for all species except haddock, whiting, European hake and horse mackerel which have been determined to be moderate to low (Aires *et al*. 2014). The likelihood of the presence of juveniles has been defined with reference to the Random Forest probability of presence scale, low probability is defined as 0 ranging to high probability at around 0.99 (maximum score is dependent on species type and ranges from 0.525 for herring to 0.99 for haddock).



GREENLINK INTERCONNECTOR
FISH SPAWNING AND NURSEY AREAS
ROI Waters - Sheet 1 of 2

Drawing No: P1975-FISH-003	A



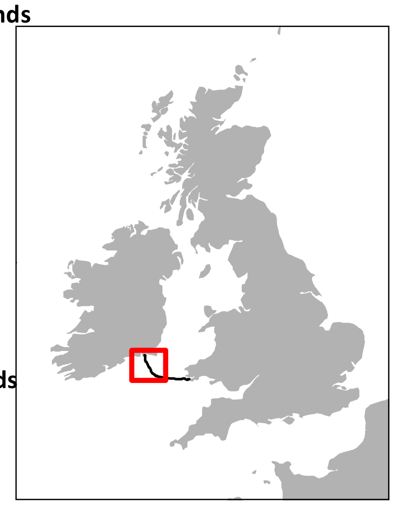
Legend
- Proposed Development
- Irish Offshore
- Wales Marine
- ROI 12nm Territorial Sea Limit
- UK 12nm Territorial Sea Limit
- Median Line

CEFAS Nursery Grounds
- Anglerfish
- Blue Whiting
- Cod
- European Hake
- Herring
- Lemon Sole
- Ling
- Mackerel

CEFAS Spawning Grounds
- Cod
- Herring
- Lemon Sole
- Ling

FEAS Nursery Grounds
- Cod
- Hake
- Mackerel

FEAS Spawning Grounds
- Cod
- Herring



NOTE: Not to be used for Navigation

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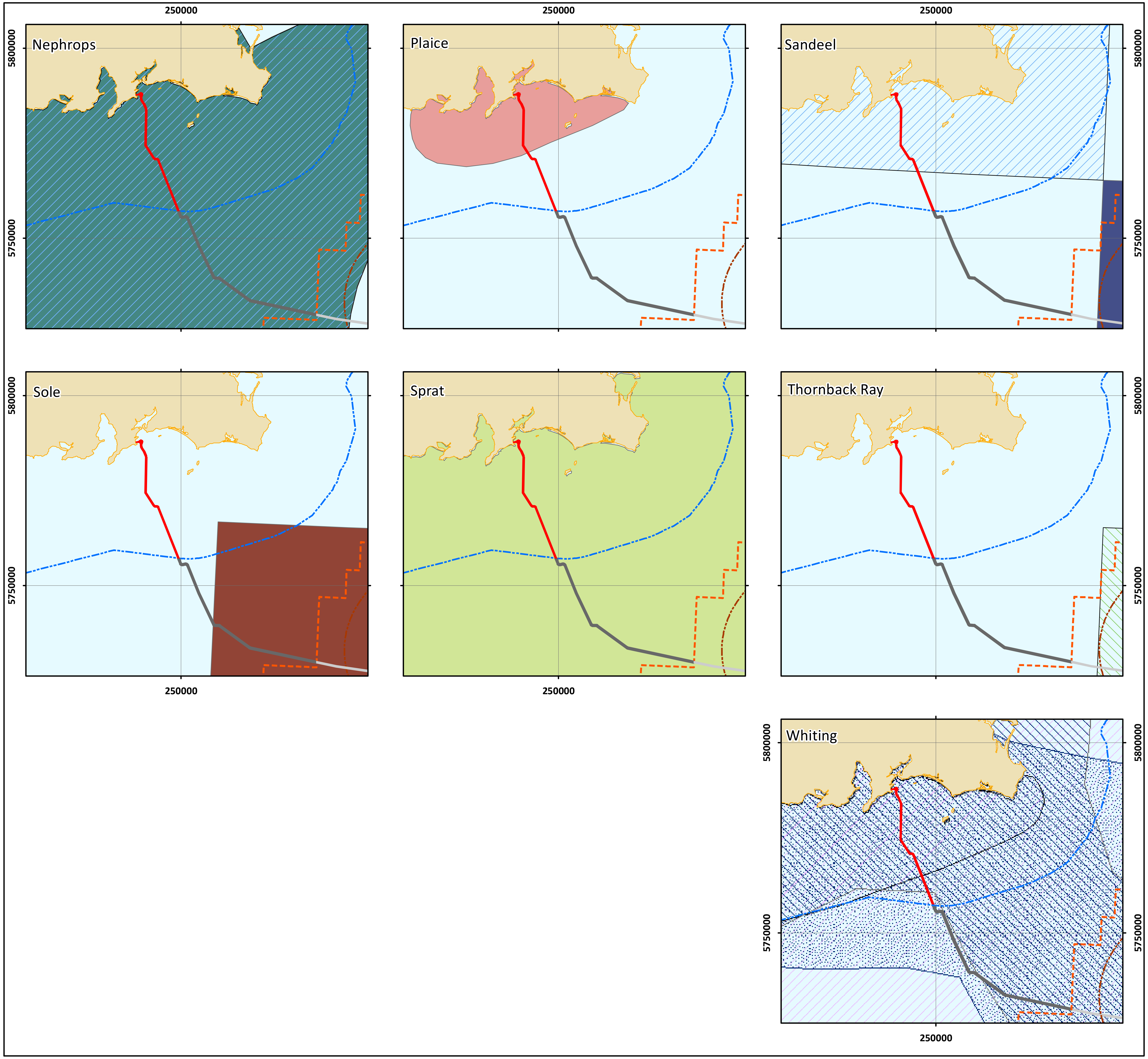
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; GEBCO; CEFAS; FEAS; Greenlink
File Reference	J:\P1975\Mxd\07_FISH\ P1975-FISH-003.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

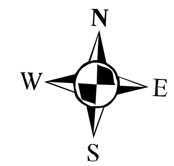
Co-financed by the European Union Connecting Europe Facility

0 10 20 30 40 km



GREENLINK INTERCONNECTOR
FISH SPAWNING AND NURSEY AREAS
ROIWaters - Sheet 2 of 2

Drawing No: P1975-FISH-004 | **A**



Legend

- Proposed Development
- Irish Offshore
- Wales Marine
- ROI 12nm Territorial Sea Limit
- UK 12nm Territorial Sea Limit
- Median Line

CEFAS Nursery Grounds
- Nephrops
- Sandeel
- Thornback Ray
- Whiting

CEFAS Spawning Grounds
- Nephrops
- Plaice
- Sandeel
- Sole
- Sprat

FEAS Nursery Grounds
- Whiting

FEAS Spawning Grounds
- Whiting

Date	Friday, April 5, 2019 15:25:49
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; GEBCO; CEFAS; FEAS; Greenlink
File Reference	J:\P1975\Mxd\07_FISH\ P1975-FISH-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 10 20 30 40 km

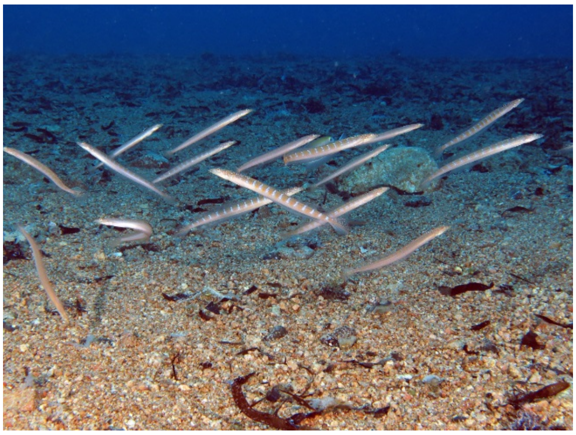
8.3.3 Marine fish

The majority of marine fish known to occur in the Proposed Development and Irish Offshore are demersal and dwell in or near to seabed habitats ranging from muds and sands to gravels and rocky/hard substrates. As described in Chapter 6, all of these physical conditions are reported to be present within the Proposed Development and Irish Offshore (MMT 2019). For the most-part the demersal species are commonly found in waters away from the coast (MarLIN 2016).

Pelagic species occupy the open waters between the coast and the edge of the continental shelf in depths of 20-400m. These areas are highly productive and supply nutrients for the growth of plankton which forms the food for the smaller pelagic species. These populations provide an important source of food for other fish species, marine mammals, seabirds and man. Pelagic fish are highly mobile and migratory, following their food source, and returning to spawning areas. Outside of their spawning period pelagic fish tend to stay away from coastal waters.

Of the demersal species present in the area, sandeel and herring are known to be particularly sensitive to seabed disturbance. This is because they lay their eggs on the sediment and live within close contact with the sediments, these species are discussed in more detail below (ICES 2009; O'Sullivan et al. 2013)

8.3.3.1 Sandeel



Sandeel are known to display strong seasonal and diurnal activity patterns. Sandeel hibernate in generally coarse sand or fine gravel in autumn and winter, whilst in spring and summer they exhibit diurnal movements, burying themselves in the seafloor at night and feeding on plankton in the water column above their burrows during the day (Engelhard et al. 2008). They will therefore be more vulnerable to cabling activities during the autumn and winter.

As key prey species, reductions in sandeel populations can result in low breeding success in seabird colonies and reduction in predatory fish stocks, therefore sandeel are important both commercially and ecologically.

Sandeel are known to nurse along the Proposed Development from November through to April. Juvenile and adult sandeel are largely resident and rarely disperse over distances greater than 30km (RSPB 2017). Studies have found that sandeel do not migrate between fishing grounds, which may suggest that sandeel are not successful re-colonisers (Jensen *et al*. 2011). This limited movement of sandeel between areas is believed to be associated with the patchy distribution of suitable sandeel habitat (RSPB 2017).

Marine Space et al. (2013) categorise seabed sediments into four sandeel sediment preferences groups depending on their sand content. An extensive assessment of potential sandeel habitat has been conducted (see Technical Appendix D for the full assessment). It was concluded from the 'heat' mapping assessment that the Irish Offshore interacts with $1.75km^2$ of potential 'high' 'heat' sandeel habitat. The area in which this habitat is present falls to the east, close to the Irish/UK marine boundary, in the Irish Offshore component of Greenlink, and correlates with the BGS data layers showing the presence of sand and slightly gravelly sand in this area ('preferred' habitat).

8.3.3.2 Herring

Atlantic herring are an important commercial fish in Irish waters. In coastal waters spawning takes place mostly between September and February in high energy environments, usually at the mouth and bays of estuaries where tidal currents are strong. Herring are benthic spawners and like to lay their eggs on gravel and rock (O'Sullivan et al. 2013). The dependency of herring on these specific substrates makes the species potentially susceptible to disturbance.

Figure 8-1 (Drawing P1975-FISH-003) provides the location for spawning grounds close to the Proposed Development and Irish Offshore. The Proposed Development passes through one of the three SW Ireland sub stock population areas. For most of the year the different populations mix, but during the spawning season they migrate to their separate spawning areas. In addition, the Proposed Development crosses coastal herring spawning sites, referred to as the Dunmore East herring spawning grounds (O'Sullivan et al. 2013).

Herring have a specific habitat preference which limits the spatial extent of their spawning grounds. Eggs adhere to the seabed and can form extensive egg beds, meaning they are particularly sensitive to seabed disturbance. The suitability of the seabed substrate as a spawning habitat for herring, is a function of:

- Particle size - spawning typically occurs on coarse gravel (0.5-5cm) to stone (8-15cm) substrates (ICES 2012);
- Seabed features – preference for crest of ridges and ripples rather than hollows (ICES 2012),
- High oxygenation of sediments e.g. well mixed-waters (Behrens 2007);
- Current speed – prefer reasonably strong tidal currents (1.5 to 3 knots) (Reid et al. 1999); and
- Water depth – prefer relatively shallow water (approximately 15-40m deep) (Reid et al. 1999).

Herring numbers fluctuate annually, and herring often abandon and then return to suitable areas, therefore all suitable areas of herring spawning habitat are important to maintain a resilient herring population.

Marine Space *et al.* (2013) categorise seabed sediments into four herring sediment preferences groups depending on their mud and gravel content. An extensive assessment of potential herring spawning habitat has been conducted along with relevant literature (see Technical Appendix D for the full assessment). It was concluded that the Proposed Development will interact with herring spawning areas within Irish waters based on interpretation of various data sets, including BGS data and the Coull et al. (1998) spawning habitat data and O'Sullivan et al. (2013). Noting that consideration should be made of the Dunmore East herring spawning bed (O'Sullivan et al. 2013).

8.3.4 Diadromous fish

It is possible that diadromous species maybe found near the proposed marine cable corridor at certain times of the year. Diadromous species are those which migrate between marine and freshwater as part of their lifecycle and include species such as lamprey, salmonids and European eel; the Celtic and Irish Sea is an important migration route for these species. Diadromous fish either spawn in fresh water and feed at sea (anadromous) or spawn at sea and feed in fresh water (catadromous).

There are four anadromous species which may be observed within the Proposed Development:

- Sea lamprey (*Petromyzon marinus*) – late April to early June;
- River lamprey (*Lampetra fluviatilis*) – September to June;
- Twaite shad (*Alosa fallax*) – April onwards
- Atlantic salmon (*Salmo salar*) – May to June and autumn months.

The Atlantic salmon and three lamprey species the sea lamprey, brook lamprey and river lamprey are listed on Annex II on the EC Habitats Directive and are qualifying features for the River Barrow and River Nore SAC. Twaite shad an Annex II species and a member of the herring family is also a qualifying feature of the River Barrow and River Nore SAC. Brook lamprey (*Lampetra planeri*) does not migrate to the sea and therefore will not be observed in the Proposed Development.

Twaite shad and Atlantic salmon has known spawning grounds at the upper tidal reaches in the River Barrow and River Nore SAC. Twaite shad spawns between April and May and Atlantic salmon spawns between November and January. These two species spawn along rivers where the current is swift and substrate is clean. They deposit their eggs over substrate that can vary from sand to pebbles.

Telemetry investigations by the Inland Fisheries Ireland indicate that Twaite shad do not move in a single event to spawning areas but make a series of up- and downriver migrations, dropping far down into the Waterford Harbour area, at least, prior to settling for a short period in the spawning areas. The telemetry work and sampling in the near-shore marine areas indicate that the adult shads migrate in- and out of the estuarine areas and open sea, presumed to be feeding movements. The telemetry study has also shown movements from one estuary to another, one fish moving from the Munster Blackwater to Waterford Harbour over the course of two to three days immediately after spawning. Comments received from Inland Fisheries Ireland on the Foreshore License application for the Greenlink marine survey indicates that they consider that shad movements are occurring all of the time between the open sea area and the estuarine area around Hook Head.

Other diadromous species that may be present are European eel (catadromous), which are also listed on Annex II of the EC Habitats Directive. Although there is no information to suggest that rivers adjacent to the Proposed Development contain European eel it is possible that fish migrating from further north out to the Atlantic may pass through the area.

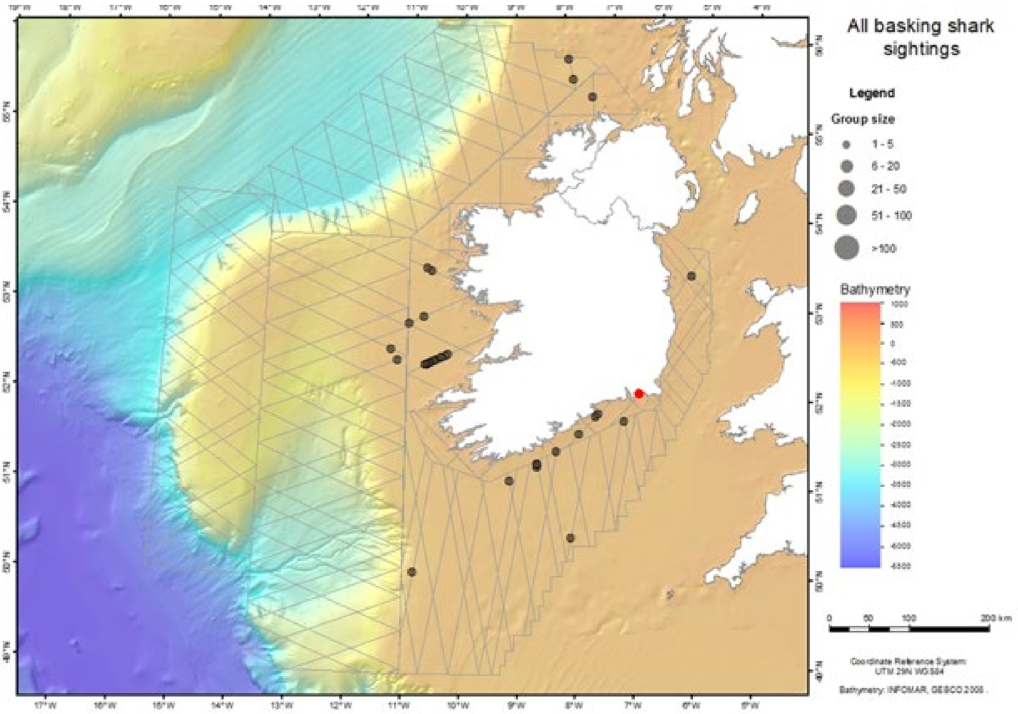
8.3.5 Elasmobranchs (sharks, rays and skates)

Elasmobranchs (sharks, skates and rays) are among the most vulnerable marine fish due to their slow growth rates, late maturity, low fecundity and productivity which limits their capacity to recover from population declines. All sharks and rays are on the OSPAR list of threatened and declining species.

The basking shark (*Cetorhinus maximus*) is the largest fish in the North Atlantic and the second largest in the world. Results from the obSERVE project (a three-year aerial survey programme aimed to collect data on the distribution of cetaceans seabirds and other marine megafauna in Irish offshore waters) have recorded the basking shark in low numbers around the St Georges Channel (Figure 8-3) (Berrow and Heardman 1994; Solandt and Chassin 2014; Rogan et al. 2018). Most sightings occur in summer months but it is less clear where they spend the winter. Basking sharks are listed on the OSPAR list of threatened and/or declining species and receive further protection through the Bonn Convention. The blue shark (*Prionace glauca*) has also been observed in low numbers in the Irish Sea (Figure 8-4). This species is on the IUCN red list as near threatened. However, sightings have been recorded in the south, away from the Proposed Development.

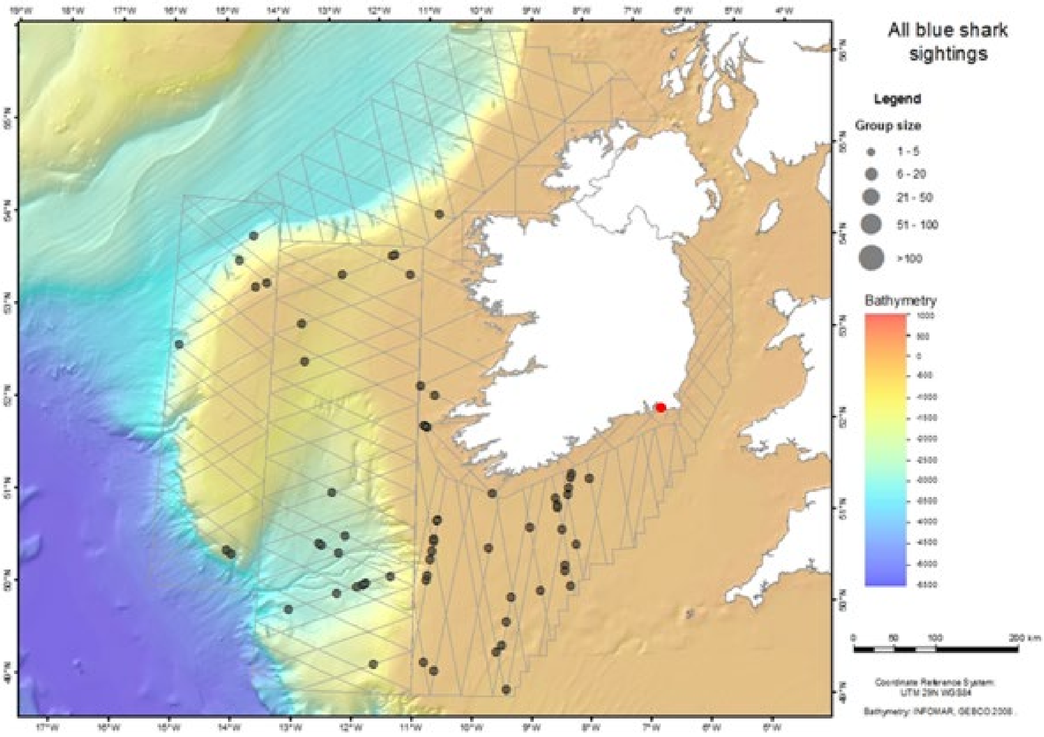
Tope are known to migrate large distances and are thought to migrate from Scotland through the Irish Sea. The lesser and greater spotted dogfish (*Scyliorhinus canicula* and *Scyliorhinus stellaris*) are also very abundant in the Irish Sea.

Figure 8-3 Basking shark sightings



Source: obSERVE (Rogan et al. 2018). Red dot = Hook Head.

Figure 8-4 Blue shark sightings



Source: obSERVE (Rogan et al. 2018). Red dot = Hook Head.

8.3.6 Shellfish

The Greenlink fishing activity study (Technical Appendix E) identified that fisheries near the Proposed Development target shellfish such as crab, lobster, *Nephrops*, shrimp, scallop and whelk (MarineSpace 2018). Further detail on these species is provided below.

8.3.6.1 Brown crab

The brown (edible) crab (*Cancer pagurus*) are a target commercial species. They reach a maximum size of approximately 27cm and can live up to 15 years. The females move inshore in late spring to moult and shortly afterwards mating occurs. The females store the sperm, then in late summer move offshore again and use the stored sperm to fertilise their eggs in the winter. The females carry their eggs under their abdomen; this is commonly known as being 'berried'. The larvae are pelagic and drift with water movements until they settle to the seabed as miniature adults (about 2.5 mm in size) in summer or autumn depending on latitude and water temperature. Juvenile crabs are more commonly found in shallow inshore waters.

The brown crab is most abundant on rocky grounds, where it hides in holes and crevices. The crab is generally found in shallow water close to shorelines, although it can be found in water as deep as 100m (Marlin 2018).

8.3.6.2 Lobster

The Common Lobster (*Homarus gammarus*) is a nocturnal, solitary creature that hide in holes during the day. They are found on rocky seabeds living in holes and excavated tunnels from the lower shore to approximately 60m in depth. During summer they live in shallow waters but retreat to deeper waters in the winter months. Lobster feed on a variety of ground dwelling invertebrates like crabs, molluscs, sea urchins, polychaete worms and starfish, but occasionally also fishes, plants and carrion. Spawning usually occurs in the summer when the female is said to be 'berried', the eggs are fertilized as they are extruded through the small ducts and are carried underneath the abdomen for 9-12 months (Marlin 2018).

8.3.6.3 Nephrops

The Norway lobster (*Nephrops norvegicus*) is found sublittorally in soft sediment, commonly at depths of between 200-800m. They live in shallow burrows and are common on grounds with fine cohesive mud which is stable enough to support their unlined burrows. Nephrops is an opportunistic predator feeding on crustaceans, molluscs and to a lesser extent polychaetes and echinoderms (Marlin 2018).

8.3.6.4 Shrimp

Shrimp are found at depth of 100m or more, but it is occasionally found in rock pools on the lower shore. Offshore migration takes place in most areas in October/November, followed by a migration into shallow water. Individuals mature and breed in the first year of life. Generally, eggs are laid from November to February and hatch in April/May. Shrimp feed mainly on hydroids, small crustaceans and polychaetes.

8.3.6.5 Scallop

Generally, scallops are found between tidemarks, to depths of 100m and on sand or gravel, often in high densities. The queen scallop occurs amongst beds of horse mussels *Modiolus modiolus*.

8.3.6.6 Whelks

The common whelk (*Buccinum undatum)* is a large carnivorous whelk that grows up to 10cm high and 6cm wide. The species is found occasionally in the intertidal area, but more usually sub-tidally down to approximately 1200m deep (Marlin 2018). Whelk prefer muddy sand, gravel and rock habitats where they and feed on polychaete worms and other molluscs, such as bivalves. It also scavenges for carrion, which it detects by 'smell' using a 'siphon', which is used to funnel water to the gills, and sensory organs. Breeding takes place from October to May, and the they spawn in November where their eggs attach to rocks, shells and stones in protective capsules grouped together in large masses of over 2000 eggs (DECC 2016). The species is widely distributed around the North Atlantic up to Iceland and is common around the UK and northwest European coasts.

8.3.7 Protected species and species of conservation importance

There is legislation in place which protects certain species of fish and molluscs in Irish waters. The key legislation is the European Communities (Natural Habitats) Regulations (S.I 94 of 1997) which provide protection for the following marine species:

- *Lampetra fluviatilis* (River lamprey or Lampern)
- *Alosa alosa* (Allis shad)
- *Alosa fallax* (Twaite shad)
- *Salmo salar* (Salmon) (only in freshwater)
- *Margaritifera margaritifera* (Freshwater pearl mussel) – known to occur in the River Nore

Sea lamprey, river lamprey, brook lamprey, Atlantic salmon and twaite shad are listed on Annex II of the Habitats Directive (92/43/EEC) as a species of community interest whose conservation requires the designation of special areas of conservation. These species are a qualifying feature of the River Barrow and River Nore SAC, but not a primary reason for site selection. There is potential that these species will be located within the zone of influence of the Proposed Development, as discussed in Section 8.3.3.2.

8.3.8 Natural evolution of the baseline

Predicting future trends to fish populations is difficult due the various factors that combine to influence their number and distribution such as future storm events and increases in fishing pressures (DCCAE 2015). It is expected however that species currently at their southern habitat range, such as poor cod, will redistribute northwards due to rising sea temperatures, with warmer-water species such as sprat and anchovy becoming more abundant (Marine Institute 2009). This increase in population of commercially exploitable species may lead to an increase in fishing effort in the region, preventing some populations from capitalising on the improved conditions. Migratory fish in Ireland such as salmon, sea trout and European eel have declined in numbers over recent decades, with changes in the local climatic and oceanic conditions and anthropogenic impacts being at least partly responsible (Marine Institute 2009). Shellfish species may be affected by increased acidification, with shell formation becoming increasingly metabolically taxing and leading to reductions in populations.

8.4 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.

- Death or injury by collision;
- Visual disturbance;
- Siltation rate changes, including smothering (depth of vertical sediment overburden);
- Temperature change; and;
- Hydrocarbon and PAH contamination.

The pressures listed in Table 8-3 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 8-3

Table 8-3 Identification of potential pressures and zone of influence – fish and shellfish

Project Phase	Project Activity	Aspect	Potential Pressure	Receptor	Zone of Influence
Installation	Cable burial	Cable trenching (ploughing and jet trenching)	Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Species with demersal life stages	15m
Operation	Offshore repair and maintenance operations				
Decommissioning	Cable removal				
Installation	Cable burial	External cable protection	Physical change (to another seabed type)		HDD exits = 208m^2 Irish Offshore at 4 crossing locations:

Project Phase	Project Activity	Aspect	Potential Pressure	Receptor	Zone of Influence
					combined = 4036m²*
Operation	Offshore repair and maintenance operations				5 discrete repairs each maximum of 1km x 10m
Installation Operation Decommissioning	Cable burial Offshore repair and maintenance operations Cable Removal	Pre- & post-installation survey	Underwater noise changes	Clupeids: Herring Sprat Twaite shad	2.2km
		Presence of Project vessels			50m
		External cable protection			50m
		UXO detonation		All species	54km
Operation	Operation of cables	Emission of EMF	Electromagnetic changes	Elasmobranchs Other sensitive fish	Distance at which EMF attenuates to background levels 12m at HDD exit point where cables are unbundled 2m for remainder of route where cables are bundled

* Each crossing will have a footprint of ~1009m², approximately 120m long by 8.4m wide.

8.5 Embedded Mitigation

The project description, described in Chapter 4, provides the design. This includes mitigation measures which form part of the design and are therefore an inherent part of the project. The embedded mitigation relevant to shipping is provided in Table 8-4 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 8-4 Embedded mitigation

ID	Embedded mitigation
EM5	Control measures and shipboard oil pollution emergency plans (SOPEPs) will be in place and adhered to under MARPOL Annex I requirements for all project vessels.
EM15	Submarine cables will be bundled together, which reduces which reduces the seabed footprint of installation activities and the electromagnetic field generated during operation, thus minimising any potential compass deviation effects.

ID	Embedded mitigation
EM17	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed.
EM18	Project vessels will not exceed 14 knots within the Proposed Development.
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-routing 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.

8.6 Significance Assessment

8.6.1 Summary of Assessment

Table 8-5 presents the summary of the impact assessment conducted on the Proposed Development activities. Sections 8.6.2 to 8.6.5 provide the justification behind the conclusions. Project Specific Mitigation, if proposed, is described in Section 8.7. Where there is still potential for residual effects this is discussed further in Section 8.8.

Table 8-5 Impact assessment summary – fish and shellfish

Determination of potential effect						Impact assessment			Consideration of mitigation	Residual effect assessment		
Section	Project Phase	Aspect	Embedded Mitigation (Table 8-4)	Potential Pressure	Receptor	Magnitude	Sensitivity	Significance	Project Specific Mitigation (Table 8-6)	Magnitude	Sensitivity	Significance of Residual Effect
8.6.2	Installation Operation (Repair & Maintenance) Decommissioning	Cable trenching (ploughing and jet trenching)	EM15, EM17	Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Demersal species - sandeel	Low	Medium	Slight	-	-	-	-
					Dunmore East Herring Spawning area - Herring eggs and larvae during spawning	Medium	High	Significant	PS5	Low	Low	Slight
8.6.3	Installation Decommissioning	External cable protection	EM15, EM17	Physical change (to another seabed type)	All species	Low	Low	Slight	-	-	-	-
	Operation (Repair & Maintenance)	External cable protection	EM15, EM17	Physical change (to another seabed type)	All species	Low	Low	Slight	-	-	-	-
					Dunmore East Herring Spawning area - Herring eggs and larvae during spawning	Low	High	Significant	PS5	Low	Low	Slight
8.6.4	Installation Operation (Repair & Maintenance) Decommissioning	Continuous noise - Geophysical survey	None	Underwater noise changes	All species	Low	Low	Slight	-	-	-	-
					Herring during spawning	Low	Medium	Slight	-	-	-	-
	Installation Operation (Repair & Maintenance) Decommissioning	Continuous noise - vessel activity	EM18	Underwater noise changes	All species	Low	Low	Slight	-	-	-	-
					Herring during spawning	Low	Medium	Slight	-	-	-	-
	Installation Operation (Repair & Maintenance) Decommissioning	Impulsive noise - UXO detonation	EM21	Underwater noise changes	All species, including hearing specialist fish species – herring, sprat, twaite shad	Low	Medium	Slight	-	-	-	-
8.6.5	Operation of cables	Emission of EMF	EM15	Electromagnetic changes	Elasmobranchs and Demersal species	Low	Low	Slight	-	-	-	-

8.6.2 Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion

8.6.2.1 Installation

Activities that physically disturb the seabed e.g. pre-sweeping, pre lay grapnel run, plough trenching, jet trenching and rock placement, have the potential to disturb species with demersal life stages (e.g. herring, twaite shad), larval or juvenile ages, or fish and shellfish species that live in contact with the seabed (e.g. sandeel). Although disturbed, the composition of sediments are unlikely to significantly change and the habitat should be suitable for demersal spawning once activities have ceased.

The only change in seabed sediments would be if external cable protection is installed e.g. concrete mattresses / rock berms. This would result in a physical change (to another seabed type), which is assessed in Section 8.6.2 below. This is only proposed as a contingency at the HDD duct exits and for discrete sections of seabed in the Irish Offshore area where third-party asset crossings are required– a negligible amount in the context of the habitat available within the wider area.

Cable installation activities are more likely to take place during spring and summer, due to potentially better weather during this time. Table 8-2 (Section 8.3.2) identifies that spawning species are present in the vicinity of the Proposed Development all year round. Of the species present, sandeel and herring are particularly sensitive to habitat loss and disturbance. A full assessment of herring and sandeel habitat can be found in Technical Appendix D. Twaite shad and Atlantic salmon are also a species of importance however, spawning habitat will not be affected as this is associated with estuaries and rivers and not located in the nearshore environment.

Sandeel
The Irish Offshore runs through a historical sandeel fishing area. The Irish Offshore component interacts with 1.75 km^2 of suitable sandeel habitat (identified through production of a 'heat' map, see Technical Appendix D). The percentage of suitable sandeel habitat that the Irish Offshore intersects with is 0.05% of that available at a population scale within the Irish and Celtic seas. Installation of the cable will not result in changes to the sediment composition unless rock protection is installed. Comparison of the indicative rock installation locations and the 'heat' maps (Technical Appendix D) indicates that rock is proposed for areas that fall outside potential sandeel habitat.

The temporary and localised nature of the installation, the lack of change to sediment composition within the construction area, the small scale zone of influence and the low number of sandeel removed and/or displaced within the Proposed Development and Irish Offshore, indicates that the magnitude of the pressure is low. The sensitivity of sandeel is considered to be medium as installation will be outside their dormant phase. Sandeel are likely to recover from disturbance fairly quickly and therefore the effect of disturbance has been assessed as **Slight** and is **Not Significant**.

Herring

The Proposed Development interacts with identified areas of herring spawning according to the assessment conducted using a variety of data (Technical Appendix D). These areas were identified using spawning bed analysis (O'Sullivan et al. 2013), which was supported in part by the seabed habitat, identified as medium potential. The spawning grounds are known as Dunmore East and are the largest spawning grounds in the Celtic Sea (approximately 36km^2) (O'Sullivan et al. 2013).

Installation of the cable will not result in changes to the sediment composition. This temporary localised disturbance of the seabed will result in the local sediment backfilling the trench leaving the seabed in a similar state as found (with no significant change to sediment composition). This temporary disturbance would only disrupt the herring spawning if undertaken in the same temporal scale. Peak herring spawning season is identified as September and February/March (O'Sullivan et al. 2013), which is corroborated by Scientific, Technical and Economic Committee for Fisheries (STECF) landings data for ICES Rectangles 32E3, 32E4 and 33E3 (further information provided in Technical Appendix E). Local knowledge indicates that for Dunmore East the peak season is usually around October/November and December/January (O'Sullivan et al. 2013), corroborated by peak landings in Quarter 4 for ICES Rectangles 32E3, 32E4 and 33E3 (Technical Appendix E).

If the installation works were carried out during the peak spawning months the sensitivity of the eggs and larvae from disturbance of installation on the seabed would be high, as the receptor would have a low tolerance with a low recoverability within the installation zone of influence (not necessarily the entire spawning area). Due to the size of the Dunmore East spawning area, the magnitude for the area would be low, however for the herring eggs and larvae directly affected within the zone of influence the magnitude would be high; overall the magnitude has been assessed as medium on the population on the spawning event as there may be a delayed recovery. The overall significance of the effect during peak spawning months (October to January), has been assessed as **Significant.**

Project Specific Mitigation has therefore been proposed to reduce the significance of the effect, presented in Section 8.7.

Planned works on the Proposed Development are anticipated to be during the summer, however there may be potential for schedule migration due to unforeseen delays.

Outside of the peak spawning months the key receptor is the seabed habitat. With regards to spawning habitats as a whole within the Dunmore East spawning area, and including the wider assessment area, disturbance caused by the Proposed Development is assessed as being temporary with the seabed habitat quickly recovering to pre-installation conditions; the habitat would be able to support future spawning events. Therefore, the overall magnitude of effect on spawning habitat is low. As habitat loss will not permanently affect areas of herring spawning, the effect on the herring population has been assessed as **Not Significant**.

Twaite Shad

Twaite shad are known to spawn in rivers or the upper reaches of estuaries. As the Proposed Development will pass through the Campile Estuary there is potential for twaite shad spawning grounds to be affected during construction. However, the estuary will be crossed using horizontal directional drilling (HDD) and therefore, the installation will have no interaction with the seabed within the estuary. As a result, there is no pathway for disturbance of seabed within twaite shad spawning grounds.

Other Fish and Shellfish Species

The potential pressure on other species with demersal life stages, including thornback ray and seabass, is expected to be the same as for sandeel. The effects of the installation activities are temporary and any disturbance is temporary, transient and localised. In addition, the area effected by the Proposed Development and Irish Offshore is minimal in terms of the extended spawning areas available for fish species within the region. Mobile fish and shellfish species (such as brown crab and lobster) will be able to relocate away from the installation activity to nearby alternative habitat, and will return to the area once activity has ceased. Localised mortality may occur within species with limited mobility e.g. bivalve molluscs, but the impact will be extremely localised and will not have an effect at a population level. This assessment takes into consideration embedded mitigation, EM15 and EM17. The effect of disturbance to species with a demersal life stage has been assessed as **Slight** and is **Not Significant**.

8.6.2.2 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 a smaller magnitude when compared to cable installation. The assessment considered five discrete cable repairs during operation and concluded that the effects will reduce to **Imperceptible** due to the restricted duration and spatial extent of works and is **Not Significant**. The same Project Specific Mitigation (PS5) will be applied for repair works - no works undertaken between October-January; Section 8.8.

8.6.2.3 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 effects on fish and shellfish 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 project will be of a comparable magnitude to those assessed above for cable installation and so the effect has been assessed as **Slight** and is **Not Significant** outside of herring spawning season**.** The same Project

Specific Mitigation will be applied for decommissioning as for installation – see PS5: no works undertaken between October-January; Section 8.8.

8.6.3 Physical change (to another seabed type)

8.6.3.1 Installation

If burial in sediment cannot be achieved at the HDD exit points, external cable protection, covering a total area of 208m^{2,} will be used. In addition, external cable protection will be used in the Irish Offshore at the third-party asset crossing locations, covering an area of 4036m^2. Where external cable protection is used the seabed habitat within the footprint will be lost and replaced with harder substrate, changing the seabed type.

Sandeel
Where external cable protection is used the seabed habitat within the footprint of the deposit will be lost and replaced with substrate which may be unsuitable for future sandeel use. External cable protection will interact with potential suitable sandeel habitat, but at such a negligible scale (<0.05% entire habitat availability) than negligible pressure is expected.

The extent of suitable habitat in the sediments adjacent to the Proposed Development and Irish Offshore has been calculated using the methodology produced by MarineSpace (2013) (see Technical Appendix D), which suggests that similar habitat to that found within the Proposed Development and Irish Offshore is available outside the Proposed Development and Irish Offshore. Although there is a small amount of suitable sandeel habitat within the Irish Offshore component of Greenlink, there are extensive areas present within the broader Irish Sea region. As habitat loss is small scale the effect on the sandeel population has been assessed as **Slight** and is **Not Significant**.

Herring
Comparison of the indicative external cable protection areas and the ‘heat’ maps (Technical Appendix D) indicates that the external cable protection at the HDD exits and third-party asset crossings are located in areas with no data; although it could be inferred from the sediment types and surrounding potential that the locations would represent low potential herring spawning habitat. The HDD exit points are on the edge of the known spawning area (given its shallow water depth), whilst the crossing locations are outside of the known spawning area (O’Sullivan et al. 2013).

Due to the very small scale habitat loss and the wider availability of suitable habitat, the magnitude of the effect has been assessed as low. The sensitivity of herring has been assessed as medium. The overall significance of the effect has been assessed as **Slight** and is **Not Significant**.

Other Fish and Shellfish Species
The potential effect from physical change to the seabed due to the installation of cable protection on fish species with demersal life stages, including thornback ray

and seabass, is expected to be limited. The installation area of cable protection is minimal in the context of the wider area available within the region for fish spawning. Figures 8-1 and 8-2 (Drawings P1975-FISH-003 and P1975-FISH-004) demonstrates the potential spawning and nursery areas available for fish species within the region, it is demonstrated that such habitats are extensive and therefore, the loss of such a very small amount of suitable habitat is unlikely to affect species at a population level. Fish species are mobile and will have access to suitable spawning and nursery areas even when considering the small loss of habitat due to installation of cable protection.

Mobile fish and shellfish species (such as brown crab and lobster) will be able to relocate away from the installation activity to nearby alternative habitat and will return to the area once activity has ceased. Localised mortality may occur within species with limited mobility e.g. bivalve molluscs, but the pressure will be extremely localised and will not have an effect at a population level.

This assessment takes into consideration embedded mitigation EM15 and EM18, which seek to reduce the footprint of activities. The magnitude of the effect is considered to be low in the context of the available habitat within the region, and the sensitivity of fish species is considered low as a result of their mobility allowing them to move to alternative spawning and nursery grounds. The effect of disturbance to species with a demersal life stage has been assessed as **Slight** and is **Not Significant**.

8.6.3.2 Operation

The assessment considered five discrete repair events and as a worst case the deposit of 1km of external cable protection at each location. Given that seabed sediments in the Proposed Development and Irish Offshore are predominantly sand with sufficient depth to achieve full burial in sediment it is highly unlikely that external cable protection would be required for the cable repair loop. However, if external cable protection is required effects are likely to be on a similar scale to those assessed above for installation. Therefore, the overall significance of the effect is assessed as **Slight** and is **Not Significant** for all receptors except for herring during peak spawning season. If repair or maintenance works occur within the Dunmore East spawning bed area during the spawning season the overall effect is assessed as **Significant**. The same Project Specific Mitigation will be applied for maintenance and repair as for installation – see PS5: no works undertaken between October-January; Section 8.8.

8.6.3.3 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 additional effects on fish and shellfish 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. This would in effect return the seabed to pre-installation conditions. Therefore, the overall significance of the effect is assessed as **Negligible** and is **Not Significant** for all receptors except for herring. However, in line with the installation any decommissioning works would need to follow the same Project Specific Mitigation: PS1 no works undertaken between October-January; Section 8.8.

8.6.4 Underwater noise changes

8.6.4.1 Installation, Operation (including maintenance and repair) and Decommissioning

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 (herring, sprat, twaite shad 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.

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 calculate the zone of influence for recoverable and temporary injury to fish an assessment has been conducted 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. The assessment used thresholds for injury derived from Popper 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 Technical Appendix C; and key information relevant to the assessment is summarised below.

Cable laying and rock placement
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).

Clupeids, herring, sprat and twaite shad are the only hearing specialist fish present within the Proposed Development. Nedwell et al. (2012) reviewed herring 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.

Technical Appendix C 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.

It has been estimated that on average 220 vessels pass the Proposed Development every month (Chapter 13). Therefore, it is likely that existing background noise levels from shipping within the Celtic Sea will mask some of the disturbance effect to herring within the Proposed Development.

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. 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. Herring are considered to have low sensitivity to underwater sound changes except within the spawning period (October to January) when sensitivity is medium. An assessment of herring spawning within the Proposed Development has shown that there is likely to be spawning within the area (see Technical Appendix D). The magnitude of effect has been assessed as low as the zone of influence is a small percentage of the total known spawning bed (O'Sullivan et al. 2013), and it is considered that much of the works are transient and do not encompass a large area for prolonged periods of time but small sections along the route.

Twaite shad and allis shad spawn within rivers therefore there will be no interaction with spawning activity. However, juvenile shad are known to forage in the nearshore environment, so some interaction may be possible. Considering the extent of inshore habitat available the likely magnitude of effect on juvenile twaite and allis shad has been assessed as low.

Sprat are also expected to interact at minimal levels considering the available habitat space.

Based on the above discussion, any disturbance effects from noise associated with operations will be localised, temporary and transient and therefore the magnitude of the effect is assessed as low. The sensitivity of receptors to underwater sound changes has been assessed as low for all species with the exception of herring during the spawning period when the sensitivity increases to medium. The overall significance of the effect has been assessed as **Slight** and is **Not Significant**.

This assessment has taken into account embedded mitigation, EM18, which will ensure that vessel speeds are limited to reduce the amount of noise emitted into the water column.

Geophysical survey

Geophysical survey activities are not considered in the discussion above; although like cable trenching and rock placement they are considered a continuous sound source. 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.

Technical Appendix C concluded that 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.

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. Therefore, it is extremely unlikely that fish will experience a significant effect other than temporary displacement from the immediate area surrounding the survey activity.

No conclusive records of a decline in catch rates have been noted following geophysical survey activities (Thompson et al. 2014), which suggests that fish return to areas after the temporary displacement.

For the same reasons as the assessment for cable trenching and rock placement, the sensitivity of receptors to underwater sound changes has been assessed as low for all species with the exception of herring during the spawning period when the sensitivity increases to medium. The magnitude of the effect has been assessed as low, due to the transient and temporary nature of the effect. The overall significance of the effect has been assessed as **Slight** and **Not Significant**.

UXO detonation

It is unknown how many, if any, UXO detonations will be required within the Proposed Development. The Greenlink UXO desk-based assessment (1st Line Defence 2018) identified a high-risk area in the St Georges Channel; a former WWII sea mine ground. It is therefore 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.

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.

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. 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).

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, Technical Appendix C 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.

The modelling results concluded that mortality and potential mortal injury was possible within 6.2km of the detonation source. 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.

A wide number of fish species may be present in the vicinity of the Proposed Development, including species which are protected under Irish statute. Clupeids such as Atlantic herring, sprat and twaite shad, as well as salmon and European eels will be most sensitive to an explosion as they all have swim bladders. 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). The magnitude of the effect has therefore been assessed as low. The sensitivity of the receptor has been assessed as medium as there is the potential that individuals will be killed, although the activity is unlikely to affect the viability of any species, populations or stocks. The overall significance of the effect of UXO detonation has been assessed as **Slight** and **Not Significant**.

8.6.5 Electromagnetic changes

8.6.5.1 Operation

When operating, the cables will generate an electromagnetic field (EMF) consisting of a magnetic (B) field and an induced electric (iE) field (described further in Chapter 4). The effect will be present along the entire marine cable route.

It has been calculated that the Greenlink cables when bundled 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.

For a short distance in water depths of between 9m and 15m the cables will not be bundled as they exit the HDD point and before they are able to be bought together and bundled. In this area the iE fields will be slightly higher, up to 128.7μV/m at the seabed reducing to 63.7μV/m at 10m from the cable and to natural background levels within 12m.

Whilst it is acknowledged that a number of taxonomic groups potentially occurring in the vicinity of the Proposed Development are sensitive to electric and or magnetic fields there is limited understanding of the response to anthropogenic magnetic and iE fields and therefore any effects.

A range of potential effects of the generation of EMF during the operation of a subsea power cable have been identified. Thomsen et al (2015) (cited in NIRAS 2017) suggests that the most likely effects relate to attraction or avoidance of the iE field associated with cables. Adverse effects to individuals and potentially populations could result if there was a repulsion from an area or confusion between anthropogenic and bioelectric fields (NIRAS 2017). Other potential pressures from iE fields include confusion with bioelectric fields and physiological effects.

Potential effects on species which utilise magnetic fields for navigation and or orientation may occur if anthropogenic electromagnetic fields interfere with natural behaviour. Some studies (e.g. (Zimmerman et al. 1990; Cameron et al. 1993) cited in NIRAS 2017) have also identified the potential for artificial magnetic fields to have physiological effects on developing eggs, embryos or larvae (NIRAS 2017).

Induced electric (iE) fields

The predominant groups of marine organisms that are electroreceptive are elasmobranchs (sharks, skates and rays) and holocephalans (chimaeras such as ratfish), which possess specialist electroreceptive organs called ampullae. They have an extremely acute sense, sensitive to 5 to 20 nV/m, which is used for detecting the bioelectric fields of prey, predators and conspecifics (organisms of the same species), orientating to ocean currents and sensing their magnetic compass headings (e.g. EC 2018, Boehlert and Gill 2010), as well as for navigation (NIRAS 2017). Agnathans (jawless fish e.g. sea and river lamprey) are also electrosensitive but do not possess specialised electroreceptors; they are able to detect induced voltage gradients associated with water movement through the geomagnetic field. Teleost fish such as European eel, cod, plaice and Atlantic salmon are also electrosensitive.

Three potential pressures resulting from iE fields are possible: repulsion; confusion with bioelectric fields; and physiological effects. These are considered in turn below:

<u>Repulsion</u>

Elasmobranchs are known to be repelled by strong electric fields, which has previously raised concerns that cables inducing such electric fields may act as barriers to movement across areas (e.g. between feeding, mating and nursery areas).

Exactly what magnitude of electric field induces an avoidance response in elasmobranchs is less certain. NIRAS (2017) reports that avoidance behaviour has only been documented in a few elasmobranchs; when small-spotted catsharks (Scyliorhinus canicula) were presented with DC electric fields of 1,000 µV/m (Gill & Taylor 2001), and when silky (Carcharhinus falciformis), white tip reef (Traenodon obesus) and zebra (Stegostoma fasciatum) sharks were presented with both DC and AC fields of 1,000µV/m (Yano et al. 2000). As these studies didn't consider a range of field strengths an avoidance threshold cannot be deduced. However, other research demonstrated repeated, unequivocal attraction behaviour to DC fields of approximately 60 μV/m ([Kalmijn 1982; Kimber et al. 2011] cited in NIRAS 2017), and whilst the latter study recorded the majority of responses to DC fields of approximately 400 to 600 μVm as attraction, some occurrences of avoidance were observed. NIRAS (2017) suggests based on the discussion above, that the threshold electric field between attraction and avoidance lies somewhere between approximately 400 and 1,000 μV/m.

Calculations for the cables in the bundled and unbundled configuration estimate that the iE fields at 1m from the cables (i.e. on the seabed) are below the thresholds for attraction and avoidance. It is therefore concluded that it is very unlikely that there will be iE fields strong enough to result in an avoidance response from electroreceptive fish.

Confusion with bioelectric fields

Elasmobranchs are responsive to electric fields below those that elicit repulsive reactions, and use them for detecting prey, predators and mates and for navigation (Tricas & Sisneros 2004, cited in NIRAS 2017). The concern is that elasmobranchs will be confused by anthropogenic electric field sources and unable to distinguish them from natural fields of similar strength. Potentially, they may waste time and energy “hunting” electric fields such as those associated with subsea electrical cables whilst searching for bioelectric fields associated with their prey.

Pelagic species such as the basking shark are unlikely to be affected due to their habits leading them to be distant from the seabed and strongest iE fields. Benthic species, which are more likely to encounter the iE fields around the cables, include several commercially important species that have also suffered significant population declines, such as skates, rays and spurdogs. iE fields will represent a very minor change (comparable to the maximum natural background iE field), therefore the potential effects are insignificant.

Physiological effects

Physiological effects upon elasmobranchs are unlikely due to the relatively weak electric fields involved. Some research (Sisneros et al. 1998; Ball 2007 cited in NIRAS 2017) suggests embryonic thornback rays may have stopped body movement upon sensing artificial electrical fields because they were minimising detection as the electric fields were similar to those of predators. Whilst there is potential for HVDC iE fields to affect this behaviour, there is no evidence to confirm it. The potential for a significant proportion of a population e.g. a ray breeding ground to be affected by a linear cable is likely to be limited. iE fields will represent a very minor change (comparable to the maximum natural background iE field) to the natural electric field of the Earth, therefore the potential effects are insignificant. Therefore, it is unlikely that there would be significant physiological effects occurring due to exposure to iE fields.

Magnetic (B) fields

Magnetically sensitive marine organisms may be split into two main groups; the first directly detect magnetic fields through the use of magnetic particles (magnetite) within their tissues whilst the second indirectly detect the presence of a magnetic field by detection of the iE field.

Physiological effects

Shellfish

There is little evidence to suggest any significant effects on physiological development from magnetic field detection. Whilst Zimmerman et al. (1990) (cited in NIRAS 2017) demonstrated B fields ranging between 1-100μT delayed embryonic development in sea urchins and Leya et al. (1999) (cited in NIRAS 2017) demonstrated high frequency AC EMF causing cell damage to barnacle larvae and interfering with their settlement, these studies contrast with Nielsen (1986) (cited in NIRAS 2017) who provides evidence of benthic invertebrates living directly upon DC electrodes with no apparent effects (Walker 2001; Swedpower 2003) (cited in NIRAS 2017). It appears that DC magnetic fields cause fewer biological effects upon these taxa than AC magnetic fields, although this assumption is made tentatively owing to a lack of supporting studies (NIRAS 2017).

Fish

There is limited evidence to suggest that there could be physiological effects on fish from the generated electromagnetic fields of the cables. Demersal fish are most likely to come into contact with the cables (NIRAS 2017). Shallow sandy areas, in particular, are important nursery areas for many demersal fish species (e.g. herring), but in such areas the cables will be buried to 0.6m to 1m which will prevent fish (including eggs and juveniles) from encountering the stronger fields, including those on the cable surfaces.

In areas where the cables cannot be buried, and they are protected by rock placement it is possible fish could inhabit crevices in the rock and get close to the cables but rock protection can also reduce detection of EMF and it is thought unlikely to result in physiological effects.

The only evidence for physiological effects relates to fish embryonic development, which Cameron et al. (1985) and Cameron et al. (1993) (cited in NIRAS 2017) demonstrated was delayed by AC magnetic fields. However, AC fields are not comparable to static DC fields and as such a similar effect from DC fields should not be implied (NIRAS 2017).

Conclusion

The effect of EMF will be present along the entire Proposed Development for the lifetime of the operating cable, but due to the extremely localised nature of the pressure it will only result in a minor shift away from baseline conditions. Therefore, the magnitude of the effect is assessed as low. As discussed above, any effects upon fish and shellfish behaviour will be localised and brief. Any fish species that remain within the elevated EMF zone are expected to be tolerant to this level without adverse effects. Therefore, the sensitivity has been assessed as low.

Overall the significance of the effect has been assessed as **Slight** and is **Not Significant**.

8.7 Project Specific Mitigation

In addition to the embedded mitigation outlined in Table 8-4, Table 8-6 presents measures that GIL is committed to adopting.

Table 8-6 Project specific mitigation – fish and shellfish

ID	Project Specific Mitigation
PS5	Avoid intrusive works (e.g. those that disturb the seabed) within Dunmore East Herring Spawning area during peak spawning period (October to January).

8.8 Residual Effect

The results of the EIA in Table 8-5 indicated that two pressures will have a significant effect. The significance of these pressures was re-assessed taking into consideration the Project Specific Mitigation outlined in Section 8.7 to determine if a significant residual effect remains.

8.8.1 Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion

The assessment identified that during the months of peak herring spawning (October to January), intrusive seabed works e.g. cable trenching, repair and maintenance activities, within the Dunmore East Herring Spawning area would cause Significant effects if unmitigated. A seasonal constraint on intrusive seabed works has been proposed in the form of Project Specific Mitigation PS5. By applying this mitigation the residual effect reduces to **Slight** and is **Not Significant** as the herring eggs and larvae will not be present on the seabed outside of this time and no pressure pathway will exist.

8.8.2 Physical change (to another seabed type)

If burial in sediment cannot be achieved at the HDD exit points, external cable protection, covering a total area of 208m^{2}, will be used. In addition, external cable protection will be used in the Irish Offshore at the third-party asset crossing locations, covering an area of 4036m^{2}. In future, in the unlikely event that the cables require repair that necessitates the use of external cable protection, it is also possible that rock or concrete mattresses may be deposited within the Proposed Development. The EIA identified that should external cable protection be required within the Dunmore East Herring Spawning area during the peak spawning period (October to January) there would be a Significant effect if unmitigated. The seasonal constraint proposed to mitigate the pressure 'Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion' i.e. PS5, would also be applicable to the deposition of external cable protection.

By applying this mitigation the residual effect reduces to **Slight** and is **Not Significant** as the herring eggs and larvae will not be present on the seabed outside of this time and no pressure pathway will exist.

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9. Birds

This Chapter describes the existing baseline environment for birds, identifies the pressures associated with the Proposed Development and Campile Estuary on the receptors, presents the findings of the environmental impact assessment, and describes how significant effects (if any) will be mitigated.

The Proposed Development refers to the Irish Marine components of Greenlink from mean high-water springs (MHWS) at the Irish landfall at Baginbun Beach, Co. Wexford to the 12nm limit. 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.

This chapter also provides information on the Irish Offshore components of Greenlink from the 12nm limit to the Republic of Ireland/UK median line.

The Campile Estuary component of Greenlink lies along the onshore cable route. Horizontal directional drilling (HDD) will be used to cross the River Campile. The bores will be at a depth of >10m below the river bed. As the bores under the estuary cross the Foreshore, they will be included within the Foreshore Licence application, and therefore the significance of any effects on birds have been assessed in this chapter. The compounds from which the HDD will initiate and terminate will be either side of the estuary, setback above MHWS, and are outside the scope of this EIAR. A separate EIAR will be prepared for the Irish Onshore components of Greenlink, which will include the HDD compounds.

9.1 Data Sources

Baseline conditions have been established by undertaking a desktop review of published information. The data sources used to inform the baseline description and assessment include, but are not limited to the following:

- National Parks and Wildlife Services (NPWS) protected sites conservation objectives and site synopsis;

- Aerial surveys of Cetaceans and Seabirds in Irish waters: Occurrence, distribution and abundance in 2015-2017 (Rogan et al. 2018);
- BirdWatch Ireland (2019) description of species;
- Winter bird surveys in Co. Wexford (Dixon.Brosnan 2016); and
- Ecological assessment of estuarine habitats at Campile estuary and terrestrial ecology in proximity to Baginbun Beach for a proposed electricity interconnector between Ireland and Wales (Dixon.Brosnan 2019)

9.1.1 Bird Surveys

Two winter bird surveys have been conducted for Greenlink as follows:

1. A survey was carried out in November and December 2015 and between January and March 2016 to assess winter bird usage of coastal sites, which could have been selected as landfalls for the Proposed Development (Dixon.Brosnan 2016). The survey covered a total of 4 sites, namely Booley Bay, Boyce's Bay, Baginbun Beach and Sandeel Bay, and observations took place over 6 days.
2. Three vantage points locations where surveyed on six separate occasions from October 2018 to March 2019. The survey locations were based on information gathered during the original site walkover and the location of the Proposed Development, Onshore Ireland and Campile Estuary, preferred routes.

The survey methodology for both winter bird surveys was based on that used by the British Trust for Ornithology (BTO), Wetland Bird Survey (WeBS) and also that for the Irish Wetland Bird Survey (I-WeBS), as outlined in Gilbert et al. (1998). Ninety-minute counts were undertaken at either high tide, mid tide or low tide. The winter bird survey was undertaken using 8.5×45 binoculars and a Swarovski ATX30-70x95 spotting scope.

All waterbirds present within the count areas other than passerines, doves and pigeons were identified to species and their behaviour was also noted. Waterbirds are defined as ''birds that are ecologically dependent on wetlands'' (Ramsar Convention, 1971) which are a diverse group that includes divers, grebes, swans, geese and ducks, gulls, terns and wading birds. Birds flying over the count area but not utilising the resources within it, were not included in the counts, however notes were made on any substantial movements of birds that were observed. Birds re-locating within a site were not counted twice.

Conditions experienced during the survey along with survey notes were also recorded. It is important to note that waterbird counts represent a 'snapshot' of bird numbers during a count session, so in general and taking into account all potential sources of error, resulting data are regarded to be underestimates of population size.

9.2 Consultation

Table 9-1 below summarises the relevant consultant responses on birds. The steps taken to contact stakeholders for comments on the EIA scope is documented in Chapter 5.

Table 9-1 Consultation responses - birds

Stakeholder	Summary of Consultation Response	How response has been addressed
National Parks and Wildlife Service (NPWS)	The following landfall and/or nearshore constraints have been identified during consultation: • Black guillemot breeding area at the Baginbun Headland (both sides of the Martello Tower); • Razorbill, Shag, Fulmar and Guillemot in the vicinity of the landfall; and • There are records of at least one Hen Harrier frequenting the Campile Estuary area, and roosting in the reed beds downstream of the proposed cable crossing. Offshore constraints: • Gannet, Puffin and Guillemot on the Saltee Islands.	The bird sensitivities identified by NPWS have been considered by the assessment (Section 9.6) for the Proposed Development and Campile Estuary. Effects on the Saltee Islands SPA has been considered in Section 9.6 and the Greenlink Marine Natura Impact Statement.

9.3 Existing Baseline

9.3.1 Campile Estuary

Table 9-2 presents the bird count data from the 2018/2019 winter bird survey at Campile Estuary. Three vantage points, north of railway, south of railway and west of Dunbrody Beach were selected to inform the baseline.

Table 9-2 Bird count data – Campile Estuary

Species	1% National	1% International	South of Railway	North of Railway	West of Dunbrody Bridge
Black-headed gull		20000	83 (LT)	16 (LT)	2 (LT)
Common gull		16400	2 (LT)		
Grey Heron	25	2700	1 (LT & HT)	1 (LT)	1 (LT)
Little Egret	20	1300	2 (LT)	2 (LT)	1 (LT)
Cormorant	120	1200		1 (LT)	
Curlew	350	8400	17 (LT)	22 (HT)	2 (LT)
Black-tailed Godwit	190	610	32 (LT)	3 (LT)	2 (LT)
Greenshank	20	2300	3 (LT)	3 (LT)	3 (HT)
Redshank	300	3900	26 (HT)	14 (HT)	3 (LT & HT)

Species	1% National	1% International	South of Railway	North of Railway	West of Dunbrody Bridge
Snipe		20000	9 (LT*)	4 (HT)	
Green Sandpiper		15500			1 (LT)
Turnstone	95	1400	3 (LT)		
Dunlin	570	13300	5 (LT*)		
Wigeon	630	15000	15 (LT)	14 (HT)	
Teal	340	5000	15 (LT)	18 (HT)	23 (HT)
Kingfisher				1 (HT)	1 (LT)
Little Grebe	20	4000	1 (LT)		
Red-throated Diver	20	3000	1 (LT)		
Notes	LT denotes Low tide; HT denotes high tide * Tide receding during survey period, exposing mudflat habitat in which waterbirds forage.				

Of the species noted, the following are listed on Annex I of the EC Birds Directive:

- Little Egret (*Egretta garzetta*)
- Kingfisher (*Alcedo atthis*)
- Red-throated Diver (*Gavia stellate*)
- Dunlin (*Calidris alpine*)

None of the waterbirds recorded by vantage point counts were recorded in high numbers and numbers were low in-comparison to the figures which would be considered nationally significant (i.e. 1% or more of the all-Ireland population of an Annex I species or 1% or more of the bio-geographical population of a migratory species).

9.3.2 Proposed Development

9.3.2.1 Winter bird counts at landfall

Table 9-3 presents the bird count data from the 2018/2019 winter bird survey at Baginbun Beach. One vantage point was selected to inform the baseline.

Table 9-3 Bird count data – Baginbun Beach

Species	1% National	1% International	Baginbun Beach
Herring Gull		10200	7 (LT)
Great Black-backed Gull		4200	15 (HT)
Lesser Black-backed Gull		5500	1 (HT)
Grey Heron	25	2700	1 (LT)
Cormorant	120	1200	4 (HT)
Shag		2000	5 (LT)
Common Guillemot			4 (HT)
Razorbill			3(HT)
Oystercatcher	690	8200	2 (LT)
Great Northern Diver	20	50	10 (LT)
Red-throated Diver	20	3000	2 (HT)
Notes	LT denotes Low tide; HT denotes high tide		

Of the species noted, the following are listed on Annex I of the EC Birds Directive:

- Great Northern Diver (*Gavia immer*)
- Merlin (*Falco columbarius*) – overflying
- Red-throated Diver (*Gavia stellate*)

9.3.2.2 Nearshore and offshore

The coastal sea cliffs, estuaries and offshore islands of Ireland are host to a number of nationally and internationally important bird species, with many areas designated as Special Protection Areas (SPAs). Coastal habitats provide important breeding sites for many species of seabirds, a number of which are protected under national and European legislation.

At least 45 species of seabird (including divers and grebes) have been recorded during at-sea surveys in Irish waters, of which 23 species regularly breed around Ireland (Mackey et al. 2004, Pollock and Barton 2008). In addition, a further 59 species of waterfowl and wader regularly occur at coastal sites such as estuaries around Ireland; including 5 grebe species, 2 heron species, 26 species of wildfowl and 26 wader species (Crowe 2005). Some of these species are migratory and are present only during migration periods in spring and autumn; others come to Ireland to breed or to spend the winter, while some are resident all year round.

The most important national and international seabird populations are protected within designated sites including Special Protection Areas (SPAs), Ramsar sites and

Natural Heritage Areas (NHAs). The Greenlink Natura Impact Statement (NIS) identified four SPAs within 10km of the Proposed Development. These sites were assessed during the Stage 1 – Appropriate Assessment (AA) Screening to determine if there was potential for connectivity to the Proposed Development. Table 9-4 presents high-level details on the four sites and the conclusion of the Stage 1 - AA Screening.

For two of the four sites, a possible pathway between the Proposed Development and the site was identified. Further details on these two sites is provided in the following sub-sections.

Table 9-4 SPAs assessed in the Greenlink Marine Natura Impact Statement, Stage 1 – AA Screening

Site name & code	Distance to Proposed Development	Features of Intertest	Stage 1 - AA Screening Conclusion
Bannow Bay SPA IE0004033	1.6km	Light-bellied Brent Goose (*Branta bernicla hrota*) Shelduck (Tadorna tadorna) Pintail (*Anas acuta*) Oystercatcher (Haematopus ostralegus) Golden Plover (Pluvialis apricaria) Grey Plover (Pluvialis squatarola) Lapwing (Vanellus vanellus) Knot (Calidris canutus) Dunlin (Calidris alpina) Black-tailed Godwit (*Limosa limosa*) Bar-tailed Godwit (*Limosa lapponica*) Curlew (Numenius arquata) Redshank (Tringa totanus) Wetland and Waterbirds	It is possible that site features could interact with the Proposed Development. Screening Conclusion: **No likely significant effects.**
Keeragh Islands SPA IE004118	4.5km	Cormorant (*Phalacrocorax carbo*)	It is possible that site features could interact with the Proposed Development. Screening Conclusion: **No likely significant effects.**
Ballyteige Burrow SPA IE004020	8.1km	Light-bellied Brent Goose Shelduck Golden Plover Grey Plover Lapwing Black-tailed Godwit Bar-tailed Godwit Wetland and Waterbirds	Screening determined it is unlikely that there will be interaction between the site features and the Proposed Development. The site was **screened out.**

Site name & code	Distance to Proposed Development	Features of Intertest	Stage 1 - AA Screening Conclusion
Saltee Islands SPA IE004002	10km	Fulmar (*Fulmarus glacialis*) Gannet (*Morus bassanus*) Cormorant Shag (*Phalacrocorax aristotelis*) Lesser Black-backed Gull (*Larus fuscus*) Herring Gull (*Larus argentatus*) Kittiwake (*Rissa tridactyla*) Guillemot (*Uria aalge*) Razorbill (*Alca torda*) Puffin (*Fratercula arctica*)	Screening determined it is unlikely that there will be interaction between the site features and the Proposed Development. The site was **screened out**.

Source: NPWS (2012a), NPWS (2012b), NPWS (2014a), NPWS (2014b)

9.3.2.3 Bannow Bay SPA

The Proposed Development lies 1.6km from the Bannow Bay SPA. This SPA has been designated as one of 68 wildfowl sanctuaries in Ireland (NPWS 2019).

Most of the estuary has been designated as a SPA because of its significant bird interest, particularly for wintering birds. Large numbers of wintering wildfowl and waders feed on the mudflats and sandflats and use the fringing vegetation of reedbed and saltmarsh for roosting and feeding.

Populations present in the Bannow Bay SPA are discussed in Table 9-5 below (NPWS 2012a). The SPA has been designated for the presence of four species: Bar-tailed godwit, Light-bellied Brent goose, Dunlin and Black-tailed godwit. A further nine species have been identified as additional special conservation interests.

Table 9-5 Designated species in the Bannow Bay SPA

Interest features	Species	Description
Selection Species		
Annex I species	Bar-tailed godwit	Baseline population within SPA: 471. The SPA support 1% or more of the biogeographical population. Bair-tailed godwit are waders, and are solely wintering in coastal areas, in particular sandy estuaries, from October to April. The species is only known to winter in 10 sites across Ireland. Bar-tailed godwit feed in shallow waters on polychaete worms.
Internationally important	Light-bellied Brent goose	Baseline population within SPA: 561. The SPA support 1% or more of the biogeographical population. Light-bellied Brent goose are found in costal estuaries and grasslands during the autumn and winter. During winter months, they feed on eelgrass.
	Black-tailed godwit	Baseline population within SPA: 546. The SPA support 1% or more of the biogeographical population.

Interest features	Species	Description
		Black-tailed godwit are waders and winter visitors, mainly encountered in September in Ireland. They are found inland and in coastal areas, in particular estuaries. The species feed on invertebrates, principally in muddy estuaries.
All Ireland's important	Dunlin	Baseline population within SPA: 3,038. The SPA support 1% or more of the Irish population. Dunlin are waders, wintering in Ireland, and are the most abundant wader during winter months. They are common along coastal areas, especially tidal mudflats and estuaries. The species feed on invertebrates and polychaete worms.
Additional special conservation interests		
Annex I species	Golden plover	Baseline population within SPA: 1,955. The SPA support 1% or more of the Irish population. Golden plover are waders over-wintering in Ireland, in particular between October and February, in large flocks. They are widespread in Ireland and can be found both inland and in coastal areas.
All Ireland's important	Shelduck	Baseline population within SPA: 500. The SPA support 1% or more of the Irish population. Shelduck are present in Ireland all year in coastal area. They breed in open seas along seashores and rivers. Spatial distribution of the animals in linked to their prey.
	Pintail	Baseline population within SPA: 52. The SPA support 1% or more of the Irish population. Pintail are present along the eastern coast of Ireland, in particular in wetlands from October to March. Wintering animals are located in coastal lagoons and estuaries. A very limited amount of pairs are known to be breeding in Ireland. The pintail's diet principally consists of underwater plants and seeds, as well as of crustaceans.
	Oystercatcher	Baseline population within SPA: 711. The SPA support 1% or more of the Irish population. Oystercatcher are a wader species. The largest densities of oystercatcher in Ireland are observed between September and March; however, some individuals are present all year in most of Ireland. In the Bannow Bay SPA, oystercatcher is only found over the winter months. The species is found in all coastal habitats, particularly open sandy coasts. Oystercatcher feed on larger invertebrates, such as mussels and cockles.
	Grey Plover	Baseline population within SPA: 142. The SPA support 1% or more of the Irish population. Grey plover are waders. They are observed during the winter in Ireland and are present in high numbers between September and April. They over-winter across Ireland, but are only found in coastal areas, in particular the east and south coast of Ireland. The distribution of grey plover is more widespread while feeding. The species principally feeds of burrowing intertidal invertebrates.
	Lapwing	Baseline population within SPA: 2,950. The SPA support 1% or more of the Irish population.

Interest features	Species	Description
		Lapwing are waders, found across Ireland, both inland and in coastal areas. In the SPA, the species is present only during the winter months. Greatest number of lapwing occur between September and April in Ireland. The species is principally found in wetlands during the winter months. Lapwing are opportunistic feeder; they feed on invertebrates.
	Knot	Baseline population within SPA: 508. The SPA support 1% or more of the Irish population. Knot are waders and winter visitors, primarily recorded between October and February in Ireland. The population in Ireland is entirely coastal, mainly in estuaries with large muddy sand areas. Knot feed on crustaceans.
	Curlew	Baseline population within SPA: 891. The SPA support 1% or more of the Irish population. Curlew are widespread in Ireland, including some individuals present all year around inland. Population of curlew within the SPA are winter visitors, in particular in wetland habitats. Curlew feed in estuaries and target invertebrates.
	Redshank	Baseline population within SPA: 377. The SPA support 1% or more of the Irish population. Redshank are winter visitors along the Irish coastline. They are generally found in large estuaries and inlets. Highest numbers of the species are recorded during the early autumn.
Note: baseline population is a 5-year mean peak count for the period 1995/1996 to 1999/2000 (NPWS 2012a).		

Source: NPWS (2012a), BirdWatch Ireland (2019)

9.3.2.4 Keeragh Islands SPA

The Proposed Development route lies 4.5km from the site. The SPA consists of two low-lying islets, approximately 1km from the coastline. The Keeragh Islands SPA have a nationally important breeding colony of cormorant, which is considered to be one of the largest in Ireland (NPWS 2014a). No Annex I species have formed part of the selection process for the site.

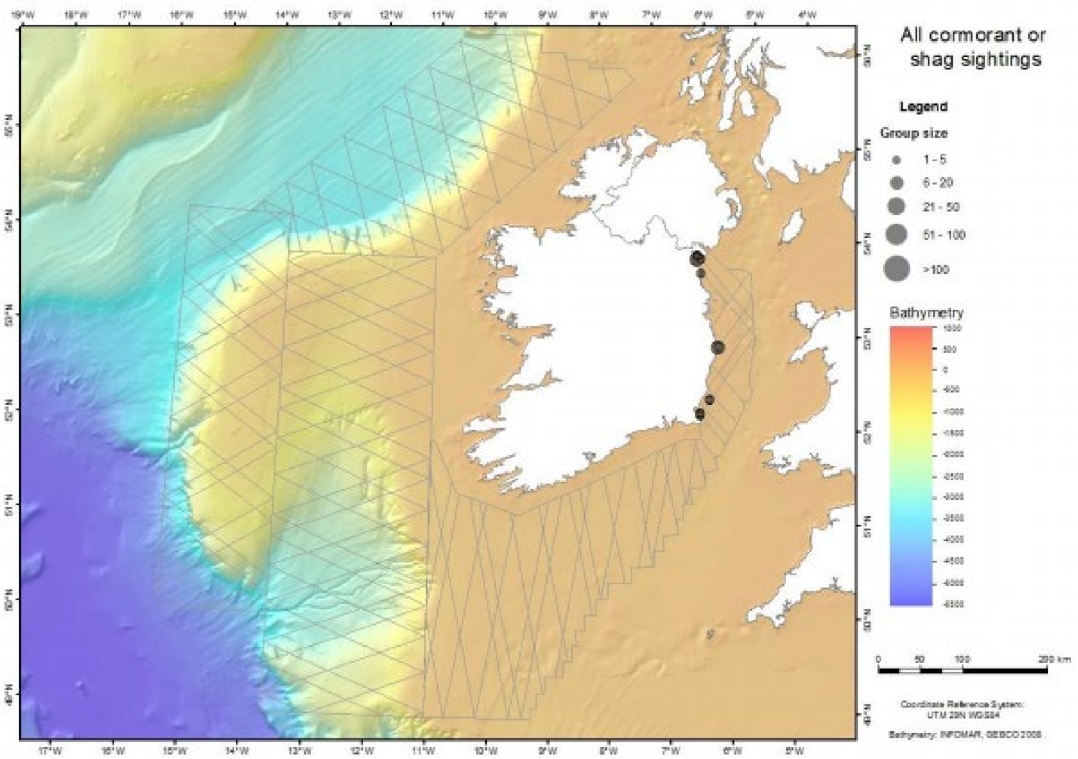
The cormorant colony has been well-monitored since it was first recorded in 1968 and there has been a long-term ringing programme. Cormorant usually start breeding on Keeragh Island in March and their eggs usually hatch after one month, their young fledge in about two months and after that are dependent on their parents for food for a further three months. Therefore, the breeding season extends from February to September (Wexford Naturalists 2012a). Approximately 200 pairs of breeding cormorants were recorded in the Keeragh Islands SPA in 2000 (NPWS 2014a).

The SPA also attracts breeding terns, species that are listed on Annex I of the European Commission (EC) Birds Directive, though none have been recorded since the 1970s. In winter the Keeragh Islands are a refuge and night roost for flocks of brent goose and for ducks, notably mallard and wigeon with smaller numbers of teal and shoveler (NPWS 2014a).

A small number of cormorant observations, the designating feature of the Keeragh Islands SPA were recorded across two days in December 2015 and March 2016 in Baginbun Bay during the 2015-2016 bird survey. No more than one cormorant was recorded per day at Baginbun Bay (Dixon.Brosnan 2016). Four cormorant were counted during the 2018-2019 winter bird counts at Baginbun Beach (Dixon.Brosnan 2019).

Aerial surveys, reported in Rogan *et al.* (2018), recorded 14 observations of cormorants and/or European shags (these species could not be differentiated during the surveys). Most sightings occurred in coastal areas in the Irish Sea (see Figure 9-1), and primarily occurred during the winter, when the species is known to use the Kerragh Islands SPA.

Figure 9-1 Cormorant sightings



Source: Rogan *et al.* (2018)

9.3.3 Protected species and species of conservation importance

There is legislation in place which protects certain bird species in Ireland. The key legislation is the Wildlife (Amendment) Act 2000 which provides protection for all wild birds with the exception of those listed in the Third Schedule (which includes Greater Black-backed gull, Herring gull and Lesser Black-backed gull). The Act transposes into statute Irelands obligations under The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention); The Convention on the conservation of European wildlife and natural habitats (Bern Convention), the Convention on International Trade in Endangered Species (CITES) and the African-Eurasian Migratory Waterbirds Agreement (AEWA).

9.3.4 *Natural evolution of the baseline*

Introduction of key legislation such as the 1976 Wildlife Act in Ireland and the EC Birds Directive 1979 gave rise to strong protections for Irish seabirds, with it being made an offence to kill, maim or interrupt the breeding of wild birds (DCCAE 2015). These protections, along with similar legislation set out in the UK, reductions in oil pollution and efforts to remove mammalian predators from important breeding sites have led to an increase in populations of many coastal species, with predictions indicating that such species will continue to increase in abundance or remain stable.

Not all species will see such population increases however, with changes in the distribution of prey species having led to declines in some species (DCCAE 2015). Further climate change impacts on coastal processes, such as coastal erosion, may lead to a reduction in foraging habitat for wading bird species and increase pressure on such populations. Continued monitoring of vulnerable species and climatic conditions is needed to endure negative population trends are identified promptly along with their cause.

9.4 *Potential Pressure Identification and Zone of Influence*

A scoping exercise undertaken to inform the content of the EIA has excluded the following pressure from further consideration in this topic Chapter. Explanation for the exclusion is provided in Chapter 5, Table 5-2:

- Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion.

The pressures listed in Table 9-6 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 9-6.

Table 9-6 Pressure identification and zone of influence - birds

Project Phase	Project Activity	Aspect	Potential Pressure	Receptor	Zone of Influence
Installation	Campile Estuary HDD	Onshore works	Visual disturbance	Birds	Campile Estuary
	Pre-installation and post-installation survey Cable burial	Presence of project vessels	Visual disturbance	Divers and sea ducks	4km radial distance from vessel*
				All other species	2km radial distance from vessel*
Operation	Maintenance survey Repair and maintenance operations				

* 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 2017).

9.5 Embedded Mitigation

The project description, Chapter 4, provides the design. 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 birds is provided in Table 9-7 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 9-7 Embedded mitigation

ID	Embedded Mitigation
EM5	Control measures and shipboard oil pollution emergency plans (SOPEPs) will be in place and adhered to under MARPOL Annex I requirements for all project vessels.
EM7	Chemicals will be stored in a secure, designated area in line with appropriate regulations and guidelines. A Chemical Risk Assessment will be prepared for the use of chemicals. A chemical inventory shall be kept of all chemicals and oils used.
EM18	Project vessels will not exceed 14 knots within the Proposed Development.

9.6 Significance Assessment

9.6.1 Summary of assessment

Table 9-8 presents the impact assessment conducted on the Proposed Development activities. Section 9.6.2 provides justification for the conclusions. Where the assessment concluded the effects are significant, Project Specific Mitigation has been proposed and is described in Section 9.7. Where there is still potential for residual effects, this is discussed further in Section 9.8.

Table 9-8 Impact assessment summary - birds

Determination of potential effect						Impact assessment			Consideration of mitigation	Residual effect assessment		
Section	Project Phase	Aspect	Embedded mitigation (Table 9-7)	Potential Pressure	Receptor	Magnitude	Sensitivity	Significance	Project Specific Mitigation (Table 9-9)	Magnitude	Sensitivity	Significance of Residual Effect
9.6.2	Campile Estuary	Onshore works	EM5, EM7, EM18	Indirect disturbance	Estuary birds	Low	Medium	Slight	PS6, PS7, PS8	Negligible	Medium	Not Significant
	Installation Operation Decommissioning	Presence of vessels		Visual Disturbance	Bannow Bay SPA	Negligible	Low	Not Significant	-	-	-	-
					Keeragh Islands SPA	Negligible	Medium	Not Significant	-	-	-	-

9.6.2 Visual Disturbance

9.6.2.1 Campile Estuary

The mudflat habitat noted along the Campile estuary is of value for waders e.g. Curlew, Black-tailed Godwit, Greenshank and Redshank all of which were recorded during the 2018-2019 winter bird survey. Although the works under the foreshore will not result in the disturbance of the birds, as the bores will pass >10m below the riverbed, there is the potential for effects from the onshore works at the HDD compounds. The HDD compounds are set-back from the MHWS approximately 100-200m

The onshore works at the HDD compounds have the potential to cause temporary to short-term disturbance. However, effects will be minimised by the use of a trenchless crossing technique which moves the potential disturbance away from the more sensitive foreshore area to the agricultural grassland which has a low ecological value at a local level (Dixon.Brosnan 2019). The magnitude of the effect has been assessed as low. The sensitivity of birds at the estuary has been assessed as medium due to the proximity of the works. The overall significance of the effect has been assessed as **Slight** and is **Not Significant**.

The Irish Onshore ecological assessment (Dixon.Brosnan 2019) concluded that effects can be further minimised by seasonal restrictions on activities, and the Irish Onshore EIAR has proposed Project Specific Mitigation – see Section 9.7.

9.6.2.2 Proposed Development: Installation

The landfall, nearshore and offshore waters of the Proposed Development are of value to marine birds which use the area for feeding, loafing and breeding. The additional temporary activity associated with the Proposed Development e.g. presence of vessels, may disturb birds.

Disturbance can lead to a number of physiological and behavioural responses which can affect demographic characteristics of the population. Responses to disturbance can result in loss of energy; impaired breeding; unrest through increased vigilance; and disruption to incubation leading to increased nest failures due to predation and nest abandonment (Valente and Fischer 2011).

The extent to which a seabird responds to disturbance is dependent upon a number of factors including: period of breeding cycle during which disturbance occurs; duration, type and intensity of the disturbance; presence of opportunistic predators; and the degree of habituation with the disturbance (Showler *et al*. 2010). Some seabirds are more resilient to disturbance than others.

The most vulnerable birds to disturbance would be birds located within the zone of influence, as defined in Table 9-6. Disturbance could result from the presence and movement of 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 (Valente and Fischer 2011). Whilst birds present on the surface waters in the vicinity of project vessels could be temporarily displaced from their chosen feeding/resting location, they are likely to readily move to another nearby location.

The Greenlink Marine NIS identified a possible pressure-receptor pathway between the Proposed Development and the conservation objectives of two SPAs:

- Bannow Bay SPA; and
- Keeragh Islands SPA.

The effects of visual disturbance on seabirds within these SPAs is discussed further below.

Bannow Bay SPA

The Bannow Bay SPA is located 1.6km from the Proposed Development. Large numbers of wintering wildfowl and waders feed on the mudflats and sandflats and use the fringing vegetation of reedbed and saltmarsh for roosting and feeding. The wildfowl and waders, which the SPA supports, are identified as being sensitive to visual disturbance. The presence of vessels may cause birds within this SPA to cease feeding or move away from the area, which may affect the energy requirements of the birds and influence individual fitness. Given the proposed development overlaps with the zone of influence for disturbance (2km),it is possible that over wintering birds within this site could be disturbed by installation activities (due to the presence of vessels).

However, the majority of birds within the SPA are waders and given that they roost and feed on land and in the Bannow Bay intertidal area, they are unlikely to be present within the Proposed Development. None of the species of interest for the site were recorded in the 2018-2019 winter bird counts at Baginbun Beach.

In addition, any disturbance is likely to be limited, both in time and space, and the availability of alternative suitable habitat within the local area is expected to be high. The magnitude of the effect has been assessed as negligible. The sensitivity of species has been assessed as low, and visual disturbance is not expected to result in changes to the bird population within the Bannow Bay SPA. The overall significance of effect has been assessed as **Not Significant**.

This potential effect has also been assessed within the Greenlink Marine NIS. It concluded No Likely Significant Effects and that an Appropriate Assessment is not required for this site.

Keeragh Islands SPA

The Keeragh Islands SPA has a nationally important breeding colony of cormorant (200 pairs recorded in 2000), which is considered to be one of the largest in the country.

The zone of influence of disturbance of nesting birds is considered to be up to 2km from the vessels based on JNCC (2017). The Proposed Development lies 4.5km from the site i.e. outside the zone of influence for nesting birds.

The foraging distances for breeding Cormorant is stated in Thaxter et al. (2012) as a maximum of 35km and mean of 5km. Therefore, it is possible that cormorant may forage within the Proposed Development and may be disturbed by the presence of the installation vessels. They may also use the Proposed Development for loafing.

The Joint SNCB Interim Displacement Advice Note (JNCC 2017) categorises species by their sensitivity to disturbance and their habitat specialisation. Cormorant is classed as having a moderate habitat specialisation and high susceptibility to disturbance (score of 3 out of 5 for specialism and 4 out of 5 for disturbance). The sensitivity of the receptor has therefore been assessed as medium.

The cable installation activities will not reduce, other than temporarily the natural range of cormorant, nor will it have a significant effect on the habitat that the cormorant require to maintain the population.

The project vessels will be slow moving, and any such disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc. Operations in the foreshore area will be of short duration, after which vessels will leave the area. Given the wider area available, birds are likely to be able to find alternative feeding / loafing grounds temporarily. The magnitude of the effect has been assessed as negligible.

The overall significance of the effect has been assessed as **Not Significant**.

This potential effect has also been assessed within the Greenlink Marine NIS. It concluded No Likely Significant Effects and that an Appropriate Assessment is not required for this site.

9.6.2.3 Proposed Development: Intra-project effects

The Campile estuary is too far away from the onshore / offshore interface at Baginbun beach to contribute to any potential intra-project cumulative effects. The area identified as having potential for intra-project effects is at the interface between onshore works at the Baginbun landfall HDD compound and nearshore works in the Proposed Development.

The protected sites for birds and the species they support, which have potential to be affected by the onshore works differ from those which have potential to be affected by the nearshore works. Therefore there is no overlap of effects on a given bird receptor. Additionally, timings of when the vessels will be present in the nearshore for the cable pulling operations are likely to differ by at least a season to the noisiest activities (HDD drilling) onshore. HDD drilling has to come first with cable pull through afterwards. Therefore, it is unlikely that there will be a temporal overlap of effects. The assessment concluded that effects from the Proposed Development will not accumulate with effects from the Irish Onshore or other components of Greenlink in a manner that increases the significance of the effect.

9.6.2.4 Proposed Development: 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 a smaller magnitude when compared to cable installation, due to the restricted duration and spatial extent of works. The assessment considered five discrete repair events and concluded that effects are **Not Significant**.

9.6.2.5 Proposed Development: 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 effects on birds 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 project will be of a comparable magnitude to those assessed above for cable installation and so the effect has been assessed as **Not Significant**.

9.7 *Project Specific Mitigation*

In addition to the embedded mitigation outlined in Table 9-8, Table 9-9 presents measures that GIL is committed to adopting.

Table 9-9 Project specific mitigation - birds

ID	Project Specific Mitigation
PS6	Mandatory separation distance between construction works and the high water mark at Campile Estuary is to be observed as follows: 75m at the northern side, and 50m at the southern side.
PS7	No works will be carried out at the Campile Estuary during the period: 1 October to 31 March (inclusive).
PS8	No works will be carried out within 100m of the high tide line (landward side) to prevent flight response.

9.8 *Residual Effect*

The assessment presented in Section 9.6 concluded that the Proposed Development and Campile Estuary will not have any significant effect on birds. Project Specific Mitigation has been proposed in the Irish Onshore EIAR to further reduce the significance of effects from the HDD drilling at Campile estuary. This has been replicated here as PS4, PS5 and PS6 which will ensure that the onshore works are scheduled to reduce the sensitivity of estuarine and intertidal birds. This will reduce the significance of the residual effect from Slight to **Not Significant**.

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10. Marine Mammals and Reptiles

This Chapter describes the existing baseline environment for marine mammals and reptiles, identifies the pressures associated with the Proposed Development on the receptors, presents the findings of the environmental impact assessment, and describes how significant effects (if any) will be mitigated.

The Proposed Development refers to the Irish Marine components of Greenlink from mean high-water springs (MHWS) at the Irish landfall at Baginbun Beach, Co. Wexford to the 12nm limit. 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.

This Chapter also includes information on the Irish Offshore components of Greenlink from the 12nm limit to the Republic of Ireland/UK median line.

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

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

10.1 Data Sources

Baseline conditions have been established by undertaking a desktop review of published information. The data sources used to inform the baseline description and assessment include, but are not limited to the following:

- Ireland Marine Atlas (Marine Institute 2015);
- Habitat of individual cetacean species within Irish waters (NPWS 2015);
- Offshore Energy Strategic Environmental Assessment. Department of Energy and Climate Change – marine mammals (DECC 2016);
- Atlas of cetacean distribution in northwest European waters (Reid et al. 2003);
- Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III (Hammond et al. 2017);
- Saltee Islands Special Area of Conservation (SAC) supporting documents (NPWS 2011 and 2013); and
- Other data sources as listed at the end of the Chapter.

10.2 Consultation

Table 10-1 summarises the relevant consultation responses on marine mammals and reptiles. The steps taken to contact stakeholders for comments on the EIA scope is documented in Chapter 5.

Table 10-1 Consultation responses – marine mammals and reptiles

Stakeholder	Summary of Consultation Response	How response has been addressed
Natural Resources Wales (NRW)	It is recommended that NMFS (2016) criteria is used for thresholds of marine mammal permanent threshold shift (PTS) and temporary threshold shift (TTS).	The NMFS issued a 2018 revision to the 2016 guidance on Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. The 2018 guidance has been used in the noise assessment presented in Technical Appendix C and summarised in Section 10.6.1.

10.3 Existing Baseline

10.3.1 General overview

Marine mammals present in the vicinity of the Proposed Development include cetaceans (whales, dolphins and porpoises), pinnipeds (seals) and potentially otter. Chelonians (marine turtles) are the only type of reptile that may potentially be encountered.

Most cetaceans are wide-ranging and individuals encountered within Irish waters form part of a much larger biological population whose range extends into adjacent jurisdictions. As a result management units (MUs) have been have been outlined for seven of the common regularly occurring species following advice from the Sea Mammals Research Unit and the International Council for the Exploration of the Sea (ICES) (DECC 2016). These provide an indication of the spatial scales at which effects of anthropogenic activities should be taken into consideration. Species, for which MUs have been defined and the relevant MUs are shown in Table 10-2.

10.3.2 Cetaceans

There are 24 species of cetacean reported in Irish waters with ten species known to be present all year round (NPWS 2015). Some species can occur close to shore, and may be found within enclosed bays, harbours and estuaries e.g. harbour porpoise;

others are highly migratory and show a preference for deeper water offshore habitats e.g. blue whale.

The species of cetaceans that are frequently spotted in the surrounding waters off south east Ireland include: harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), short beaked common dolphin (*Delphinus delphis*), minke whale (*Balaenoptera acutorostrata*), Risso's dolphin (*Grampus griseus*), killer whale (*Orcinus orca*), pilot whales (*Globicephala melas*), humpback whales (*Megaptera novaengliae*) and fin whales (*Balaenoptera borealis*) (Marine Institute 2015).

Table 10-2 lists species which may be present in the Proposed Development and provides an appraisal of the frequency of sightings. Generally, the greatest numbers of cetacean species are present in coastal waters within the summer months[1].

The Irish Whale and Dolphin Group (IWDG) website (http://www.iwdg.ie/) has 67 records of cetacean sightings near the Proposed Development for the period February 2018 to February 2019. Species identified include harbour porpoise; minke whale; Risso's dolphin; bottlenose dolphin; short beaked common dolphin; and humpback whale. Observations have been included in Table 10-2.

Harbour porpoise and short beaked common dolphin are the most abundant and commonly sighted species in the area, with most sightings taking place between spring and autumn. These two species are discussed in further detail below.

Harbour porpoise is the most abundant and widely distributed cetacean species in Irish waters, and the most frequently observed in the near shore section of the proposed marine cable route (DAHG, 2014).

Other toothed whales (e.g. white beaked dolphin and long finned pilot whale) are sighted in low numbers, most frequently between spring and autumn. Baleen whales (e.g. minke, humpback and fin whale) may also be sighted. The most frequently sighted baleen whale is the minke, with peak sightings taking place from May to September.

The baseline description below focuses on two cetacean species: Harbour porpoise; and short-beaked common dolphin. These species have been selected as they are either a Qualifying Feature of an SAC in the region (harbour porpoise) or they are the most abundant species in the region (short-beaked common dolphin).

[1] Summer is classed as April to September and winter classed as October to March.

Table 10-2 Cetacean species whose distribution includes the Proposed Development

Species	Frequency of sightings*	IWDG sightings (Feb 2018 - Feb 2019)	Estimation of density (animals/km^2) **	Applicable MU***	Abundance of animals in MU***
Toothed whales (odontocetes)					
Harbour porpoise (*Phocoena phocoena*)	Common from June through the autumn/winter. Peak period in August. Commonly recorded off the Hook Head Peninsula.	April, May, July & November. Individuals and up to 6 animals.	0.118-0.239	Celtic and Irish Seas	47,229
Short-beaked common dolphin (*Delphinus delphis*)	Peak period is spring and summer and winter peak on the south coast associated with prey items.	Large pod in region (off Helvic Head) numbering 100-150 animals observed October to January.	0.374	Celtic & Greater North Seas	56,556
Bottlenose dolphin (*Tursiops truncatus*)	Common year round but most frequent in summer.	1 animal sighted July.	0.008 - 0.06	Offshore Channel and SW England	4,856
Striped dolphin (*Stenella coeruleoalba*)	Irregular in Irish Sea. Summer and early autumn months.	-	0.005	N/A	No data available
Risso's dolphin (*Grampus griseus*)	Peak period in April - Sept	June, July, September. Individuals and up to 15 animals.	0.031	Celtic & Greater North Seas	No data available
White-beaked dolphin (*Lagenorhynchus albirostris*)	Irregular in Irish Sea. More regular in late summer - autumn.	-	No data available	Celtic & Greater North Seas	15,895
Long-finned pilot whale (*Globicephala melas*)	Most frequent between April and September	-	No data available	N/A	No data available
Killer whale (*Orcinus orca*)	Occasional sightings in Irish Sea waters.	-	No data available	N/A	No data available
Baleen whales (mysticetes)					
Minke whale (*Balaenoptera acutorostrata*)	Peak period July and August	May, July, November. Individuals and up to 4 animals.	0.011 - 0.017	Celtic & Greater North Seas	23,528
Humpback whale (*Megaptera novaeangliae*)	Occasional sightings in Irish Sea waters.	October, November. Individuals	No data available	N/A	No data available
Fin whale (*Balaenoptera physalus*)	Unclear, contradictory evidence with sightings during summer months, and acoustic monitoring data suggest a peak in November - December.	October through to January. Individuals and up to 6 animals.	No data available	N/A	No data available

Sources: * Marine institute (2015) and Reid et al. (2003), ** Hammond et al (2017) ICES Management Units D and E (Celtic/Irish seas) and *** DECC (2016).

Harbour porpoise

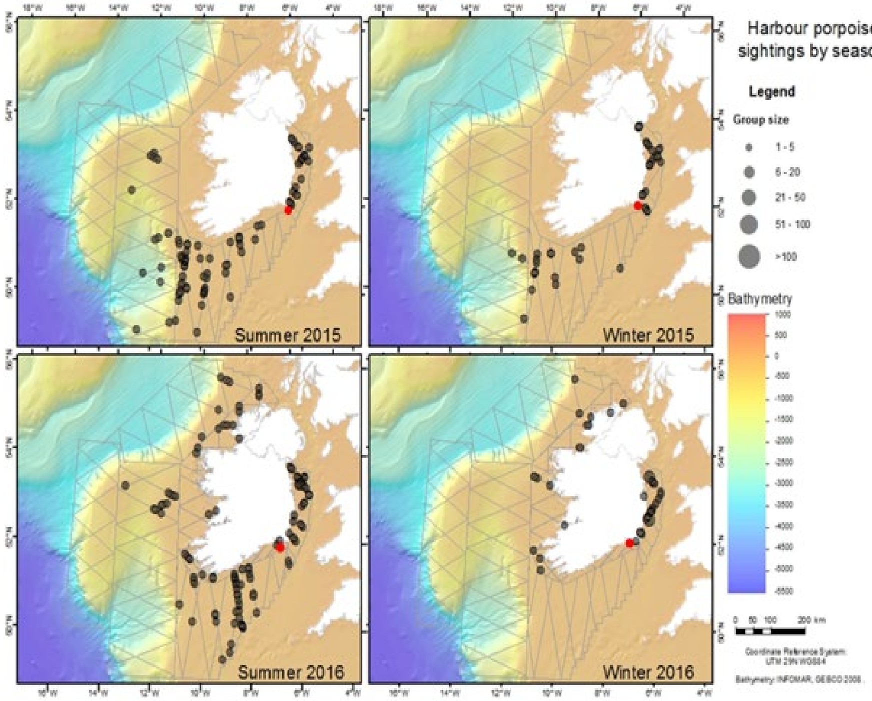
Harbour porpoise is the most common cetacean in Irish and UK waters, it is wide-ranging and abundant, both coastally and offshore, with the most signing occurring in the coastal area, close to islands and headlands with strong tidal currents (DECC 2016). Harbour porpoise generally prefer coarser sediments which is the habitat of sandeel, a known prey species. Many sightings of harbour porpoise have been recorded by the obSERVE Project around the Hook Head Peninsula (Figure 10-1). As can be seen from this figure, harbour porpoise near to Hook Head are observed all year round, with the greatest number of sightings taking place during the summer months.

The Proposed Development and Irish Offshore cross the Celtic and Irish Sea MU. Harbour porpoise survey data was analysed and modelled to determine areas of high porpoise density within the MU. These areas were then considered in order to identify a network of SACs recommended for the protection of harbour porpoise. Within the Celtic and Irish Sea MU, there are currently four SACs, the Bristol Channel Approaches / Dynesfeydd Môr Hafren SAC, West Wales Marine / Gorllewin Cymru Forol SAC, North Anglesey Marine/ Gogledd Môn Forol SAC and North Channel SAC. This network of protected sites will contribute towards maintaining the favourable conservation status of the wider population of harbour porpoise (JNCC 2017). Although these sites are located over 50km from the Proposed Development, harbour porpoise from these sites maybe visitors to the area.

To summarise, harbour porpoise is likely to be present throughout the Proposed Development and Irish Offshore throughout the year, but densities will be highest during the summer and autumn months.

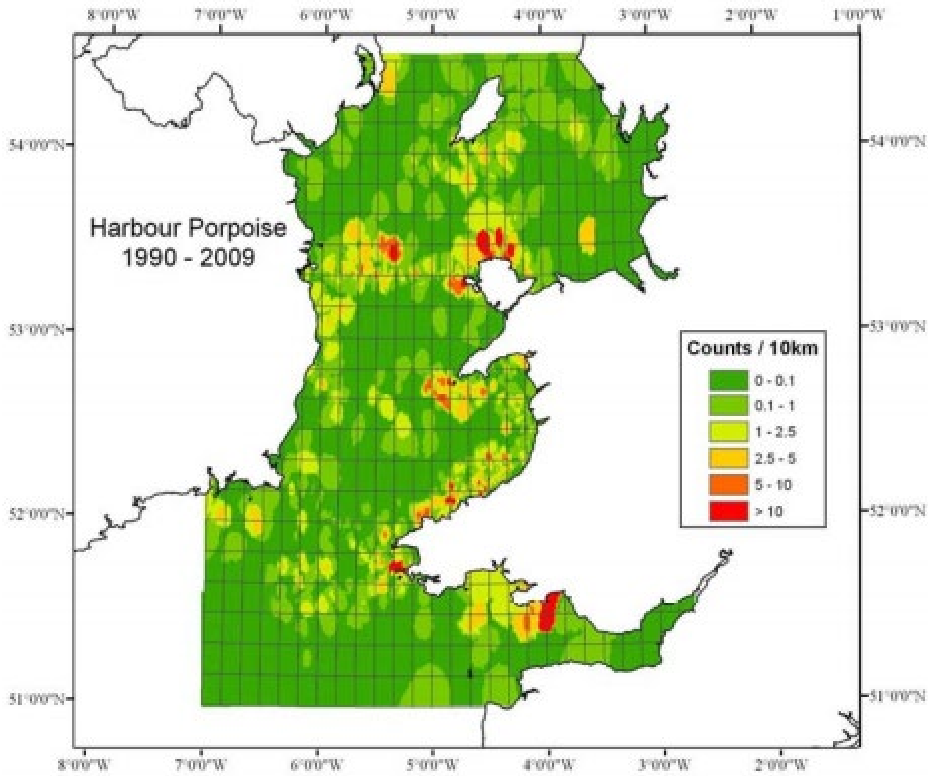
Figure 10-1 below shows the concentration of harbour porpoise sightings between 1990-2009.

Figure 10-1 Harbour porpoise sightings



Source: obSERVE (2016) red dot = Hook Head

Figure 10-2 Long term sighting rates (vessel counts per 10km) of harbour porpoise



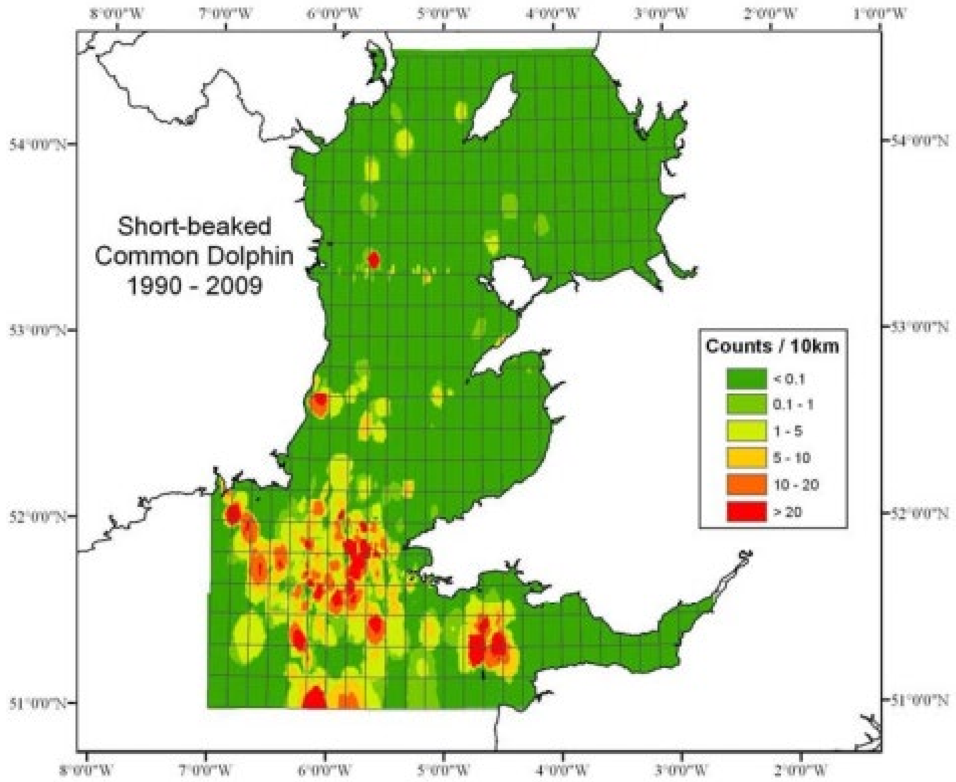
Source: Baines and Evans (2012)

Short-beaked common dolphin

During the summer this species is widely distributed throughout the Proposed Development. Strong seasonal shifts in their distribution have been noted, with winter inshore movements onto the Celtic Shelf and into the western English Channel and St. George's Channel resulting in pronounced concentrations. During the summer, coinciding with the mating/calving period (May to September), the majority of sightings are more widely dispersed along and off the continental shelf slope and off the west coast of Ireland.

Figure 10-2 below presents the concentration of short-beaked common dolphin sightings between 1990-2009; showing well defined areas of higher density in the Celtic Sea offshore of southeast Ireland (Figure 10-3). The high-density area may be associated with a frontal system of high primary productivity, termed the Celtic Sea Front (Baines and Evans 2012).

Figure 10-3 Long term sighting rates (vessel counts per 10km) of common dolphin



Source: Baines and Evans (2012)

10.3.3 Pinnipeds

Two species of seal are resident within Irish waters - grey seals (*Halichoerus grypus*) and harbour (or common) seals (*Phoca vitulina*).

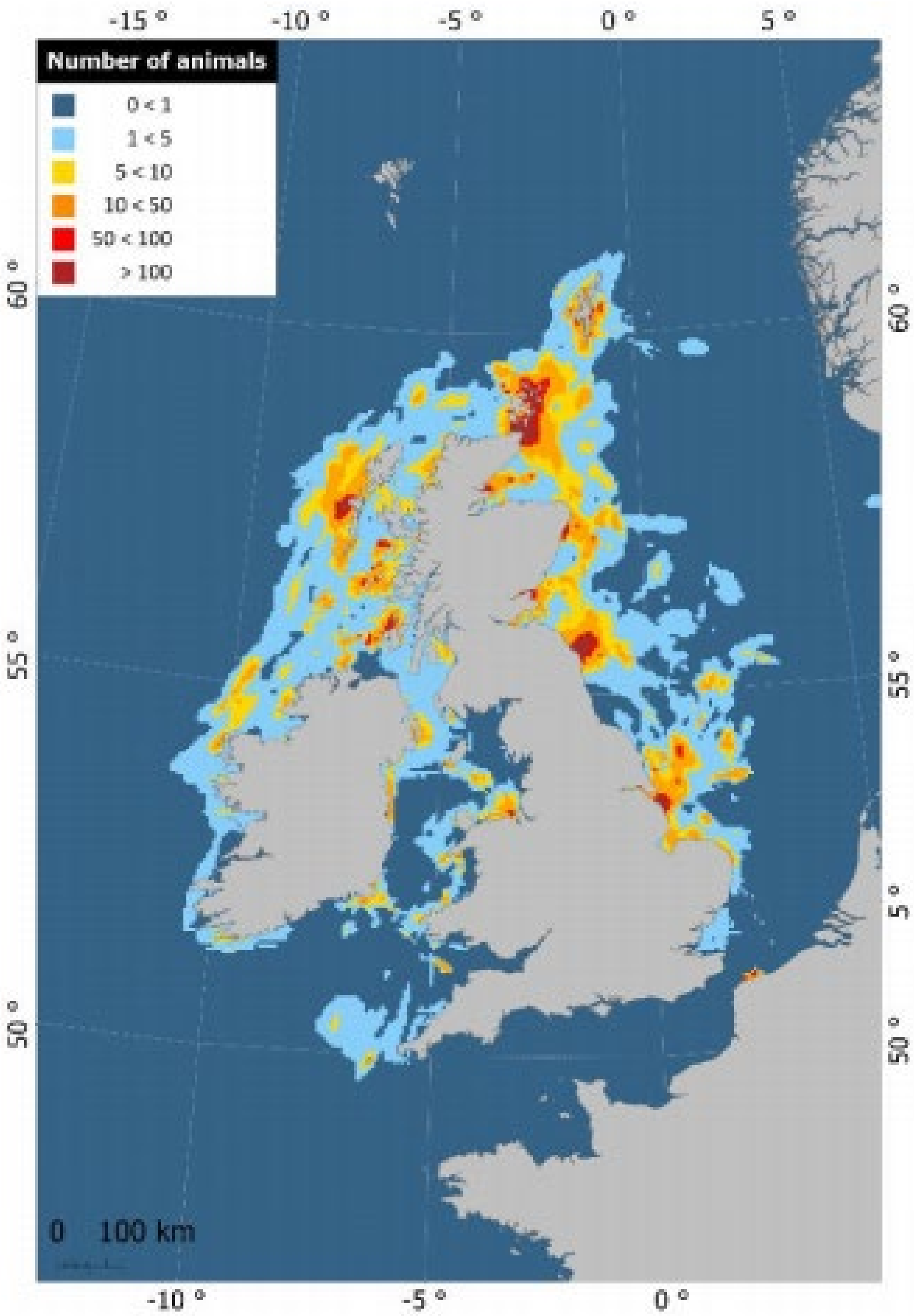
There are three periods in the seal's life cycle which are of particular importance: breeding, moulting and pupping. At these times seals tend to be restricted to haul out sites e.g. males defending territory and females, females feeding pups which can't swim, animals undergoing the moult, and are unlikely to be found offshore. These seasons vary between species and sometimes regions.

Grey seal

Grey seals utilise the area of the Saltee Island SAC (located 6km from the Proposed Development) as one of the very few breeding grounds in eastern Ireland. Grey seal occupies both aquatic and terrestrial habitats in the SAC, including intertidal shorelines that become exposed during the tidal cycle and outlying rocky skerries when these are not inundated by wave action. Grey seal are present at the site throughout the year during all aspects of its annual life cycle which includes breeding, moulting and non-breeding foraging and resting phases (NPWS 2011).

Grey seals at and around the site are vulnerable to disturbance during periods when time is spent ashore by individuals or groups of animals. This occurs immediately prior to and during the annual breeding season, which takes place predominantly during the months of August to December. Pups are born on land, usually on remote beaches and uninhabited islands or in sheltered caves (NPWS 2011). The breeding population was estimated at 571-744 individuals in 2005. A one-off moult count in 2007 gave a figure of 246 individuals. Pupping time occurs primarily from August through to December. After three weeks the pups moult with adults congregating in large numbers on beaches between December and February to moult. This species is a Feature of Conservation Importance for the Saltee Island SAC (NPWS 2013).

Figure 10-4Grey seal at-sea usage: mean

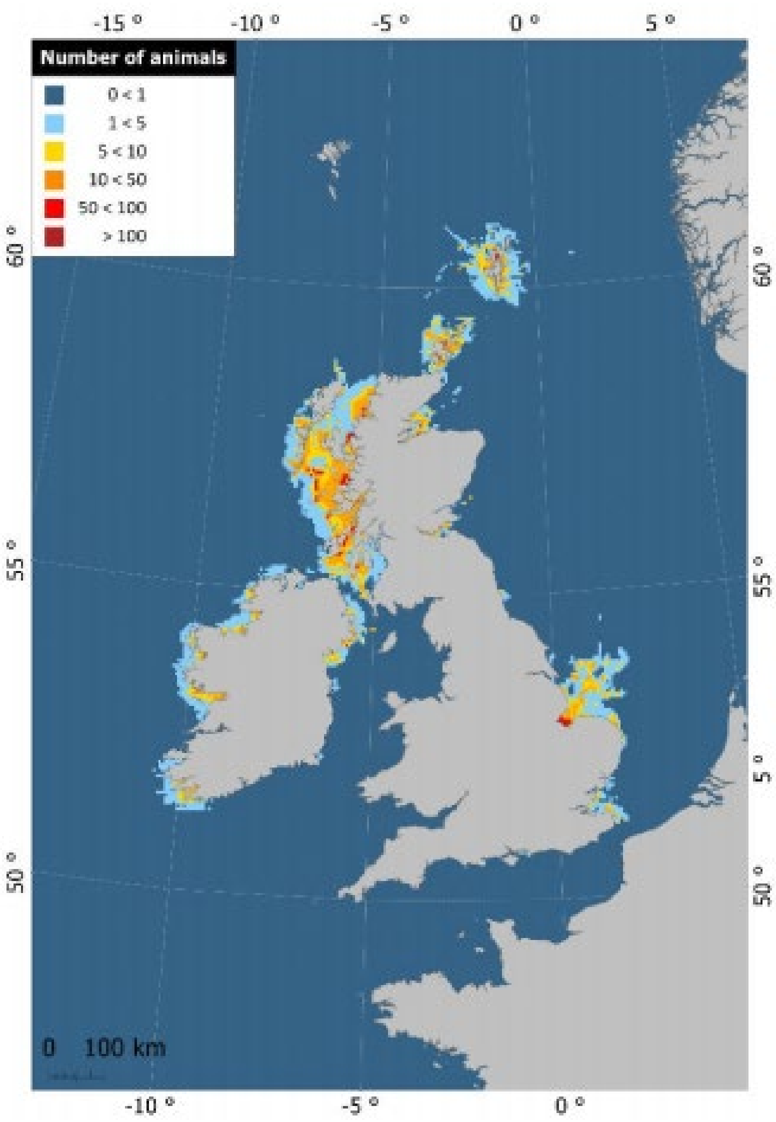


Source: Russell et al (2017)

Harbour seal

The harbour seal is widespread around the shores of Ireland, but population density varies greatly from place to place with low numbers at many sites. Sightings of the harbour seal within the vicinity of the Proposed Development are infrequent (< 1 individuals per $5km^2$), as illustrated in Figure 10-5.

Figure 10-5 Harbour seal at-sea usage: mean



Source: Russell et al (2017)

10.3.4 Chelonians

Five species of turtle have been recorded in Irish waters; the vast majority of these are leatherback turtle (*Dermochelys coriacea*) which are generally sighted between August and October. Loggerhead (*Caretta caretta*) and kemp ridley (*Lepidochelys kempii*) turtle have also been observed infrequently whilst records of green and hawksbill turtles are extremely rare. There are approximately 33 animals sighted per year in all UK and Irish waters (approximately 88% of all turtle sightings) (DECC 2016).

Most sightings are on the west and south coasts of Ireland. The Irish Sea is considered a through route for leatherbacks passing from south Ireland and south west England through to Northern Ireland and the west coast of Scotland. Leatherback turtles are most commonly observed around the UK and Ireland between June and October, with peak abundances in August (DECC 2016).

10.3.5 Otter

Otter (*Lutra lutra*) are semi-aquatic mammals which may inhabit rivers, lakes, coastal areas and marshy areas some distance from open water. Coastal populations utilise shallow, inshore marine areas for feeding but also require fresh water for bathing and terrestrial areas for resting and breeding holts. They are commonly seen foraging within a narrow zone close to the shore (<100m) and only rarely cover larger distances, moving between islands (DECC 2016).

Otter are a Feature of Conservation Importance within the River Barrow and River Nore SAC. Otters are frequent throughout the SAC both on open coast and in the River Barrow waterway especially in areas where there is good access to the sea, sufficient tree and scrub cover and near streams where salt water can be washed off. Otter have also been recorded along the Campile Estuary

Dixon.Brosnan Environmental Consultants undertook an otter survey of the Campile River and Baginbun Beach in 2018 and 2019. A review of existing National Biodiversity Data Centre (NBDC) records show that otter has been recorded in close proximity to sections of the proposed route at Baginbun Beach and in close proximity to the Great Island Power Station. Signs of otter were recorded i.e. spraint (Figure 4-7). A live otter was recorded during a bat survey at Dunbrody Bridge. No holts or couches were recorded. Fresh otter tracks were noted along Baginbun Beach in March, 2019 (Figure 4-8).

Figure 10-6 Locations of otter spraint along the Campile River Estuary.

Figure 10-7 Otter track recorded on Baginbun Beach.

10.3.6 Summary

Table 10-3 highlights the periods when marine mammals and reptiles species are most likely to be present within or near to the Proposed Development.

Table 10-3 Seasonal summary of marine mammal and reptile presence within and near the Proposed Development

Receptor	Associated protected area*	Winter			Summer						Winter		
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Harbour porpoise	None												
Short beaked common dolphin	None												
Bottlenose dolphin	None												
Other toothed wales	None												
Baleen wales	None												
Grey seal	Saltee Island SAC										Pupping		
Harbour seal	Slaney River Valley SAC							Pupping & moulting					
Leatherback turtle (and other turtles)	None												
Otter	River Barrow and River Nore SAC												

*Associated protected sites are only those within the zone of influence of the Proposed Development

10.3.7 Protected species and species of conservation importance

There is legislation in place which protects marine mammals and reptiles in Irish waters. Table 10-4 summarises the key legislation and how it applies to the species identified as present in the Proposed Development.

Table 10-4 Legislation protecting marine mammals and reptiles

<table>
<tr><th colspan="2">Legislation / Convention</th><th>Cetaceans</th><th>Pinnipeds</th><th>Chelonians</th><th>Otter</th></tr>
<tr><td>European Communities (Natural Habitats) Regulations (S.I 94 of 1997)</td><td rowspan="2">Include the necessary legal measures to fulfil the requirements of:
• The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention); The Convention on the conservation of European wildlife and natural (Bern Convention) and
• EC Habitats Directive (particularly in relation to European Protected Species)</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Wildlife (Amendment) Act, 2000</td><td>✓</td><td>✓</td><td></td><td>✓</td></tr>
<tr><td colspan="2">OSPAR (Convention for the Protection of the Marine Environment of the North-East Atlantic) list of threatened and/or declining species</td><td>Harbour porpoise</td><td></td><td>Loggerhead turtle, leatherback turtle</td><td></td></tr>
</table>

All cetaceans, chelonians and otter are listed on Annex IV of the EC Habitats Directive as European Protected Species. It is an offence to deliberately kill, injure or disturb animals classed as EPS.

The following protected sites list a pinniped or otter as a designating feature. These are assessed in detail in the Greenlink Marine Natura Impact Statement (NIS).

- River Barrow and River Nore SAC – otter;
- Saltee Islands SAC – grey seal;
- Lower River Suir SAC – otter; and
- Slaney River Valley SAC – otter and harbour seal.

The Greenlink Marine NIS also considers UK protected sites designated for marine mammals.

10.3.8 Natural evolution of the baseline

While the effects of climate change on marine mammals are not fully understood, one effect that has already been observed is a shift of cold-water species such as white-beaked dolphin further north, with species such as the striped dolphin increasing in population in the Irish Sea (DCCAE 2015, DECC 2016). One of the primary reasons for this shift in distribution is the change in prey availability. Increased fishing pressures as a result of changing commercial fish distributions could also affect local populations, with the potential for increased bycatch of marine mammals. The effects of noise on marine mammals are still not fully understood, so any increase in noise levels generated by human activities, such as offshore windfarm construction, could lead to a negative population effect.

While long-term trends are difficult to predict due to the varying responses that species will have to external pressures, protection of important prey species will help to keep marine mammal populations stable.

10.4 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.

- Death of injury by collision; and
- Hydrocarbon contamination.

The pressures listed in Table 10-4 will be assessed further. For each pressure the assessment considered the different aspects of the Proposed Development and Campile Estuary 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 10-5.

Table 10-5 Pressure identification and zone of influence – marine mammals and reptiles

Project Phase	Project Activity	Aspect	Potential Pressure	Receptor	Zone of Influence
Installation	Cable burial	Continuous noise – vessel dynamic positioning thrusters, cable trenching, rock or concrete mattress placement	Underwater noise changes - physical injury	Cetacean Pinniped Otter	No effect
Operation	Repair & maintenance operations		Underwater noise changes - disturbance	Cetacean Pinniped Otter	130m
Decommissioning	Cable removal				
Installation	Pre-installation, post-installation survey	Continuous noise – Geophysical survey, vessel activity	Underwater noise changes - physical injury	Cetacean Pinniped Otter	180m
Operation	Maintenance survey		Underwater noise changes - disturbance	Cetacean Pinniped Otter	2.6km
Decommissioning	Survey				
Installation	Cable burial	Impulsive noise e.g. Unexploded ordnance (UXO) detonation	Underwater noise changes - physical injury	Cetacean	27km
				Pinniped	17km
				Otter	7.6
				Chelonian	6.2
Operation	Repair & maintenance operations		Underwater noise changes - disturbance	Cetacean	54km
				Pinniped	
				Otter	
Operation	Presence of cables	Magnetic fields (B fields)	Electromagnetic changes - impairment of navigation or orientation	Cetaceans	Distance at which EMF attenuates to background levels 12m at HDD exit point where cables are unbundled 2m for remainder of route where cables are bundled

* Defined in Technical Appendix C – Noise Assessment

10.5 Embedded Mitigation

The project description, Chapter 4, provides the design. 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 marine mammals and reptiles is provided in Table 10-6 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 10-6 Embedded mitigation

ID	Embedded Mitigation
EM18	Project vessels will not exceed 14 knots within the Proposed Development..
EM19	GIL will require that the appointed contractor(s) follow the Department of Arts Heritage and the Gaeltacht (DAHG) 'Guidance to Manage the Risk to Marine Mammals from Man-made sound sources in Irish Waters' (DAHG 2014); in particular Section 4.3.4
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-routing the marine cables. 2. If it cannot be avoided, consider whether it is safe to move. 3. If it cannot be moved, arrange for detonation.
EM23	GIL will require that the appointed UXO contractor follows the follow the Department of Arts Heritage and the Gaeltacht (DAHG) 'Guidance to Manage the Risk to Marine Mammals from Man-made sound sources in Irish Waters' (DAHG 2014); in particular Section 4.3.5 'Blasting' including (but not limited to): • At least one qualified and experienced marine mammal observer (MMO) shall be appointed to monitor for marine mammals. • Only the minimum quantity of explosives to achieve the desired result must be used. • Establishing a default 1km mitigation zone for marine mammal observation, measured from the explosive source and with a circular coverage of 360 degrees. • Only commence explosive detonations during daylight hours and good visibility. • 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. • In waters up to 200m deep, the MMO shall conduct a pre-start up constant effort monitoring at least 30 minutes before the detonation. Sound-producing activity shall not commence until at least 30 minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO.

10.6 Significance Assessment

10.6.1 Summary of Assessment

Table 10-7 presents the summary of the impact assessment conducted on the Proposed Development activities. Sections 10.6.2 to 10.6.3 provide the justification behind the conclusions. Project Specific Mitigation, if proposed, is described in Section 10.7. Where there is still potential for residual effects this is discussed further in Section 10.8.

Table 10-7 Impact Assessment Summary – marine mammals and reptiles

Determination of potential effect						Impact assessment			Consideration of mitigation	Residual Impact assessment		
Section	Project Phase	Aspect	Embedded mitigation (Table 10-6)	Potential Pressure	Receptor	Magnitude	Sensitivity	Significance	Project Specific Mitigation (Table10-10)	Magnitude	Sensitivity	Significance of Residual Effect
10.6.2	Installation Operation Decommissioning	Impulsive noise - UXO detonation	EM21, EM23	Underwater noise changes - injury	Marine mammals	Medium	High	Significant	PS9, PS10, PS11	Low	Medium	Slight
					Sea turtles	Low	Medium	Slight	PS9, PS10, PS11	Low	Low	Slight
				Underwater noise changes - disturbance	Marine mammals	Low	High	Moderate	PS9, PS10, PS11	Low	Medium	Slight
10.6.2	Installation Operation	Continuous noise - Geophysical survey	EM19	Underwater noise changes - injury	Marine mammals	Low	Negligible	Imperceptible	-	-	-	-
				Underwater noise changes - disturbance		Low	Medium	Slight	-	Low	Medium	Slight
10.6.2	Installation Operation Decommissioning	Continuous noise - Vessel activity	EM18	Underwater noise changes - injury	Marine mammals	Negligible	Negligible	Imperceptible	-	-	-	-
				Underwater noise changes - disturbance		Low	Medium	Slight	-	Low	Medium	Slight
10.6.3	Operation	Magnetic fields (B fields)	EM15	Electromagnetic changes - impairment of navigation or orientation	All cetacean species	Low	Negligible	Imperceptible	-	-	-	-

10.6.2 Underwater noise changes

10.6.2.1 Installation, Operation (including maintenance and repair) and decommissioning

One of the most important environmental concerns related to the Proposed Development is the potential effects of underwater sound. This pressure considers the potential for marine mammals to be affected by sound associated with activities undertaken during each phase of the Proposed Development.

Both cetaceans and pinnipeds 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), an assessment has been conducted 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. The assessment has 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 Technical Appendix C; 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 10-8.

Table 10-8 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, 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 sound is categorised into two distinct types: impulsive and continuous (i.e. non-pulse). Activities undertaken during the Proposed Development fall into both categories, as outlined in Table 10-9. Sound sources were obtained through literature review (referenced in Technical Appendix C).

Table 10-9 summarises the zones of influence for each sound category, activity and marine mammal group as calculated in Technical Appendix C.

Table 10-9 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 majority of cetacean species identified with the potential to be present within Proposed Development are mid-frequency cetaceans with the exception of minke whale which, like other baleen whales, is more sensitive at lower frequencies and harbour porpoise which is sensitive at higher frequencies.

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).

Technical Appendix C and Table 10-9 concludes that sound resulting from cable installation activities (DP vessel, trenching, rock placement etc.) does not exceed the thresholds for permanent (PTS) or temporary (TTS) injury. Cetaceans and pinnipeds are therefore not at risk of injury from the cable installation, and the significance of the effect has been assessed as **Imperceptible** and is **Not Significant**.

This potential effect has also been assessed within the Greenlink Marine NIS, with respect to potential effects on the Saltee Islands SAC and the Slaney River Valley SAC, designated for grey seal and harbour seal respectively. The NIS concluded no potential for significant effects and that an Appropriate Assessment is not required for these activities.

Injury from continuous sound – geophysical survey

Technical Appendix C (with worst-case zones of influence summarised in Table 10-9) concludes that:

- Minke whale (low-frequency cetacean) are vulnerable to permanent injury with 15m and to temporary injury within 40m of the multi-beam echosounder.
- Toothed whales and dolphins (mid-frequency cetaceans), which are the majority of species encountered in the Proposed Development, are vulnerable to permanent injury within 2.6m and to temporary injury within 7m of the multi-beam echosounder.
- 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.
- Pinnipeds 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.

There is the potential for grey seal from the Saltee Islands SAC and harbour seal from the Slaney River Valley SAC, to be present within the Proposed Development. Individual animals from other protected sites may also be present within the Proposed Development as marine mammals are highly mobile.

The most sensitive species to underwater sound changes within the Proposed Development is harbour porpoise. As part of an appropriate assessment looking at effects of underwater sound on an area of importance for harbour porpoise, BEIS (2018) stated that "Geophysical surveys (primarily 2D and 3D seismic) have the potential to generate sounds that exceeds thresholds of injury, but only within a limited range from source (tens to hundreds of metres); for site surveys [which includes sub-bottom profilers], the range from source over which injury may occur will be even smaller." For geophysical survey it is best practice to follow the DAHG (2014) 'Guidance to Manage the Risk to Marine Mammals from Man-made sound sources in Irish Waters' Adherence to the guidelines constitutes best practice and will, in most cases, reduce the risk of deliverable to injury to marine mammals to negligible levels. Adherence to the guidelines has been incorporated into the Proposed Development as embedded mitigation EM20.

In line with the conclusions of the AA Screening and NIS, the EIA process has concluded that the embedded mitigation EM20 (adherence to DAHG (2014) guidelines for geophysical survey) reduces the sensitivity of the receptors (grey seal) to negligible. The magnitude has been assessed as low because there will be site specific changes in sound levels. The overall significance of the effect has been assessed as **Imperceptible** and is **Not Significant**.

This potential effect has also been assessed within the Greenlink Marine NIS with respect to potential effects on the Saltee Islands SAC and the Slaney River Valley SAC, both designated for grey seal. The NIS concluded no potential for significant effects and that an Appropriate Assessment is not required for these activities.

Injury from impulsive sound

It is unknown how many, if any, UXO detonations will be required within the Proposed Development. The Greenlink UXO desk-based assessment (1st Line Defence 2018) identified a high-risk area in the St Georges Channel; a former WWII sea mine ground. However, the likelihood of needing to detonate UXO within the Proposed Development or Irish Offshore is very low. 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). 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 sound pressure levels, 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, Technical Appendix C 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 if this size of UXO is encountered during the pre-installation UXO survey, there is generally sufficient sea room to be able to micro-routed the cables around any discoveries. It is very unlikely that UXO detonation will be required.

Results from the noise assessment (Technical Appendix C) 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 provided in Technical Appendix C and summarised in Table 10-8, conclude that cetaceans and pinnipeds 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.

- Minke whale (low-frequency cetacean) are vulnerable to permanent injury with 13km and to temporary injury within 17km from the UXO detonation;
- Toothed whales and dolphins (mid-frequency cetaceans), which are the majority of species encountered in the Proposed Development, are vulnerable to permanent injury within 5.8km and to temporary injury within 8.6km of the UXO detonation;
- Harbour porpoise (high-frequency cetacean) are vulnerable to permanent injury within 23km and to temporary injury within 27km of the UXO detonation; and
- Pinnipeds 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 impact of UXO detonations on harbour porpoise in the North Sea. The study showed that a detonation of 263kg of explosive (794kg explosive weight has been used for this assessment) could result in physical injury within 500m of the explosion.

Although all species are at risk of injury from an UXO detonation, harbour porpoise are the species likely to be affected over the greatest distance – 23km for permanent (PTS) and 27km for temporary injury.

The Proposed Development is located less than 10km from the Saltee Islands SAC and the Slaney River Valley SAC lies approximately 29km from the Proposed Development. The conservation objectives of both sites is to maintain the favourable conservation condition of the grey seal and harbour seal Special Conservation Interest features of the sites respectively.

A single UXO detonation, could cause sound levels sufficient to cause temporary injury to grey seal over a 17km radial distance.

This potential effect has also been assessed within the Greenlink Marine NIS. The AA Screening and NIS concluded significant effects are likely and that an Appropriate Assessment is required.

In line with the conclusions of the Greenlink Marine NIS, the EIA process has concluded that as grey seal and harbour seal are designating features of the Saltee Islands SAC and Slaney River Valley SAC, the sensitivity of the receptor is high. The magnitude has been assessed as medium because the spatial extent of the effect is greater than the Proposed Development footprint and the activity could cause injury. The overall significance of the effect has been assessed as **Significant**.

Project Specific Mitigation has been proposed in Section 10.7, to reduce the significance of the residual effect.

Effect of impulsive sound from UXO detonations on sea turtles has also been considered in Technical Appendix C. Mortality and potential mortal injury were considered likely to occur within 6.2km and 4.2km respectively of the sound source. Sea turtles are unlikely to be found in high numbers in the Proposed Development, as they are rare visitor (see Section 10.3.4). The effects on sea turtles is therefore considered to be **Slight** and is **Not Significant**.

Project Specific Mitigation has been proposed in Section 10.7, to reduce the significance of the residual effect.

Disturbance from continuous sound – cable installation

The modelling conducted in Technical Appendix C 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.

The assessment concluded that the magnitude of the effect was negligible and that the sensitivity was negligible, given the small zone of influence, the brief nature of the effects and the mobile nature of the animals. The overall significance has been assessed as **Imperceptible** and is **Not Significant**.

Disturbance from continuous sound – geophysical survey

The geometric spreading model (Technical Appendix C) suggests that disturbance could occur within up to 2.6km from the sound source as a worst-case. This suggests that all marine mammals could be disturbed by the sound emitted by the SBP, MBES and SSS. The worst-case disturbance is resulting from noise emitted from the SBP.

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 that observed responses to a 10-day 2D seismic survey. The 2D seismic survey took place in September 2011 and exposed a 200km^2 area to noise throughout that period. A 470 cubic inch airgun array was used, which generated peak-to-peak source levels of 242-253 dB re-1µPa @ 1m. A relative decrease in density of harbour porpoise within 10km of the survey vessel was reported. However, these effects were short-lived, with porpoise returning to the area within 19 hours after cessation of activities. BEIS (2018) also states that “information on the potential effects of other geophysical surveys (e.g. sub-bottom profilers) is currently very limited and the most recent UK Offshore Energy Strategic Environmental Assessment (DECC 2016) concluded that effects are negligible but with a high degree of uncertainty”.

The underwater sound changes associated with the 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. The proposed geophysical surveys would be restricted in duration and will progress slowly within the Proposed Development. Animals will have sufficient time to avoid the survey vessel, and it is unlikely that they will swim over operating equipment. Animals may actively avoid the survey but as demonstrated by the research in the Moray Firth will return to the area once the survey has passed through i.e. within a day if not hours. The surveys would therefore not act as a barrier to migration routes or cause significant long-term disturbance.

Marine mammals are highly mobile, and species identified as likely to be observed in the Proposed Development range widely across their management unit. While the sound generated by the geophysical survey may create a disturbance for marine mammals that lead to them avoiding the area for a short-time, the species are wide ranging and will return.

It is likely that marine mammals within the application area will experience transient disturbance and the embedded mitigation EM20 (i.e. following DAHG (2014) guidelines for geophysical survey) will help to reduce the likelihood of significance effects. The assessment has therefore concluded that the significance of the effect on any marine mammals is **Slight** and is **Not Significant**.

Disturbance from impulsive sound

In the event that UXO detonation is required, it is likely to result in disturbance to marine mammals over a large area, regardless of the weight of the explosive. As mentioned above, 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, which could effect the Saltee Islands SAC and the Slaney River Valley SAC, both designated for pinnipeds; and therefore could result in a likely significant effect, prior to the implementation of any project specific mitigation. However, it is anticipated that any behavioural effects will be reversible. The UXO detonation would be discrete, one-off occurrences and effects are brief.

This potential effect has also been assessed within the Greenlink Marine NIS. The NIS concluded significant effects are likely and that an Appropriate Assessment is required.

In line with the conclusions of the Greenlink Marine NIS, the EIA process has concluded that as pinnipeds are a designating feature of the Saltee Islands SAC and the Slaney River Valley SAC, the sensitivity of the receptor is high. The magnitude has been assessed as low because the spatial extent of the effect is greater than the Proposed Development footprint but the disturbance will be brief (one-event in one day). The overall significance of the effect has been assessed as **Moderate** and is **Significant**.

Project Specific Mitigation has been proposed in Section 10.7, to reduce the significance of the residual effect.

10.6.3 Electromagnetic changes

10.6.3.1 Operation (including maintenance and repair)

Cetaceans are thought to use the magnetic particles in their tissues to detect magnetic fields (Kirschvink 1997, cited in NIRAS 2017). The mechanism of how this is done is still unknown, but it is generally acknowledged that they are able to use magnetic cues, such as the Earth's geomagnetic field to navigate their environment during migration. Marine mammals are potentially sensitive to minor changes in magnetic fields and local variations cause by power cable electromagnetic fields.

The background geomagnetic field in the vicinity of the Proposed Development is anticipated to be approximately 48.7 μT (Natural Resources Canada 2019). Submarine power cables generate magnetic fields owing to the electric current flowing along the cables. The magnitude of the magnetic field (B field) produced is directly dependent on the level of flow.

In addition, localised static electric fields may be induced as seawater (tidal flow) or other conductors such as marine organisms pass through the DC cable's magnetic field. These induced electric fields (iE fields) will attenuate with both horizontal and vertical distance from the cable conductor. Burial depth can reduce the effect range of EMFs but to a lesser extent than cable bundling, due to mutual cancellation of the positive and negative poles and currents travelling in opposite directions.

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.

For a short distance in water depths of between 9m and 15m the cables will not be bundled as they exit the HDD point and before they are able to be bought together and bundled. In this area the iE fields will be slightly higher, up to 128.7μV/m at the seabed reducing to 63.7μV/m at 10m from the cable and to natural background levels within 12m.

Emissions of magnetic fields (B fields) have the potential to cause temporary changes in swim direction or greater detours during migration in sensitive species (Gill *et al*. 2005). This may temporarily affect sensitive species crossing the submarine cables or passing along their length, and therefore temporarily reduce their navigational ability when within the immediate vicinity of the cables. The implications for temporary loss of navigation for cetaceans are not fully understood. However, there have been no reported effects to the migration of harbour porpoise or other cetacean over existing interconnector cables (Gill *et al*. 2005). Harbour porpoise migration across the Skagerrak and western Baltic Sea has been observed unhindered despite several crossings over operating sub-sea HVDC cables (Walker 2001, cited in NIRAS 2017).

Owing to their predominantly pelagic existence, the rapid attenuation of the B field to background levels or below within 12m of the unbundled cables at the HDD exit point and 2m from bundled cables along the remainder of the cable route, the water depth greater than 10m over most of the Proposed Development, combined with lack of evidence of effects upon cetaceans, it is expected that cetaceans will be unaffected by magnetic fields from the Proposed Development.

There had been a widely held view that cetaceans are not sensitive to electric fields, however, a study by Czech-Damal *et al*. (2011) (cited in NIRAS 2017) which demonstrated electroreception of AC fields in a dolphin suggests that this may be incorrect. The authors state that their perception system appears to be far less sensitive than those used by elasmobranchs; a 460 μV/m threshold of sensitivity was established, approximately three orders of magnitude lower than elasmobranchs (NIRAS 2017). However, given that the cables will be buried to 1m below the seabed; and iE fields above 460 μV/m are typically found within 0.5m of the cables (i.e. within the seabed); and that the predominant habitat of cetaceans is pelagic they are expected to be unaffected by iE fields.

In conclusion, it is very unlikely that marine mammals will be exposed to the strongest fields which would cause behavioural effects. The magnitude of the effect has been assessed as low because although it will be a long-term change, the alteration will be extremely localised (within 12m for a short section of the cables and 2m for the remainder of the route) and the underlying character of the baseline will be similar to the pre-development situation. As cetaceans are EPS the receptor value should have been categorised as high. However, expert judgement has reduced this to low as a classification of high would suggest that the cetacea have low tolerance to the change and they would not recover, effectively resulting in injurious effects to the population. The assessment has concluded that it is unlikely that the cetaceans will be sensitive to the localised change and therefore a classification of negligible is more appropriate; as the species population viability will not be effected by the pressure. The assessment therefore concluded that the effect will be **Imperceptible** and is **Not Significant**.

There is no current evidence to suggest that pinnipeds are directly influenced by, sensitive to, or use the Earth's magnetic fields for navigation, therefore no effect to seal species is expected.

10.7 Project Specific Mitigation

In addition to the embedded mitigation outlined in Table 10-6, Table 10-10 present measures that GIL is committed to adopting.

Table 10-10 Project Specific Mitigation – marine mammals and reptiles

ID	Project Specific Mitigation Measure
PS9	If UXO detonation is required, Passive Acoustic Monitoring (PAM) will be used during periods of darkness and poor visibility (e.g. fog and increased sea states) when marine mammal observer (MMO) watches may be reduced in their effectiveness and in order to permit 24-hour monitoring.

ID	Project Specific Mitigation Measure
PS10	Activation of an acoustic deterrent device (ADD) for 20 to 60 minutes prior to UXO detonation dependent on UXO charge size. The selection process of the ADD will be done in consultation with the DHPLG - Foreshore Unit and NPWS.
PS11	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.

10.8 Residual Effect

The assessment presented in Section 10.6 identifies that three potential pressures could have a Slight or Significant effect. The significance of these effects re-assessed taking into consideration the Project Specific Mitigation outlined in Section 10.7 above to determine if a significant residual effect remains.

10.8.1 Underwater noise changes

10.8.1.1 Geophysical survey

The assessment concluded that the geophysical survey is likely to disturb marine mammals within 2.6km of the survey vessels. The significance of the effect has been assessed as Slight. Industry best practice is to follow the DAHG (2014) ‘Guidance to Manage the Risk to Marine Mammals from Man-made sound sources in Irish Waters’ which have been embedded into the ‘base case’ project design as EM20. The geophysical surveys will be one-off events, with disturbance temporary. Animals are expected to return to the area shortly after the survey has moved through. No further mitigation has been proposed and the residual effect remains **Slight** and is **Not Significant.**

10.8.1.2 UXO detonation

If UXO detonation is required it is concluded that there will be a significant effect on marine mammals, which could include physical injury or death from exposure to large and sudden pressure changes at close range.

Marine mammals are a European Protected Species and the Proposed Development is near to two SACs designated to conserve grey seal and harbour seal, respectively.

The most effective mitigation is to avoid the need for detonation completely. 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 DAHG (2014) Guidance to Manage the Risk to Marine Mammals from Man-made sound sources in Irish Waters' (see embedded mitigation EM21). However, to further reduce the significance of the effect GIL has selected a range of project-specific mitigation measures, as described below.

In consultation with DHPLG – Foreshore Unit and NPWS, acoustic deterrent devices (ADDs) will be selected and deployed. 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 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 cetaceans 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.

The measures proposed above are in line with Industry Best Practice for UXO detonation and implementation will reduce the significance of the effect from Significant to **Slight** which is **Not Significant**.

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11. Protected Sites

There are a number of international and national protected sites of conservation value near and in the wider region of the Proposed Development. To ensure that the Proposed Development does not have a significant effect, either alone or in combination with other plans or projects, a Natura Impact Statement (NIS) has been completed to support the competent authority in undertaking Appropriate Assessment (AA).

This chapter explains the AA process, and summarises the findings of the Greenlink Marine NIS; provided as a separate document accompanying the EIAR.

The Greenlink Marine NIS covers the Proposed Development i.e. the Irish Marine components of Greenlink from mean high-water springs (MHWS) at the Irish landfall at Baginbun Beach, Co. Wexford to the 12nm limit. 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.

The Greenlink Marine NIS also covers offshore Ireland out from 12nm to the UK/Ireland median line and the Campile Estuary, where the land cables cross under the River Campile foreshore.

Separate NIS and Habitats Regulations Assessments (HRAs) have been prepared which cover individually the Irish Onshore; the Welsh Onshore; and the Welsh Marine. These include a full cumulative effects assessment of all five components of the project. Chapter 17 of this EIAR includes the cumulative assessment for the Proposed Development and Campile Estuary. As the NISs / HRAs are submitted they will be available online at www.greenlink.ie.

11.1 Appropriate Assessment process

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. Sites which have been submitted to the European Union but which have not formally been adopted e.g. candidate SACs and proposed SPAs, also form part of the network and are treated as if fully designated.

A key requirement of the Habitats Directive is that the effects of any plan or project, alone, or in combination with other plans or projects, on the Natura 2000 site network, should be assessed before any decision is made to allow that plan or project to proceed. This process is known as appropriate assessment (AA) and is provided for under Articles 6(3) and 6(4) of the Habitats Directive and is transposed into Irish law through the European Communities (Birds and Natural Habitats) Regulations 2011 (as amended) (the “2011 Regulations”)

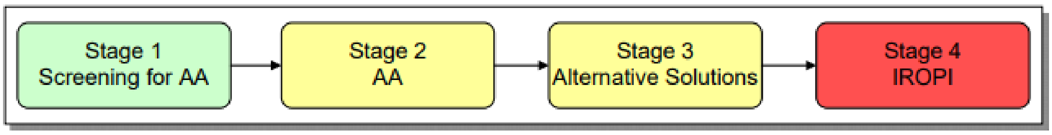
If the project is likely to have a significant effect on a Natura 2000 site, either alone or in combination with other plans or projects, it must undergo an appropriate assessment (AA) by the competent authority (those with decision making powers).

The competent authority cannot consent the plan / project without first having ascertained that it will not have an adverse effect on the integrity of the Natura 2000 site concerned. If an adverse 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 impacts to a non-significant level so that the plan/project may be approved (European Commission 2018b).

The obligation to undertake AA 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 European Commission’s methodological guidance (EC 2002) outlines a four-stage approach to the 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 11-1. The four stages collectively make up what is referred to in Ireland as the AA process.

Figure 11-1 Stages of AA



The method for undertaking the AA process is outlined in the following guidance, which was used in the preparation of the Greenlink Marine NIS.

- 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);
- Marine Natura Impact Statements in Irish Special Areas of Conservation – A Working Document (DAHG 2012);
- Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities (Department of Environment, Heritage and Local Government 2010);
- 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).

11.2 Consultation

Consultation has been undertaken with key statutory consultees and stakeholders and the public during key stages of project development. GIL has consulted with the National Parks and Wildlife Service (NPWS) of the Department of Arts, Heritage and the Gaeltacht (DAHG), throughout project design (cable routeing) to identify the ecological constraints and sensitivities of the habitats and species in the area. A scoping opinion from the DAHG, including comments from NPWS was received on the broader EIA which has informed the Greenlink Marine NIS.

Table 11-1 summarises the relevant consultation responses on protected sites.

Table 11-1 Consultation responses – Protected Sites

Stakeholder	Summary of Consultation Response	How response has been addressed
DAHG (including NPWS)	Received 04 February 2019. Outlined information to be supplied in relation to Annex I habitats including (in summary): • A full description of the proposed activity • Baseline description of relevant environment	This information has been supplied in the Greenlink Marine NIS and relevant EIA topic chapters.
	Noted that consideration should be given to whether the likely surveys would have the potential to interact with marine mammals. Stated that all survey operations should comply with "Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters" (DAHG 2014).	Compliance with the guidance has been embedded into the Proposed Development as embedded mitigation EM19 and EM23. The potential for likely significant effects on marine mammals has been assessed within Chapter 10 and the Greenlink Marine NIS.

11.3 Stage 1 – Appropriate Assessment Screening

The Proposed Development crosses the Hook Head Special Area of Conservation (SAC) (Site Code: IE0000764) and the Campile Estuary crosses the River Barrow and

River Nore SAC (Site Code: IE0002162). Greenlink is not directly connected with or necessary to the management of the Natura 2000 sites. Therefore, it is necessary that the Proposed Development and Campile Estuary component should be subject to the AA process.

To determine whether the Proposed Development and Campile Estuary is likely to have a significant effect on any Natura 2000 sites, either individually or in-combination with other plans or projects, Stage 1 AA screening was carried out (Greenlink Marine NIS, Section 5).

The screening assessed sixteen Natura 2000 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. Figure 11-2 (Drawing P1975-PROT-002) shows the sites crossed by the Proposed Development.

A review of the Proposed Development identified seven pressures that could be exerted on Qualifying Interest 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 interest features.

Initial screening (Greenlink Marine NIS, Table 5-3) concluded, that it is possible that there exists an pressure-receptor pathway between the Proposed Development and the designating features of thirteen of the sixteen sites reviewed. Further analysis of the likely significant effects taking into consideration the sites conservation objectives (Greenlink Marine NIS, Section 5.4) identified three sites, where it cannot be ruled out that the Proposed Development will not have a likely significant effect. Table 11-2 summarises the conclusions of the assessment of likely significant effects, presented in the Greenlink Marine NIS, Section 5.6.

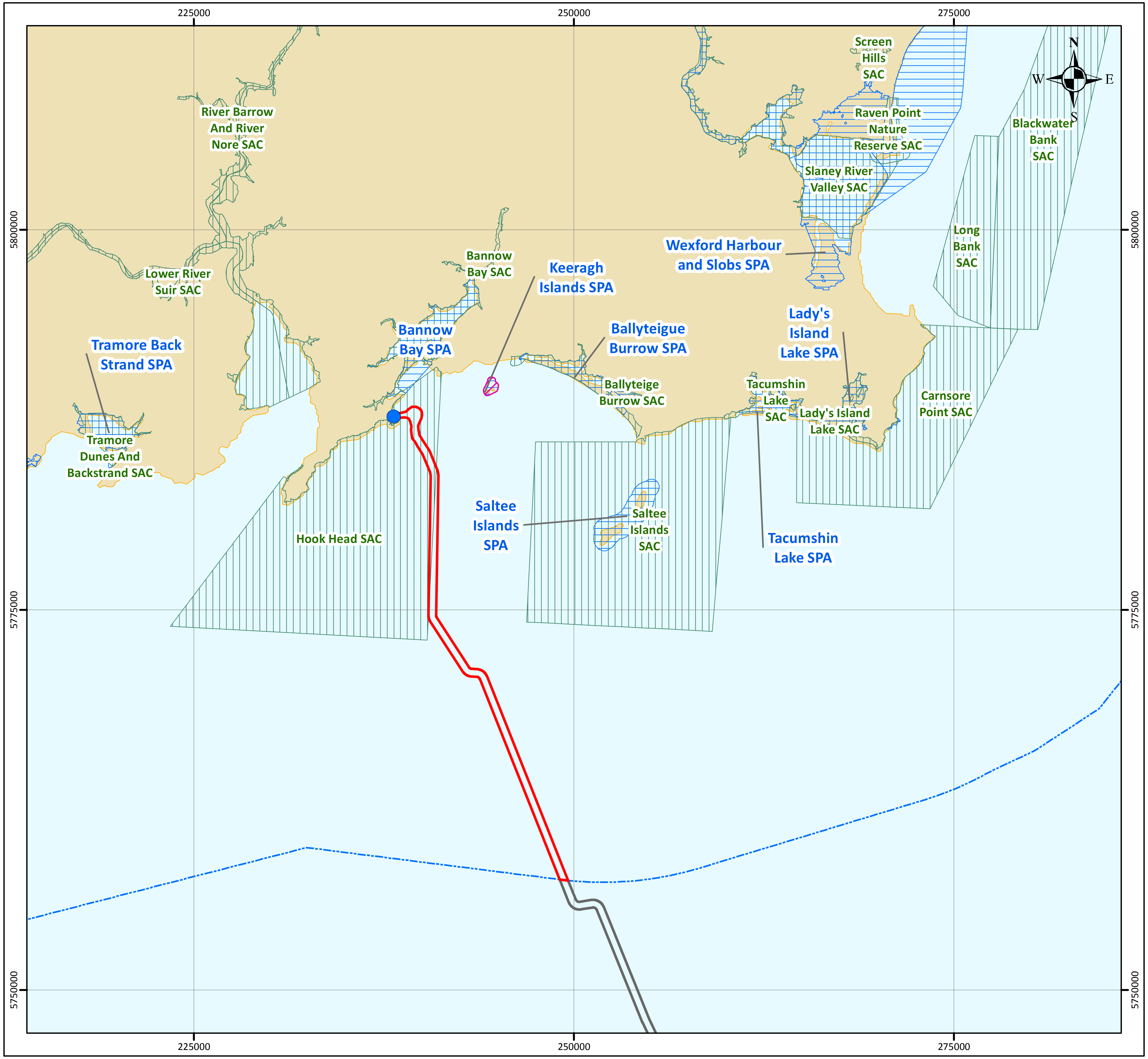
Screening has concluded (Greenlink Marine NIS, Section 5.6) that Appropriate Assessment is required for:

- Hook Head SAC (site code: IE0000764)
- Saltee Islands SAC (site code: IE0000707)

- Slaney River Valley SAC (side code: IE0000781)

Table 11-2 Summary - Potential for likely significant effects (LSE)

Site Name	Applicable conservation feature	Potential pressure on site	Conclusion
Hook Head SAC	Large shallow inlets and bays Reefs	Penetration and / or disturbance including abrasion Physical change (to another seabed type)	LSE cannot be ruled out/ AA is required
River Barrow and River Nore SAC	Otter	Disturbance	No potential for significant effects / AA is not required
	Twaite shad, Atlantic salmon*	Underwater noise changes	No potential for significant effects / AA is not required
Lower River Suir SAC	Twaite shad, Atlantic salmon*	Underwater noise changes	No potential for significant effects / AA is not required
Slaney River Valley SAC	Twaite shad, Atlantic salmon*	Underwater noise changes	No potential for significant effects / AA is not required
	Harbour seal	Underwater noise changes - UXO detonation	LSE cannot be ruled out / AA is required
Bannow Bay SPA	Wintering birds	Visual disturbance	No potential for significant effects / AA is not required
Saltee Islands SAC	Grey seal	Underwater noise changes - UXO detonation	LSE cannot be ruled out / AA is required
Pembrokeshire Marine/ Sir Benfro Forol SAC	Grey seal	Underwater noise changes	No potential for significant effects / AA is not required
West Wales Marine / Gorllewin Cymru Forol SAC	Harbour porpoise	Underwater noise changes	No potential for significant effects / AA is not required
Bristol Channel Approaches / Dynesfeydd Môr Hafren SAC	Harbour porpoise	Underwater noise changes	No potential for significant effects / AA is not required
North Anglesey Marine / Gogledd Môn Forol SAC	Harbour porpoise	Underwater noise changes	No potential for significant effects / AA is not required
North Channel SAC	Harbour porpoise	Underwater noise changes	No potential for significant effects / AA is not required
Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC	Bottlenose dolphin	Underwater noise changes	No potential for significant effects / AA is not required
Cardigan Bay/ Bae Ceredigion SAC	Bottlenose dolphin	Underwater noise changes	No potential for significant effects / AA is not required
* only in freshwater			



GREENLINK INTERCONNECTOR

PROTECTED SITES
ROI Waters

Drawing No: P1975-PROT-002	A

Legend

- Baginbun Beach
- Proposed Development
- Irish Offshore
- ROI 12nm Territorial Sea Limit

Environmental Designations

- SAC
- SPA
- NHA

Date	Wednesday, April 3, 2019 16:07:44
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Datum	D_WGS_1984
Data Source	DCCAE; UKHO; CDA; NPWS; GEBCO; Greenlink
File Reference	J:\P1975\Mxd\08_PROT\P1975-PROT-002.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

11.4 Stage 2 – Appropriate Assessment Natura Impact Statement

The Stage 1 Screening concluded that there is the potential for likely significant adverse effects on the following three sites and that an AA is required:

- Hook Head SAC (site code: IE0000764) – reef and large shallow inlets and bays
- Saltee Islands SAC (site code: IE0000707) – grey seal
- Slaney River Valley SAC (side code: IE0000781) – harbour seal

The AA is a focused and detailed impact assessment of the implications of the plan of project alone and in combination with other plans and projects, on the integrity of a Natura 2000 site in view of its conservation objectives. It is undertaken by the competent authority. To inform the AA, the applicant (i.e. Greenlink Interconnector Limited) must provide a Natura Impact Statement which provides data and information on the project and an analysis of potential effects on the Natura 2000 site.

The Greenlink Marine NIS, Section 6 concludes that the Proposed Development:

- Will not have an adverse effect on the integrity of the Hook Head SAC either alone or in combination with other plans or projects;
- Will not have an adverse effect on the integrity of the Saltee Islands SAC either alone or in combination with other plans or projects; and
- Will not have an adverse effect on the integrity of the Slaney River SAC either alone or in combination with other plans or projects.

Project specific mitigation has been proposed within the Greenlink NIS and is provided in Table 11-3 and 11-4. This mitigation has also been incorporated into the relevant topic chapters e.g. Chapters 6, 7 and 10.

Table 11-3 Project specific mitigation relevant to Hook Head SAC habitats

ID	Project Specific Mitigation
PS1	The preference is to bury the two HDD duct exits and all cables in sediment to the required depth of lowering. To achieve this the Installation Contractor should seek to engineer the HDD to exit in thick sediment in order that the duct can be trenched back down to beneath the seabed level. If the required depth of burial cannot be achieved in sediment, then some external protection will be required. Taking into consideration the exact HDD exits, the footprint of external protection should be the minimum required for burial. To achieve this, consideration should be given to undertaking part sediment burial. and part external protection; use of concrete mattresses (i.e. to reduce berm height), or other engineering solutions that reduce the footprint of external cable protection (both vertically and horizontally). If there is no technically feasible alternative the exact position, nature of and final defined size of external cable protection will be communicated to the Foreshore Unit, NPWS and Irish Maritime Administration and local fishermen.
PS2	Exclusion zones have been established around Annex I bedrock reef features; shown on Figure 7-18, Drawing P1975-INST-008) within Chapter 7. No intrusive works (e.g. cable installation, deposit of external cable protection material) will be undertaken within these exclusion zones.

ID	Project Specific Mitigation
PS4	If the contingency external cable protection is used at the HDD exit points, then the an environmental monitoring plan will be established to monitor colonisation of the external cable protection deposits. The monitoring programme will be developed in consultation with NPWS. It is proposed that this be conducted using drop-down video transects. A control transect should be established on the adjacent Annex I reef to establish a baseline for community diversity. The length of the external cable protection deposits will also be surveyed. 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 confirm (or otherwise) the conclusion that the deposition of the external protection material adds to the Reef habitat within the Hook head SAC.

Table 11-4 Project specific mitigation relevant to Saltee Islands SAC grey seal and Slaney River Valley SAC harbour seal

ID	Project Specific Mitigation Measure
PS9	If UXO detonation is required, Passive Acoustic Monitoring (PAM) will be used during periods of darkness and poor visibility (e.g. fog and increased sea states) when MMOs watches may be reduced in their effectiveness and in order to permit 24-hour monitoring.
PS10	Activation of an acoustic deterrent device (ADD) for 20 to 60 minutes prior to UXO detonation dependent on UXO charge size. The selection process of the ADD will be done in consultation with the DHPLG - Foreshore Unit and NPWS.
PS11	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.

12. Commercial Fisheries

This Chapter describes the existing baseline environment in terms of commercial fisheries, 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 refers to the Irish Marine components of Greenlink from mean high-water springs (MHWS) at the Irish landfall at Baginbun Beach, Co. Wexford to the 12nm limit. 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.

This chapter also provides information on the Irish Offshore components of Greenlink from the 12nm limit to the Republic of Ireland/UK median line.

This chapter does not discuss effects relating to shipping and navigation, and recreational fishing, which are presented within Chapter 13 and Chapter 14, respectively.

12.1 Data Sources

Baseline conditions have been established by undertaking a desktop review of published information complemented by consultation with key local, regional and national fishing organisations. This informed the compilation of a Fishing Activity Study (MarineSpace 2018), provided as Technical Appendix E, which has formed the basis of the baseline description provided in this Chapter.

The official published data sources used to inform the baseline description and assessment are listed in Table 12-1, along with any limitations presented.

Table 12-1 Official published data sources and associated limitations

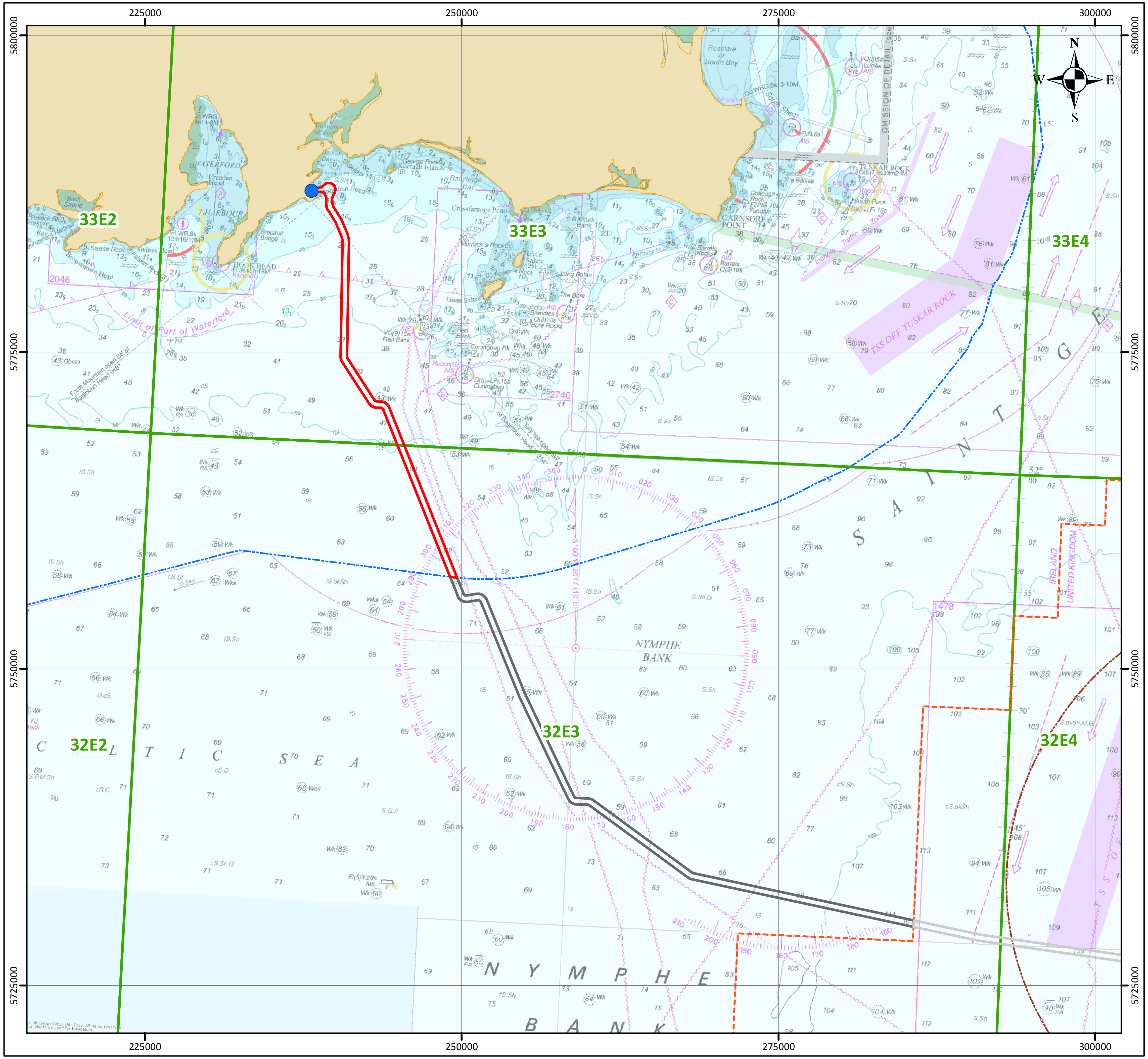
Organisation	Dataset	Limitations
Marine Management Organisation	GIS dataset for UK and non-UK >15m vessels fishing activity (2007-2010)	- Data only available until 2010 due to data privacy - Inshore fleet not generally represented as only >15m vessels
Marine Management Organisation	Marine Information System	
Scientific, Technical & Economic Committee for Fisheries (STECF)	European Commission non-UK landings by ICES rectangles (2012-2016)	- At the time of writing 'Desk-based Fisheries Assessment' data was only available up to and including 2016 - Temporal data only broken down into quarters and so less detailed than MMO data which provides monthly figures.
Marine Institute (MI)	Natura 2000 Risk Assessment (2013)	- Data gained from a one-off study in 2013, nothing more recent available - Data represents inshore fishing regions and <15m vessels only

12.2 Study Area

The study area for this Chapter covers the Proposed Development and Irish Offshore. The Proposed Development and Irish Offshore are further defined in that they lie within the following International Council for the Exploration of the Sea (ICES) rectangles 32E3 and 33E3.

The Wales Marine component of Greenlink lies within ICES rectangles 32E4 and 32E3.

Following data analysis within the Greenlink Commercial Fisheries Technical Report (Technical Appendix E) and stakeholder consultation, both 32E3 and 33E3, shown on Figure 12-1 (Drawing P1975-LOC-010), will be the focus of this Environmental Impact Assessment Report (EIAR).



GREENLINK INTERCONNECTOR

ROUTE OVERVIEW

ICES Rectangles - ROI Waters

Drawing No: P1975-LOC-010	A

Legend

- Baginbun Beach
- Proposed Development
- Irish Offshore
- Wales Marine
- ROI 12nm Territorial Sea Limit
- UK 12nm Territorial Sea Limit
- Median Line
- ICES Rectangle

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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

12.3 Consultation

Table 12-2 summarises the relevant consultation responses on commercial fisheries. The steps taken to contact stakeholders for comments on the EIA scope is documented in Chapter 5.

Prior to the cable route survey, which commenced in summer 2018, four fishing organisations were identified as having interests in the Proposed Development and Irish Offshore areas. Contact with these organisations has focused on the following objectives:

- Providing an introduction to Greenlink and updates as necessary i.e. pre- and post-survey;
- Establishing a constructive dialogue throughout the development and installation process;
- Discussing the key findings of the review of MMO/EU data to identify any particular anomalies or inaccuracies;
- Obtaining information on nearshore fishing activity (by <10m vessels) whose activity may not be fully recorded in official MMO/EU data-sets; and
- Understanding specific concerns members have in relation to installation activities.

Table 12-2 Consultation responses – commercial fisheries

Stakeholder	Summary of Consultation Response	How response has been addressed
Comments received from Irish Fisheries Liaison		
Irish South & East Fish Producers Organisation (IS&EFPO), South East Regional Inshore Fisheries Forum (SERIFF), Irish South & West Fish Producers Organisation (IS&WFPO), Bord Iascaigh Mhara (BIM)	Initial feedback was that a face to face meeting with members would be beneficial ahead of survey works commencing and to learn more or project as a whole as well as potential installation plans. Would facilitate meeting and communicate with all members. Expected that some members would be effected by proposed survey and installation works but appreciated early engagement.	Meeting attended by Fisheries Liaison Officer (FLO) held in June 2018 Ireland to discuss project, specifically cable route survey. Follow-up meetings held in in January 2019 to discuss installation. Greenlink propose maintaining this level of liaison throughout installation and operation where required.
BIM, SERIFF	The potential for effects on the herring fishery should be considered. The fishery concentrates on the 'bowl' formed by the Hook Head peninsula and the Saltee Islands promontory.	Effect upon the herring fishery has been assessed below in Section 12.7.2 and 12.7.3.

Stakeholder	Summary of Consultation Response	How response has been addressed
BIM, SERIFF, IS&WFPO,	Requested that the pressure 'risk of snagging' is scoped back into the EIAR, with particular focus on the scallop fishery which can intensively 'dredge' specific areas	The risk of snagging is assessed in Section 12.7.6.
Individual fishermen	Over 40 individual fishermen attended a meeting with the project FLO team in June 2018. Whilst the focus of the meeting was potential disruption from planned survey works, the meeting also discussed potential impacts/issues associated with the installation and operational phase.	Additional information on fishing activity used to inform the baseline section. All key issues raised by fishermen captured in the impact assessment section.
Marine Institute (MI)	It appears that the cable route will pass close to the northern edge of a commercially exploited *Nephrops norvegicus* ground (FU22). This should be considered in the EIA.	Effect upon *Nephrops* grounds have been assessed below in Sections 12.7.2 and 12.7.3.
MI	Industry consultation is vital in order to identify areas of significant importance for commercial shellfish species as the majority of the vessels targeting these species are under 10m in length and therefore aren't required to have VMS. Further, continued engagement with commercial fishing industry is strongly advised for the lifetime of the project.	Early engagement was undertaken on Greenlink through development of the Greenlink Commercial Fisheries Technical Report (Technical Appendix E) and fisheries liaison activities ahead of the cable route survey. This engagement will continue through installation and operation of the Proposed Development. Details of meetings held with key fisheries stakeholders can be found in Technical Appendix A.
Comments received for Wales Marine which are also relevant to the Proposed Development		
Marine Management Organisation	It is unclear within the scoping report whether or not fishing vessels will be able to operate with towed fishing gear over the cable once laid. This requires clarification and the effects should be considered alongside possible mitigation measures in the EIA.	The cables will be buried or were burial is not feasible externally protected, and towing allowed to continue. The risk of snagging the cables has been assessed in Section 12.7.6.
Marine Management Organisation	The cable is likely to pass through brown crab (*Cancer pagurus*), lobster (*Homarus gammarus*) and whelk (*Buccinum undatum*) habitat outside the 12nm limit. The importance of these species has been identified within the commercial fisheries section of the scoping	Indirect effect upon commercial fisheries via disturbance to habitat is assessed within Sections 12.7.2 and 12.7.3.

Stakeholder	Summary of Consultation Response	How response has been addressed
	report, it is therefore important that any effect on the ecology of these species is also considered in the EIA.	

12.4 Existing Baseline

This section provides a summary of the baseline environment which is described in more detail in the Greenlink Commercial Fisheries Technical Report (Technical Appendix E).

12.4.1 Irish Fisheries

The seas around Ireland are among the most productive and biologically sensitive areas in EU waters. The overall 2018 fishing opportunities for stocks to which the Irish fleet has access to, were 1.25 million tonnes of fish, with an estimated landed value of €1.37 billion. Ireland's total share of these Total Allowable Catches (TAC) in 2018 amounted to 215,511 tonnes with a value of €222 million (Marine Institute 2018).

This economic value is based on 2017 average prices and represent a conservative estimate. These values do not include the valuable inshore fisheries (e.g. lobster, whelk) which are not managed using internationally agreed TACs but do come within the remit of the EU Common Fisheries Policy (CFP). The inshore fisheries resource represents a very important resource base for the coastal communities around Ireland (Marine Institute 2018).

On an average day, more than 1,000 fishing vessels are active in the waters around Ireland, clocking up more than 8 million fishing hours per year. Most of the seabed near Ireland is trawled at least once per year and some regions are trawled more than 10 times per year. Fishing accounts for one of the most significant sea uses in the waters around Ireland.

There is a wide spatial distribution of commercial fishing in the Irish and Celtic Sea, with demersal and shellfish species being the most important in terms of landings by weight and value;

- The most important demersal target species include; cod, haddock, ling, monkfish, plaice, ray, skate and sole;
- Key shellfish species include; lobster, *Nephrops*, crabs, scallops, razor clams and whelks; and
- Pelagic fish landings are mainly of herring and mackerel, and of relatively less economic importance compared to demersal and shellfish species.

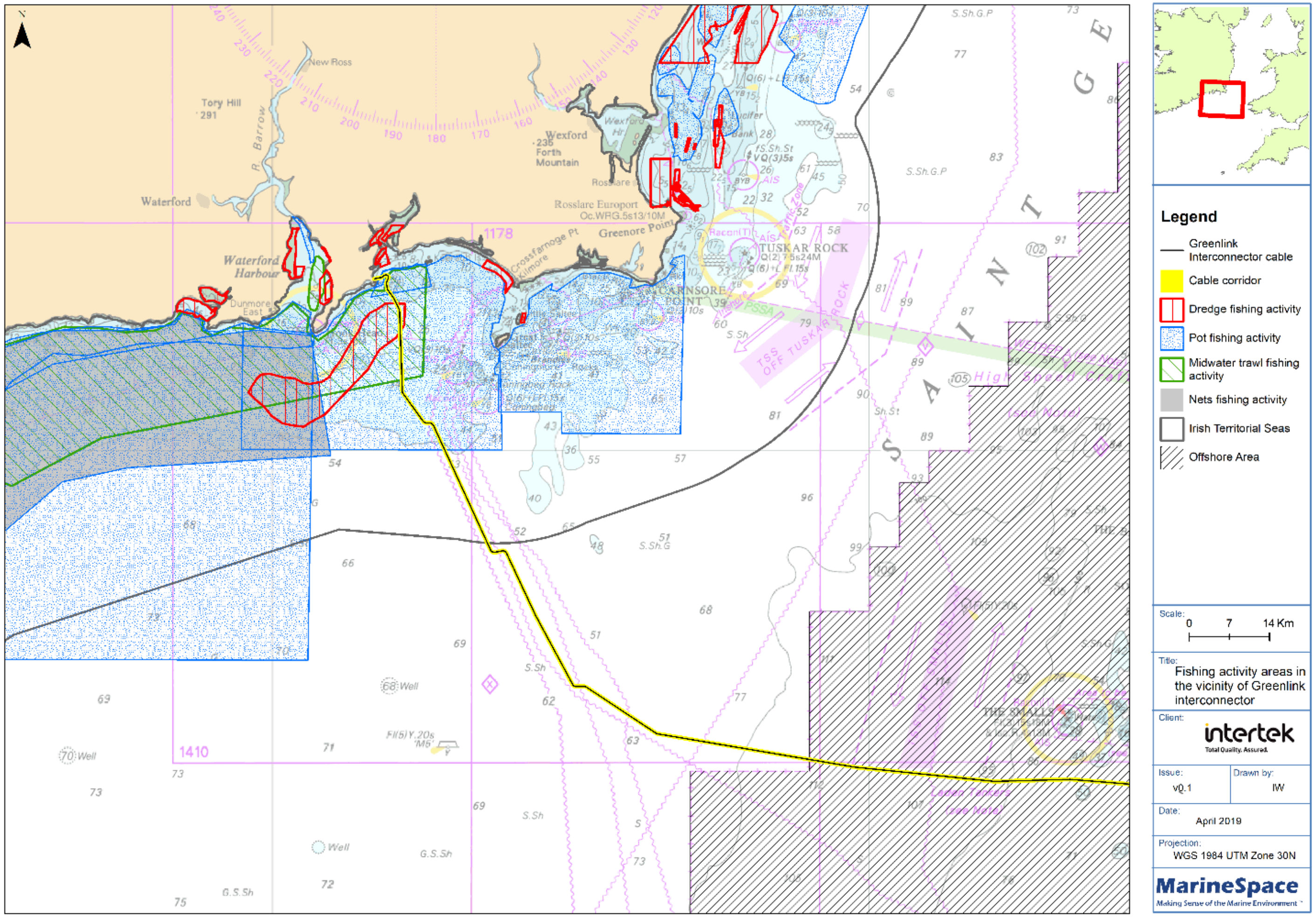
There are a large number of medium-sized ports along the south and east coast of Ireland, the largest of which is Dunmore East, Co. Waterford, which is also the closest, major port to the Proposed Development. The ports along the south coast receive a mix of pelagic, demersal and shellfish species (Marine Institute 2014).

12.4.2 Fisheries near the Proposed Development

Based on information presented in the Atlas of Commercial Fisheries for Shellfish around Ireland (Tully 2017) and specific information gained from consultation, the following key observations can be made with respect to the inshore fisheries in and around the Proposed Development:

- The spatial distribution of inshore fisheries is shown in Figure 12-2 below.
- The inshore section of the Proposed Development in and around Hook Head features high intensity static gear fishing (pots/nets) undertaken by smaller inshore vessels.
- During late summer/autumn there is an important herring fishery located in the bay between Hook Head and the Saltee Islands.
- Through consultation with individual skippers, there are known to be at least four potting vessels operating within the inshore section of the Proposed Development near to the landfall location of Baginbun Beach.
- Further offshore fishing activity is undertaken by larger vessels, albeit to a lesser intensity than the static fishing closer inshore. This is primarily with mobile gear (trawl) for white fish species.
- For the areas West and south of Dunmore East to Saltees (South coast) and South Wexford (South coast), a total of 48 vessels were registered as fishing for crab and lobster in 2015, deploying a total of 13,680 pots.
- This represented 6.2% of all vessels targeting these species in the Irish inshore fleet and 6.3% of total pots deployed in the entire Irish inshore region.
- Shrimp is another key target species for many vessels, including those landing into Dunmore East and Kilmore Quay.
- Razor clams are targeted by some vessels in the inshore region off Wexford using hydraulic water jet dredges or non-hydraulic propeller dredges used to penetrate sediment to 25cm depth. Landings over 1,000 tonnes have been made in recent years (2008-2012).
- There are key scallop fishing grounds off the south coast of Ireland with approximately 10-20 >15 m vessels and several <15 m vessels working inshore – see below.

Figure 12-2 Spatial distribution of inshore fisheries in the vicinity of the Proposed Development (Source: MI 2014)



12.4.2.2 Scallop fishing

In the waters surrounding the Wexford coastline, dredging for scallop is one of the most prevalent mobile gear fishing activities. Scallops inhabit a range of substrates from shallow, sandy sheltered inshore grounds to areas of sandy gravel interspersed with cobble. In the region around the Proposed Development, scallop fishing mainly occurs on sandy areas in the troughs between sand waves.

Scallop fishing effort is limited by western water regulations (ICES Area VII), but this has no particular effect on the Wexford coastal waters. Vessels under 10 m are limited in terms of vessel capacity and must have a track record in terms of scallop fishing in order to acquire authorisation to fish for scallops. Fishing activity for is then unrestricted and landings are not required to be reported. Vessels over 10 m are required to report landings and effort in the EU logbook.

Fishing effort (in relation to the number of dredges carried) is relative to vessel length; vessels over 15 m are limited to 24 dredges, vessels 10-15 m in length are limited to 12 dredges, and vessels under 10 m are limited to 10 dredges.

The scallop fishery in the south east of Ireland and in the region of the Proposed development utilises toothed, spring-loaded dredges, with up to 34 towed by larger vessels (Figure 12-3). This fishing technique may target the same area intensely and repeatedly throughout the scallop season (inshore peak season July to September inclusive, whilst offshore is year-round), but it may be that these areas are then not visited for years.

Figure 12-3A toothed, spring-loaded dredge used for Scallop fishing

Source: Tulley et al. (2007)

The area targeted by the scallop fishery in relation to the Proposed Development is shown on Figure 12-2.

12.4.3 Overview of Landings Data

12.4.3.1 Landings by Weight and Value

Based on Scientific, Technical and Economic Committee for Fisheries (STECF) (EU) data, the range in the sum of landed weight for Irish vessels (2012-2016), across the Proposed Development, Irish Offshore (and Marine Wales) varied from a minimum of 53.56 tonnes (2012) to a maximum of 3,947.27 tonnes (2014). The key ICES Rectangle for the Irish fleet in terms of landings was 33E3 (Irish inshore).

Within Rectangle 33E3 (Irish Inshore) the key species landed by the Irish (offshore) fleet was the European Sprat followed by "Other[1]", Herring, Great Atlantic Scallop and Edible Crab. A total of 56 species were landed by Irish vessels during 2012-2016, with 72% of all landings made from ICES Rectangle 33E3. There were significant landings of herring and scallop from both 32E3 and 33E3.

MMO data from UK vessels fishing in this region concluded that Whelk was the species with the greatest weight of landings and the second largest value of landings, followed by Crab (C.P. Mixed Sexes), Haddock, Lobster (highest value species) and Spider Crab within 32E3 (i.e. Proposed Development offshore region and Irish Offshore).

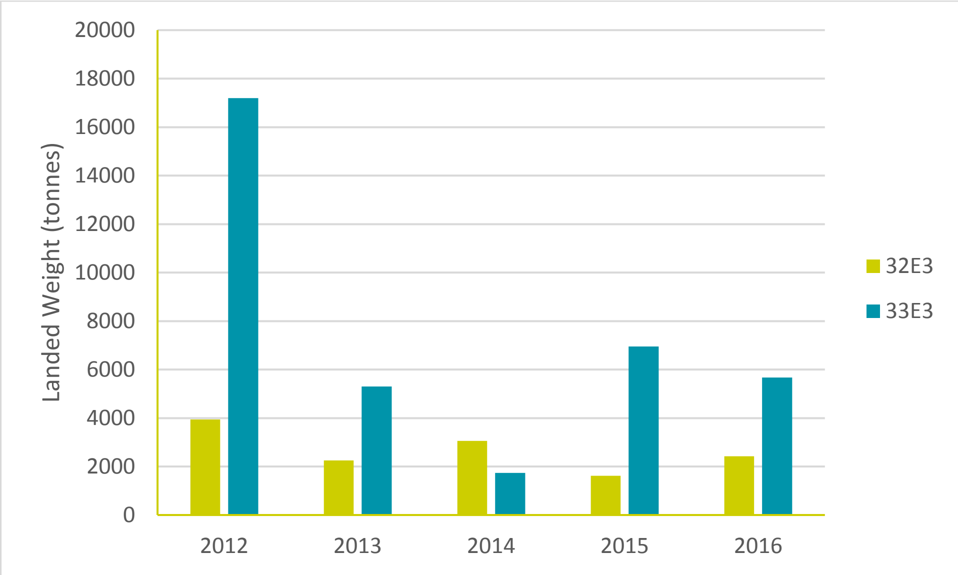
12.4.3.2 Temporal Trends (2012 – 2016)

Landings weight and value varied across ICES Rectangles (32E3 & 33E3) between 2012-2016. Landed weight from 33E3 was consistently higher than weight landed from 32E3 (Figure 12-4). In terms of intra-annual variation, landings for all species/vessels in the three ICES rectangles combined over the period 2012-2016 peaked in June/July, with a clear seasonal pattern of highest weight/value of landings between May and October each year.

When assessed in more detail, peak landings in 33E3 (Irish Inshore) and 32E3 (Irish Offshore) were actually slightly later in the year around September/October (Figure 12-5). For Irish vessels, based on quarterly data, the period October to December appears to be the most important in terms of landings, especially for species including herring, sprat and edible crab.

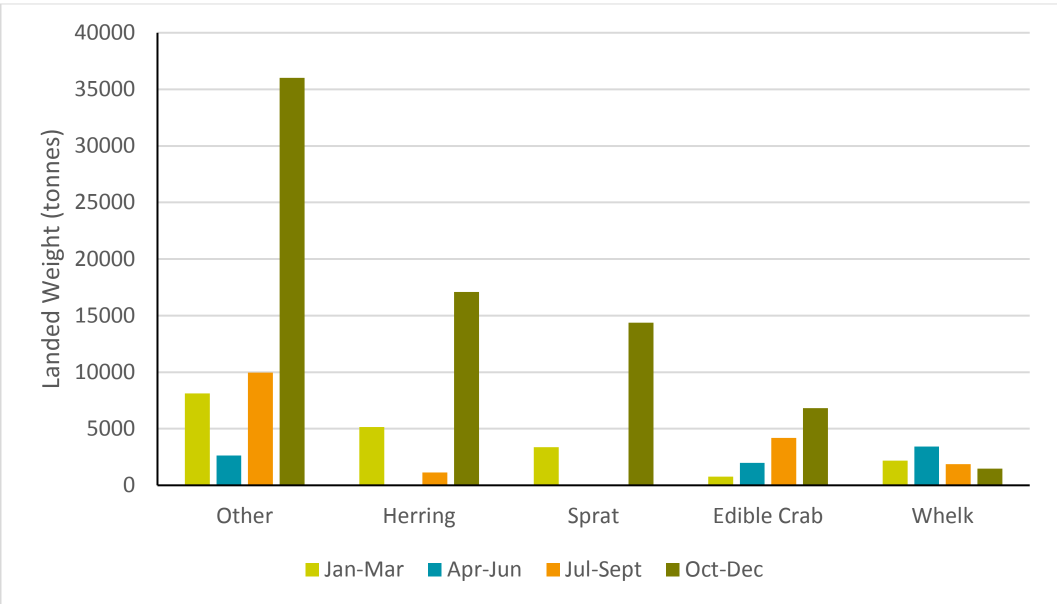
[1] Species in this category are not defined

Figure 12-4 Annual trends in landed weight (tonnes) and value (£) by Irish vessels from ICES rectangle 32E3 (Irish offshore) and 33E3 (Irish inshore) between 2012-2016



Source: STECF (2018)

Figure 12-5 Seasonal trends in landed weight (tonnes) from ICES rectangle 32E3 (Irish offshore) and 33E3 (Irish inshore) between 2012-2016



Source: STECF (2018)

12.4.3.3 Spatial Distribution (2012 – 2016)

The spatial distribution of fishing activity/value in the entire region was presented within the Greenlink Commercial Fisheries Technical Report (Technical Appendix E) via the review and analysis of Vessel Monitoring Systems (VMS) data. Fishing generally occurs across both the Proposed Development and Irish Offshore, although there appears to be a greater concentration of activity in the Proposed Development inshore region (33E3). There is a focus of activity by non-UK vessels in the Irish Offshore (32E3).

To try and further differentiate areas of particular value along Greenlink, the value of landings has been calculated based on fishery limits. This analysis has provided the following average annual values of landings over the 2012-2016 study period;

- Irish coast to 12nm: £1.2 million per annum.

With respect to the rest of Greenlink, average annual landings from the UK coast to 6nm are comparable with the above from the Irish coast out to 12nm.

12.5 Potential Pressure Identification and Zone of Influence

A scoping exercise undertaken to inform the content of the EIAR excluded the pressure 'snagging resulting from obstructions on the seabed' from further consideration in this topic chapter. This was based on the aim of GIL to ensure that the cable was either buried to an agreed "safe" target depth or protected with cable protection, resulting in this pressure not being an issue. However, as part of consultation undertaken with fishing organisations, key stakeholders requested this pressure was included and it has therefore been assessed. This represents a precautionary approach as GIL maintain their objective of installing the cable in a way that leaves no seabed obstructions.

The pressures listed in Table 12-3 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 12-3.

Table 12-3 Pressure identification and zone of influence – commercial fisheries

Project Phase	Project Activity	Aspect	Potential Pressure	Receptor	Zone of Influence
Installation	Cable burial	Presence of installation vessels & equipment	Temporary displacement of fishing activity (including required static gear clearance)/ Restricted access to fishing grounds	Mobile gear (dredgers / trawlers) Static gear (pots / traps)	1km x 12km (in any 24 hour period)
Operation	Repair & maintenance operations				1km x 1km
Decommissioning	Cable removal				1km x 12km (in any 24 hour period)

Project Phase	Project Activity	Aspect	Potential Pressure	Receptor	Zone of Influence
Installation	Seabed preparation, Cable burial	Pre-lay grapnel run, plough & jet trenching	Temporary habitat disturbance affecting spawning, nursery or recruitment to stocks	Demersal fisheries	1km x 12km (in any 24 hour period)
Operation	Repair & maintenance operations				1km x 1km
Decommissioning	Cable removal				1km x 12km (in any 24 hour period)
Installation	Cable burial	External cable protection	Permanent habitat loss affecting spawning, nursery or recruitment to stocks	Demersal and shell fisheries	HDD exits: 208m^2 Irish Offshore at 4 crossing locations: combined = 4036m^2*
Operation	Repair & maintenance operations				5 discrete repairs each maximum of 1km x 10m
Installation	Seabed preparation, Cable burial	Plough & jet trenching	Changes in suspended sediments (water clarity) indirectly leading to effects on commercially targeted species	Scallop	100m
Operation	Repair & maintenance operations				
Decommissioning	Cable removal				
Installation	Cable burial	Exposed cable on seabed	Snagging resulting from obstruction on the seabed	Fishing vessels - Mobile gear (dredgers / trawlers)	HDD exits Irish Offshore at 4 crossing locations
Operation	Repair & maintenance operations	Exposed cable on seabed, External cable protection			5 discrete locations 1km long sections
Decommissioning	Cable removal				Length of cables
Operation	Operational cables	External cable protection	Change in water depth	Fishing vessels	10m (maximum rock berm width)
Operation	Operational cables	Emission of EMF	Electromagnetic changes - deviation of magnetic compasses	Vessels operating with magnetic compass	12m at HDD exit point 2m for remainder of route where cables are bundled
			Electromagnetic changes - interference with inertial navigation	Vessels operating with INS and GPS systems	

12.6 Embedded Mitigation

The project description, Chapter 4, provides the design. 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 commercial fisheries is provided in Table 12-4 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 12-4 Embedded mitigation

ID	Embedded mitigation measure
EM1	Early consultation with relevant contacts to warn of impending activity, with vessels requested to remain at least 500m away from cable vessels during installation, repair and decommissioning.
EM2	Project vessels will comply with the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) – as amended, particularly with respect to the display of lights, shapes and signals.
EM3	Project vessels will exhibit signals in accordance with the Irish requirements for marking and identification of offshore installations as specified in the Safety, Health and Welfare (Offshore Installations) Act, 1987.
EM10	Notice will be given to sea users in the area via Notices to Mariners, Kingfisher Bulletins, NAVTEX, and NAVAREA warnings. Particular attention will be paid to ensuring the following organisations receive the notifications: Irish South and East Fish Producers Organisation (IS&EFPO); South East Regional Inshore Fisheries Forum (RIFF); Irish South and West Fish Producers Organisation (IS&WFPO); Irish Sea Fisheries Board (BIM) and individual local fishermen (as identified during cable route survey).
EM11	'As-laid' co-ordinates of the cable route will be recorded and circulated to the Irish Hydrographic Office (IHO), UK Hydrographic Office (UKHO) and KIS-ORCA Service. Cables will be marked on admiralty charts and fisherman's awareness charts (paper and electronic format).
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.
EM17	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed.
EM20	Cable protection material (rock berms and mattresses) will be designed to be over-trawlable.
EM22	Guard vessels will be used (subject to risk assessment) during installation activities to communicate with third party vessels within the vicinity of cable sections that remain unburied between cable lay and burial.
EM24	A cable burial plan will be produced which outlines proposed method statements and cable protection measures for approval by the Foreshore Unit and discussion with fisheries stakeholders.

ID	Embedded mitigation measure
EM25	Effective channels of communication will be established and maintained between Greenlink and commercial fishing interests. This will include the appointment of a Fisheries Liaison Officer (FLO).
EM26	Post-installation inspection surveys will be conducted along the length of the cables on a regular basis.
EM27	Post-installation compass deviation surveys will be undertaken to confirm compass deviation levels and the results forwarded to the UKHO and MCA.
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.

12.7 Significance Assessment

12.7.1 Summary of Assessment

Table 12-4 presents the impact assessment conducted on the Proposed Development activities. Sections 12.7.2 to 12.7.8 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 12.9. Where there is potential for residual effects, this is discussed further in Section 12.9.

Table 12-5 Impact Assessment Summary – commercial fisheries

Determination of Potential Effect						Impact Assessment			Consideration of Mitigation	Residual Effect Assessment		
Section	Project Phase	Aspect	Potential pressure	Embedded Mitigation (Table12-4)	Receptor	Magnitude	Sensitivity	Significance	Project Specific Mitigation (Table 12-7)	Magnitude	Sensitivity	Significance of Residual Effect
12.7.2	Installation	Presence of installation vessels & equipment	Temporary displacement of fishing activity/ restricted access to fishing grounds	EM1, EM10, EM25	Fishing vessels - Mobile gear (dredgers / trawlers) Static gear (pots / traps)	Low	Low	Slight	-	-	-	-
	Operation (including repair & maintenance)					Low	Low	Slight	PS12, PS13	Low	Negligible	Not Significant
	Decommissioning					Low	Low	Slight		Low	Negligible	Not Significant
12.7.3	Installation Operation (including repair & maintenance)	Plough & jet trenching	Temporary disturbance to habitat affecting spawning, nursery or recruitment to commercial stocks	EM29	Demersal & Shellfish fisheries	Low	Medium	Slight	PS14	Negligible	Medium	Not Significant
	Decommissioning			-		Low	Medium	Slight	PS14	Negligible	Medium	Not Significant
12.7.4	Installation	External cable protection	Permanent loss of habitat affecting spawning, nursery or recruitment to commercial stocks	EM14, EM15, EM17, EM29	Demersal & Shellfish fisheries	Negligible	Negligible	Imperceptible	-	-	-	-
	Operation (including repair & maintenance)			-		Low	High	Moderate	PS14	Negligible	High	Not Significant
12.7.5	Installation Operation (including repair & maintenance) Decommissioning	Plough & jet trenching	Changes in suspended sediments (water clarity) indirectly leading to effects on commercially targeted species	-	Razor clams and scallops	Negligible	Negligible	Imperceptible	-	-	-	-
12.7.6	Installation	Cable burial	Snagging resulting from obstruction on the seabed	EM1, EM10, EM11, EM15, EM20, EM22, EM25, EM26	Fishing vessels - Mobile gear (dredgers / trawlers)	Low	Low	Slight	-	-	-	-
	Operation (including repair & maintenance)	External cable protection				Low	Medium	Slight	PS12	Negligible	Medium	Not Significant
	Decommissioning	Cable left in-situ				Low	Medium	Slight	PS13	Negligible	Medium	Not Significant

Note: Electromagnetic changes and changes in water depth effects are presented in Chapter 13: Shipping and Navigation.

12.7.2 Temporary displacement of fishing activity (including required static gear clearance) / restricted access to fishing grounds

12.7.2.1 Installation

The Proposed Development has the potential to effect commercial fishing activity (both static and mobile gear) during installation via temporary displacement and temporary restricted access to fishing grounds.

Ahead of the installation vessels arriving on site, fishermen will be asked to move static gear away from the Proposed Development. It has been assumed that cable installation will be able to progress at 500m/hour (best case, but dependent on ground conditions). The zone of influence is therefore up to 12km long during any given 24-hour period. Approximately 85.1km of Greenlink lies in Irish waters (35km within the proposed Development and 50.1km in Irish Offshore) and so it is predicted here that installation would take a minimum of just over seven days; assuming simultaneous lay and burial. For the installation phase, the Proposed Development would be split into blocks, similar to those used during the cable route surveys, of which there would be three within Irish waters. To ensure that fishing gear is clear of the area well ahead of the installation vessels arriving and for the safety of all vessels, GIL will request, via direct communication with individual fishermen through the project FLO, that gear is clear of each block for the duration of works. It is currently estimated that this would be up to five days per block (15 in total), but this will be subject to change depending on installation methodology/seabed conditions and also weather.

Depending on the method of cable installation (e.g. post-lay burial), burial may also only be undertaken several weeks after the cables are laid. The cables will lay exposed on the seabed in this interim period and it is expected that all fishing stakeholders will be requested to avoid these areas until the cable is fully protected. This will result in additional temporary disturbance and displacement of fishing activity. In areas where cable burial is achieved, this additional delay will not arise.

Even though it is estimated that these excluded zones will be restricted to small areas of the Proposed Development and Irish Offshore, in terms of assessing a worst-case scenario of disturbance and displacement via initial cable installation and subsequent avoidance of areas where surface-laid cable may exist (pre installation of cable protection), a precautionary figure of 45 days has been used.

Table 12-6 Worst-case displacement

Cable installation Zone of Influence	Displacement period	Realistic displacement for fishermen	Precautionary displacement
500m/hour, 12km in any given 24 hour period	6 days (based on best-case installation scenario)	5 days per block, 15 days total	**45 days** (takes into account slower installation progress due to hard ground and the need for cable burial/protection to be implemented

In reality this displacement is expected to be of a much lesser duration for most vessels/areas as fishing will be permitted in many areas within days of successful cable burial in softer sediments. However, some discrete areas may require exclusion of fishing activity for this longer time period.

Within each block, all vessels will also be requested to remain a 500m radial distance from installation vessels and exposed cables temporarily laid on the seabed (as part of any cable post-lay-burial methodology). This temporary 'exclusion' zone will be mobile and move at the rate of progress of the associated vessels (expected to be 500m/hr). Vessels will be able to operate in the area once cable burial/protection works were complete. In addition to this, there may be temporary localised pre-installation works, associated with pre-sweeping and preparation at crossings, which would also require a 500m radial exclusion zone.

Therefore, the worst-case footprint of displacement for the local fishing fleet is 85km^2 over a period of approximately 45 days, exclusive of weather. It is fully understood that individual fishermen have preferred fishing grounds, whether that be due to target species or vessel capabilities, but it is unlikely that any individual vessel would be displaced for the full estimated 45 day disruption period.

Information derived from the Greenlink Commercial Fisheries Technical Report (Technical Appendix E) as well as consultation shows the Proposed Development and Irish Offshore passes through important local fishing grounds for herring, scallop, crab, sprat, lobster and whiting and it is acknowledged that some displacement is unavoidable for all types of commercial fisheries. Fishing grounds will be temporarily reduced and additional effort will be required to relocate static gear.

Good communication of the proposed works to the local fishing industry will be implemented via the FLO at least one month prior to the works commencing and also via Radio Navigational Warnings and NAVTEX (embedded mitigation EM1, EM10 and EM25). GIL already has well-established communication with the local fishing industry and individual fishermen in the region of the Proposed Development are known and in contact with the project FLO. These individuals have previously cooperated with gear clearance associated with the pre-construction phase of the project.

To reduce any further displacement to fishing activities all construction and support vessels will follow existing shipping routes to gain access to the Proposed Development.

The sensitivity of commercial fisheries has been assessed as low based on the evidence provided above. With the successful implementation of the above embedded mitigation measures, via the well-established system of fisheries liaison for Greenlink, along with the transient and localised nature of the displacement, the magnitude of the pressure will be low. It is concluded that the overall significance of the effect will be **Slight** and is **Not Significant.**

12.7.2.2 Operation (including repair & maintenance)

Even though the greatest scope for temporary disturbance will arise during the installation phase, there may be a requirement to undertake cable repair, remediation or protection works during the operational phase. There may also be requirements to undertake asset management surveys of the installed cable over its lifetime.

All these activities have the potential to create the same temporary disturbance as described for the main installation phase. However, any such effects will be of a smaller magnitude than those assessed above for cable installation, and therefore the effect has been assessed as **Not Significant**.

12.7.2.3 Decommissioning

At this stage the exact method of decommissioning that the Proposed Development will adopt is not known. One option, which would present the worst-case impact in terms of temporary displacement and restricted access to fishing grounds, is to leave the cable in-situ. In this instance even after the lifetime of the Proposed Development the cable infrastructure may remain on the seabed which could pose additional displacement should the cable become unburied. In the event of this occurring the local fishing fleet may potentially need to avoid some areas of the cable route over a longer period than experienced during installation. The effect of this potential method of decommissioning on commercial fishery receptors has been assessed here as **Minor** and **Not Significant**. In recognition of this potential ongoing effect, project specific mitigation is discussed in Section 12.9.

The alternative option is to remove the cables (and any associated protection). 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 project will be of a comparable magnitude to those assessed above for cable installation.

12.7.3 Temporary habitat disturbance affecting spawning, nursery or recruitment to commercial stocks

12.7.3.1 Installation

The exact technique for cable installation will depend on ground conditions and will vary along the length of the Proposed Development but will include the following methods:

- Jet-trenching; or
- Plough trenching.

A trailing suction hopper dredger or mass flow excavator will also be used for sandwave preparation (pre-sweeping) activities.

Each technique has the potential to result in an indirect effect to commercial fisheries target species as a result of disturbance to habitats affecting spawning, nursery or recruitment of stocks and/or the temporary displacement of fish from the wider area.

Potential effects upon fish resources, including potential effects on spawning and nursery grounds of commercially targeted species are assessed within Chapter 8. The assessment took into consideration efforts made during engineering to avoid sensitive habitats or to reduce the distance cables crossed a feature (EM14) and embedded mitigation EM17 and EM29 which seek to minimise the footprint of the Proposed Development on the seabed. The assessment concluded although the seabed would be disturbed during installation, that the composition of the sediment was unlikely to significantly change and that the habitat should be suitable for demersal spawning once activities have ceased.

The only change to the seabed would arise as a result of cable protection installation. Following analysis of survey results along the length of the Proposed Development, it has been concluded that the installation of cable protection will not be required and therefore no change to the seabed is expected.

The assessment within Chapter 8 concluded that even for the most sensitive species (herring and sandeel) the effect due to disturbance was concluded to be **Slight** and **Not Significant**.

Noting the above conclusion, the consequent effect on commercial fisheries is judged to be **Slight** and **Not Significant** as no large-scale changes in distribution or type of target species are envisaged via these works, either in the short-term or longer-term. Project specific mitigation is discussed regarding this impact in Section 12.9.

12.7.3.2 Operation (including repair & maintenance)

Effects during any unforeseen repair and maintenance works are likely to be on a significantly smaller scale than those assessed above for installation. Therefore, the magnitude of the effect is reduced to negligible and the effect of disturbance to the habitat affecting recruitment to commercially targeted stocks is assessed to be **Imperceptible** and is **Not Significant**.

12.7.3.3 Decommissioning

The worst-case option during the decommissioning phase of the Proposed Development for commercial fish receptors in terms of habitat disturbance and recruitment to stocks will be to remove the cable (and any associated protection). 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 as **Slight** and **Not Significant**. Project specific mitigation is discussed regarding this impact in Section 12.9. If the cables are left in-situ there will be no effects on fish and shellfish during decommissioning.

12.7.4 Permanent habitat loss affecting spawning, nursery or recruitment to commercial stocks

12.7.4.1 Installation

Following analysis of survey results along the length of the Proposed Development, it has been concluded that external cable protection is only required at the telecommunication cable crossings and as a contingency at the two HDD exit points. These locations are outside of the herring spawning grounds.

Potential effects upon fish resources, including potential effects of permanent habitat loss via cable protection on spawning and nursery grounds of commercially targeted species are assessed within Chapter 8. Taking into consideration embedded mitigation EM29, this concluded that the significance of any such effects would be Slight and is Not Significant. As there are no significant effects on the commercial fish stocks effects on commercial fisheries will be **Imperceptible** and **Not Significant**.

12.7.4.2 Operation (including repair & maintenance)

Effects during any unforeseen repair and maintenance works are likely to be on a significantly smaller scale than those assessed above for installation. The assessment considered five discrete repair events and concluded that the overall significance of the effect is **Negligible** and is **Not Significant** for all receptors except for herring. If repair or maintenance works occur within the Dunmore East spawning bed area during the spawning season the overall effect is assessed as **Moderate** and is **Significant**. See Section 12.9 for details of project specific mitigation.

12.7.4.3 Decommissioning

An option during the decommissioning phase will be to remove cable protection. In this instance habitats would be subject to localised disturbance, following which the seabed would be allowed to return to its pre-construction state. Therefore, the overall significance of the effect is assessed as **Negligible** and is **Not Significant** for all receptors except for herring, which is assessed as **Moderate** and **Significant**. As above, project specific mitigation is discussed in Section 12.9.

It is possible that during decommissioning the cable and any existing rock placement could remain in-situ, therefore removing the pathway for any additional effects on commercial fish receptors via habitat loss affecting recruitment to stocks.

12.7.5 Changes in suspended sediments (water clarity) indirectly leading to effects on commercial target species

12.7.5.1 Installation

The Proposed Development lies near to areas of potential razor clam and scallop beds which are key commercial target species. Installation of the cable has the potential to create sediment plume and deposition effects on such species and consequent effects on commercial fishers that target these species.

Potential effects upon fish resources, including sediment plume and/or deposition effects on commercially targeted species are screened out of Chapter 8 due to conclusions made in Chapter 6 which state that changes in suspended solids would be brief, and will not elevate suspended sediment concentrations above those experienced through natural variation.

No effects upon commercially important target species are predicted. The consequent indirect effect on commercial fisheries has been assessed as **Imperceptible** and is **Not Significant.**

12.7.5.2 Operation (including repair & maintenance)

The assessment considered five discrete repair events. Any effects of sediment plumes and/or deposition during any unforeseen repair and maintenance works are likely to be on a significantly smaller scale than those assessed above for installation. The indirect effect on commercial fisheries from repair or maintenance activities has been assessed as **Imperceptible** and is **Not Significant**.

12.7.5.3 Decommissioning

An option during decommissioning will be to leave the cables in-situ to reduce any further effects to receptors. The worst-case however is to remove the cables by de-trenching. Any plume/deposition effects that could arise due to the decommissioning phase will be similar to those assessed for cable installation and operation and therefore the effect has been assessed as **Imperceptible** and is **Not Significant**. If the cable were to be left in-situ then no impact pathway would exist for effects on commercial fish receptors.

12.7.6 Snagging resulting from obstruction on seabed

12.7.6.1 Installation

The primary installation technique for the Proposed Development aims to achieve a burial depth of between 0.6m and 1.0m (depending on ground conditions) along the length of the cable. The cable route survey and a smaller pre-installation survey will allow the cable route centreline to be micro-routed around regions of exposed bedrock and reef and the cables will be laid within sand channels that exist between these areas of harder substrate.

The cable route survey has identified sufficient sediment cover to reach the target depths along the route, and it is unlikely that burial cannot be achieved. However, if the selected installation contractor opts for a post-lay burial solution then the cables may be exposed on the seabed for a short-period (days) and would represent a snagging risk to a number of gear types (dredges/trawls). In the event of this, a guard vessel would be present at all times to warn other sea users of the potential obstruction (EM22) and regular NtM's would be issued to keep the commercial fishing industry informed (EM1, EM10).

It is expected that the risk of snagging on an unburied cable would be minimal. The cable burial plan will be discussed with the fishing organisations (EM24). The magnitude of the effect has been assessed as low and given the use of guard vessels the sensitivity has been assessed as low. The assessment concluded that the significance of the effect is **Slight** and is **Not Significant.**

12.7.6.2 Operation (including repair & maintenance)

Once installed the 'as-laid' coordinates of the cables will be recorded and circulated to the UK Hydrographic Office (UKHO) and KIS-ORCA Service. The cables will be marked on admiralty charts and fishermen's awareness charts (electronic and paper) (EM11). Fishermen in the area will have been aware of the installation activities and the embedded mitigation will ensure that commercial fisheries are aware of the new infrastructure.

During the operation phase of the project, the risk of fishing gear snagging on parts of the cable will be a function of the long-term burial of the cable and also the types of fishing activity that occur. There is a well-established scallop dredge fishery in the area of the Proposed Development.

Scallop fishing techniques utilise heavy toothed dredges that typically penetrate the top 2-5cm of sediment (Catherall & Kaiser, 2014). Scallop techniques often repetitively target the same region over again and this coupled with natural hydrodynamics reducing the burial depth via changes in seabed level may pose an increased risk of the cable being exposed and subsequent snagging occurring.

A cable burial risk assessment, which considered sediment types, sediment mobility and fishing risks, has been undertaken to determine the minimum depth cables should be buried to prevent future cable exposure. The target burial depth of between 0.6m and 1.0m is significantly deeper than the penetration depth of the scallop dredges. Therefore, the risk of snagging is reduced significantly and unless dredging occurs repetitively in the exact location of the cable over a long time period it is not expected that the cable would be uncovered.

During operation surveys will be conducted along the length of the cable on a regular basis (EM26) to confirm cables remain buried. If cable exposure should occur the embedded mitigation measures detailed for the installation phase would be adopted, i.e. presence of a guard vessel (EM22) and notification issued to the commercial fishing industry and wider sea users (EM1, EM10, EM25). It is expected that cable exposure, if any, would be isolated and of a short spatial scale. Once identified the risk would be managed sufficiently to reduce the effect upon commercial fishery receptors. However, it is recognised that should any cable exposure not be identified immediately commercial fisheries are sensitive to snagging. Although the likelihood of an identified exposure occurring is low, taking a precautionary approach, the sensitivity has been assessed as medium and the magnitude as low. The overall significance of the effect during the operation phase has been assessed as **Slight** and is **Not Significant**.

To further reduce the risks associated with this potential effect, Project Specific Mitigation has been proposed in Section 12.8.

12.7.6.3 Decommissioning

In terms of snagging risk, the worst-case for commercial fisheries receptors would be the cables remaining in-situ, representing an ongoing risk. It is assessed here that this form of decommissioning would represent a medium magnitude impact to commercial fish receptors at a low sensitivity and is concluded that the overall significance of the effect is **Slight** and is **Not Significant**. In recognition of this ongoing risk, project specific mitigation methods are discussed in Section 12-8.

12.7.7 Change in water depth

12.7.7.1 Operation

This pressure on fishing vessels effects the craft ability to navigate. The embedded mitigation, listed in Table 12-6, associated with this pressure is EM29. The significance of the effect has been assessed as part of the Navigation Risk Assessment, provided in Chapter 13.

Section 13.6.2 concluded that the external cable protection will be a new permanent feature. There will be sufficient under keel clearance at the proposed external cable protection locations to ensure safe navigation. The overall significance of the effect is **Imperceptible** and **Not Significant**.

12.7.8 Electromagnetic changes – deviation of magnetic compasses and interference with inertial navigation systems

12.7.8.1 Operation

This pressure on fishing vessels effects the crafts ability to navigate. The significance of the effect has been assessed as part of the Navigation Risk Assessment, provided in Chapter 13.

It is estimated that the electromagnetic field will be elevated above the background geomagnetic field up to 12m from the unbundled cables at the HDD exit point and 2m from the bundled cables along the remainder of the route. Given that the HDD has been engineered to pass under the beach and exit in water depths of 9m or greater there will be no significant change in EMF fields at the sea surface. Chapter 13 concluded that the effect **on** magnetic compasses will be **Imperceptible and Not Significant** with no interference to navigational systems.

12.8 Project Specific Mitigation

In addition to the embedded mitigation outlined in Section 12.6, Table 12-7 presents measures that GIL is committed to adopting.

Table 12-7 Project specific mitigation - commercial fisheries

ID	Project Specific Mitigation Measure
PS12	Review of operational phase asset management surveys will be undertaken and any areas of exposure/reduced depth of burial communicated to the fishing industry via Notice to Mariners.
PS13	Approval of decommissioning plan which will manage risks. If risks cannot be managed appropriately the cable, or sections of would need to be removed.
PS14	Any works associated with installation, O&M and decommissioning to occur outside the herring spawning season (October/November and December/January) with the region of the Dunmore East grounds.

12.9 Residual Effect

The assessment presented in Section 12.7 identifies that a number of potential pressures could have a significant effect. The significance of the effect was therefore, re-assessed taking into consideration any Project Specific Mitigation to determine if a residual effect remains.

12.9.1 Temporary displacement of fishing activity/restricted access to fishing grounds

12.9.1.1 Operation & Decommissioning

During the operation phase, if routine asset management surveys identify any areas of cable exposure or reduced depth of burial, then this will be communicated quickly and clearly to all relevant fishing organisations via a Notice to Mariners (PS12). Where appropriate, a guard vessel would also be deployed ahead of any remedial works being undertaken (EM22).

Leaving cables in-situ represents the worst-case impact for commercial fishery receptors in terms of displacement and restricted access to fishing grounds. In order to leave cables in-situ GIL will need to have a decommissioning plan approved by the authorities. This decommissioning plan will set-out how GIL propose to manage any risks to other marine users, including commercial fisheries. If the risk of snagging cannot be appropriately managed then the cables or at least high-risk sections would need to be removed. With this in mind and the successful implementation of project specific mitigation (PS12 & PS13), the overall significance of the effect is Not Significant.

12.9.2 Temporary habitat disturbance affecting spawning, nursery or recruitment to stocks

12.9.2.1 Installation & Decommissioning

The assessment within Chapter 8, identified that fish species with demersal life stages, specifically sandeel, would be affected by the Proposed Development. Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed as per embedded mitigation EM17. During the months of herring spawning (October/November and December/January), it was concluded that the Proposed Development would cause a major effect if unmitigated. By applying Project Specific Mitigation (PS14) of not installing or removing the cable during the aforementioned spawning period the residual effect is Negligible, i.e. the eggs and larvae are not present on the seabed and no pressure pathway will exist and the overall significance is **Not Significant**.

12.9.3 Permanent habitat loss affecting spawning, nursery or recruitment to stocks

12.9.3.1 Operation (including maintenance and repair)

The worst case assessed is that cable repair, necessitating the deposition of external cable protection, is required within the Dunmore East herring spawning grounds. This would have an effect of Moderate significance on the specific years recruitment to commercial fish stocks if eggs are disturbed. Implementation of project specific mitigation (PS14) reduces the effects on herring. The residual effect is therefore assessed as **Not Significant**.

12.9.4 Snagging resulting from obstruction on seabed

12.9.4.1 Operation (including maintenance and repair) and Decommissioning

During the operation phase, if routine asset management surveys identify any areas of cable exposure or reduced depth of burial, then this will be communicated quickly and clearly to all relevant fishing organisations via a NtM (PS12). Where appropriate, a guard vessel would also be deployed ahead of any remedial works being undertaken (EM22).

As discussed above, in order to leave cables in-situ GIL will need to have a decommissioning plan approved by the authorities. This decommissioning plan will set-out how GIL propose to manage any risks to other marine users, including commercial fisheries. If the risk of snagging cannot be appropriately managed then the cables or at least high-risk sections would need to be removed

With the successful implementation of the embedded mitigation measures i.e. use of NtMs (EM10), guard vessels (EM22) and appointment of project-specific FLO (EM25) and also project-specific measures (PS12 and PS13), the magnitude of the effect reduces to negligible and the overall residual effect is now **Not Significant**.

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13. Shipping and Navigation

This Chapter describes the existing baseline for shipping activities (including fishing and recreational boating), identifies the pressures associated with the Proposed Development on the receptors, presents the findings of the environmental impact assessment, and describes how significant effects (if any) will be mitigated.

The Proposed Development refers to the Irish Marine components of Greenlink from mean high-water springs (MHWS) at the Irish landfall at Baginbun Beach, Co. Wexford to the 12nm limit. 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.

This Chapter also provides information on the Irish Offshore components of Greenlink from the 12nm limit to the Republic of Ireland/UK median line.

13.1 Data Sources

A Navigation Risk Assessment (NRA) has been undertaken for the Proposed Development. Baseline conditions have been established by undertaking a desktop review of published information and available data. The data sources used to inform the baseline description and assessment include, but are not limited to the following:

- AIS data covering the study area between August 2017 to June 2018 (Oceaneering 2018);
- Greenlink Interim Cable Burial Risk Assessment Report (Intertek EWCS 2018);
- Greenlink Cable Route Report (Intertek EWCS 2019); and
- Admiralty charts (FindMaps 2018).

13.1.1 Study Area

For the NRA a study area of approximatively 30km wide either side of the Proposed Development and Irish Offshore has been defined from MHWS at Baginbun Bay

(KP159.27) to the UK / Ireland median line (KP73.8), as shown in Figure 13-1 (Drawing P1975-AIS-002).

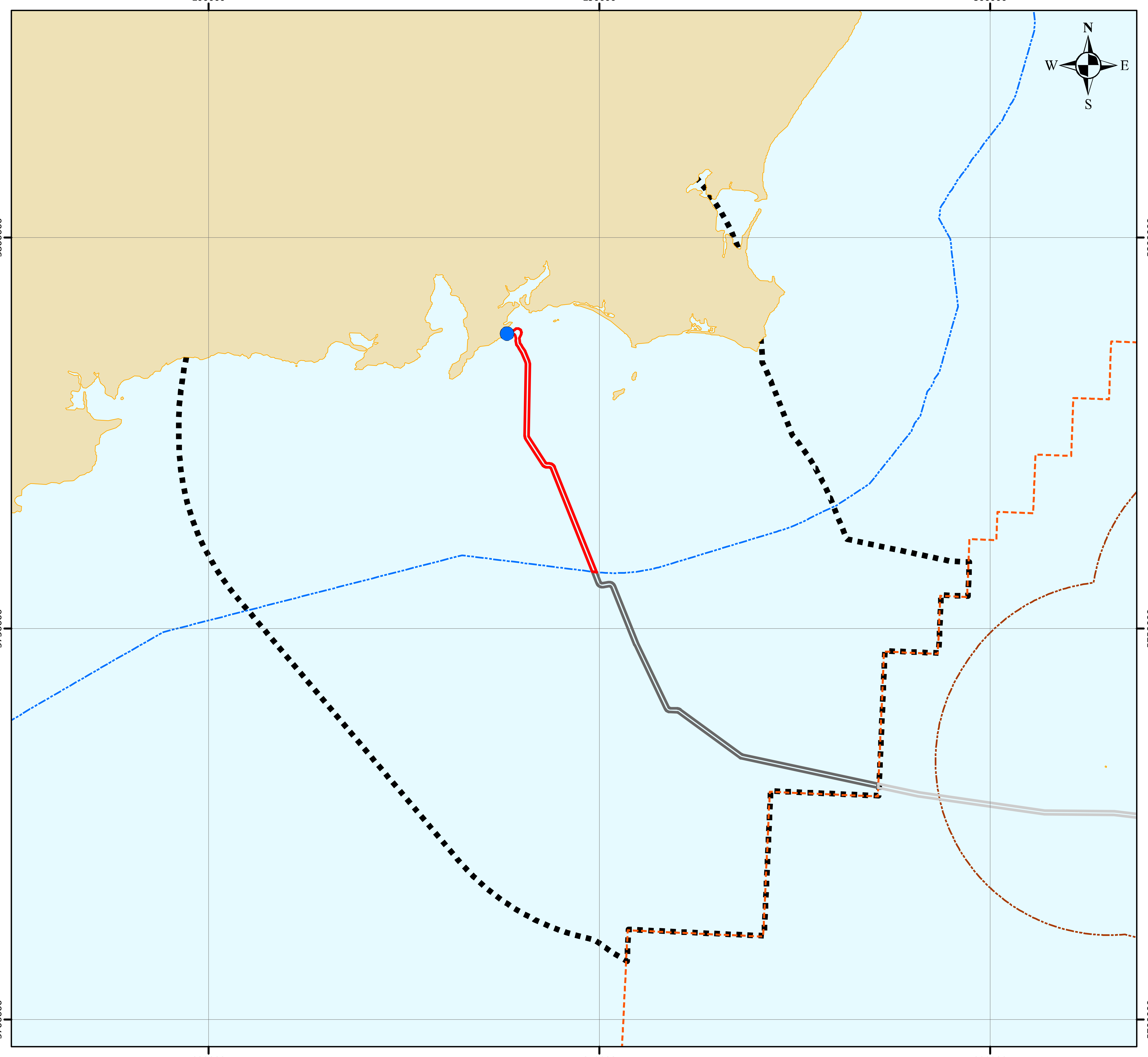
All AIS data and navigational features dataset presented in this Chapter are limited to the area of assessment.

13.1.2 Cable Burial Risk Assessment Report and Cable Route Report

The primary source of information used in this Chapter were the Greenlink Cable Route Report (Intertek EWCS 2019) and the Interim Cable Burial Risk Assessment Report (Intertek EWCS 2018) which included a review of the Cable route selection process and risk identification and assessment of anthropogenic hazards to the cable such as fishing and ship's anchors.

Within the Marine Induced Hazards review (undertaken as part of the Interim Cable Burial Risk Assessment Report, Intertek EWCS 2018), Automatic Identification System (AIS) data was used to examine the frequency of vessel movements and density of shipping. AIS data from August 2017 to June 2018 (Oceaneering 2018) were analysed to ensure consideration was given to seasonal variations.

As per Regulation 19 of Chapter V, Safety of Navigation, of the Annex to the International Convention for the Safety of Life at Sea (SOLAS V) (which came into force 1 July 2002), an AIS must be installed and operated on: all ships of 300 gross tonnage and upwards engaged on international voyages; cargo ships of greater than 500 gross tonnage not engaged on international voyages; and all passenger vessels irrespective of size. In recent years, AIS has increasingly been installed by other maritime users on smaller craft, including yachts, fishing vessels, and pleasure craft, making it a robust and reliable indicator of marine traffic.

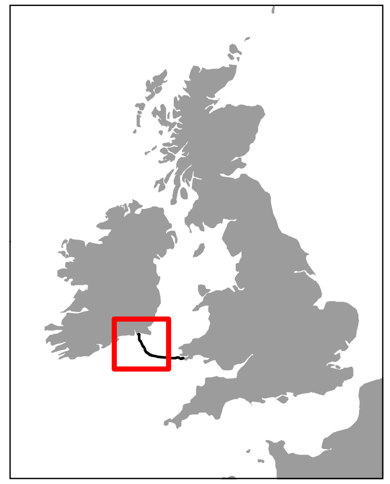


GREENLINK INTERCONNECTOR
AIS DATA
Study Area - ROI Waters

Drawing No: P1975-AIS-002 | **A**

Legend

- Baginbun Beach
- Proposed Development
- Irish Offshore
- Wales Marine
- Study Area (Irish Waters)
- ROI 12nm Territorial Sea Limit
- UK 12nm Territorial Sea Limit
- Median Line



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Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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13.2 Consultation

The steps taken to contact stakeholders for comments on the EIA scope is documented in Chapter 5. This included the Foreshore Unit, the Marine Institute and the Marine Survey Office. None of the stakeholders contacted raised any comments with respect to shipping and navigation.

Table 13-1 summarises the relevant consultation responses on shipping and navigation which were received for the Welsh Marine components of Greenlink which were thought to be directly applicable to the Proposed Development. As best practice these comments have been addressed in this Chapter to ensure a consistent assessment approach.

Table 13-1 Consultation responses - shipping and navigation

Stakeholder	Summary of Consultation Response	How response has been addressed
Natural Resources Wales (NRW)	Any consented cable protection works must ensure existing and future safe navigation is not compromised, accepting a maximum of 5% reduction in surrounding depth referenced to Chart Datum.	Consultation with the Marine Survey Office and Marine Institute confirmed that there are no similar guidance or specific regulations in Ireland in relation to reducing chart datum. However, an assessment of the significance of effect from a change in water depth as a consequence of external cable protection is provided in Section 13.6.2, using the UK guidelines as a reference.
NRW	Prior consultation and engagement is encouraged with local maritime stakeholders in advance and during the works.	Consultation has been undertaken with key navigational stakeholders in the region including Milford Haven Port Authority, Castlemartin Firing Range, Irish Ferries, fishing organisations and individual fishermen (See Technical Appendix A for list of key meetings). Ongoing engagement is part of the design of the Proposed Development - see embedded mitigation EM1 and EM25 (Section 13.5).
Royal Yachting Association (RYA)	Recreational boating should be considered in the NRA and should be considered in the assessment of effects of EMF on navigational safety	Recreational boating is considered in the NRA and Section 13.6.3 presents the assessment of effects from EMF on navigational safety.
Chamber of Shipping	Recommends that NRA includes full seasonal variation.	AIS data from all seasons has been utilised and considered in the assessment.
Chamber of Shipping	It would be considered prudent to continue to include “Risk of ship collisions” and “Accidental anchoring or emergency anchoring on unburied/buried cable” in the Shipping and Navigation receptor until the full NRA has been undertaken and the baseline established.	The NRA has been undertaken and these pressures remain scoped out. Further detail has been provided in Chapter 5.

13.3 Existing Baseline Description

13.3.1 Shipping Overview

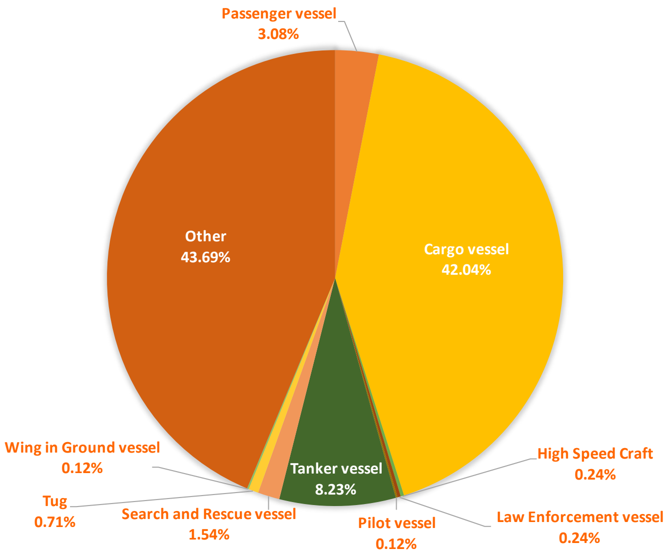
Eleven months of AIS data from August 2017 to June 2018 (Oceaneering 2018) were analysed to examine the types of shipping occurring near the Proposed Development and Irish Offshore and the typical movement of vessel activity.

A total of 1,689 unique ships were recorded in the dataset in the study area between August 2017 and June 2018.

The majority of vessels operating, during the period analysed, were ‘other / unknown’ vessels (i.e. vessel with vessel type not informed on AIS data set) accounting for 43.69% and cargo vessel which accounted for 42.04%, respectively (see Figure 13-2).

The ‘other / unknown’ vessels types have lengths ranging up to 333m. However, 86% of the ‘other / unknown’ vessels are below 30m long with vessel draught up to 5.2m, which are likely to be recreational or fishing boats.

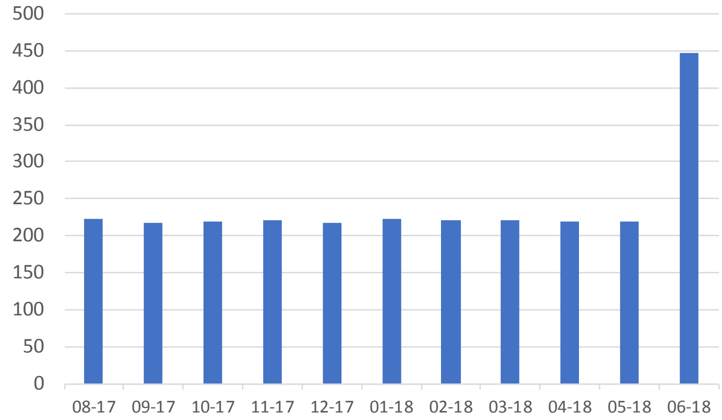
Figure 13-2 Proportion of vessel types operating within the Irish study area



Vessel counts appear to be constant in the study area for most of the months, with the exception of the month of June 2018 where unique vessels number reach 447 (Figure 13-3).

71% of the vessels present in June are categorised as ‘Other / Unknown’ vessels, and 97% of those vessels have a vessel length below 50m and are most likely to be recreational or fishing boats. Therefore, the vessel count peak in June is most certainly due to an increase of recreational and/or fishing vessel in the study area.

Figure 13-3 Number of unique vessels counts per month in the study area (August 2017 to June 2018)



	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18
Number of Unique Vessels - Study Area (Irish Waters)	223	217	219	220	218	222	221	221	219	219	447

13.3.2 Navigational Features and Anchorage

There are a number of navigation features near the Proposed Development associated with harbour, anchoring areas, disposal grounds, existing subsea cables, navigation lines and traffic separation zones, all of which are charted to aid navigation as presented in Figure 13-4 (Drawing P1975-INFR-002).

As described in Chapter 14, there are no pipelines, windfarms, renewable energy sites or aggregate extraction areas within the study area.

The Proposed Development crosses the out-of-service Celtic telecommunications cable at KP139.098. In addition the Irish Offshore crosses four in-service telecommunications cables at the following locations:

1. SOLAS at KP121.535
2. ESAT 1 at KP102.513
3. Pan European Crossing 1 at KP95.935
4. Hibernia Seg D at KP86.7

There is one IMO-adopted traffic separation scheme (TSS), TSS of Tuskar Rock, and associated navigation marks that separate the in-bound and out-bound shipping, orientated in a northeast-southwest direction. However, this TSS is located outside of the study area (see Figure 13-5, Drawing P1975-AIS-004) and should the navigation extend to the study area, the cable crosses perpendicular to this lane, minimising the risks of encountering traffic during survey, installation and any operations and maintenance campaigns.

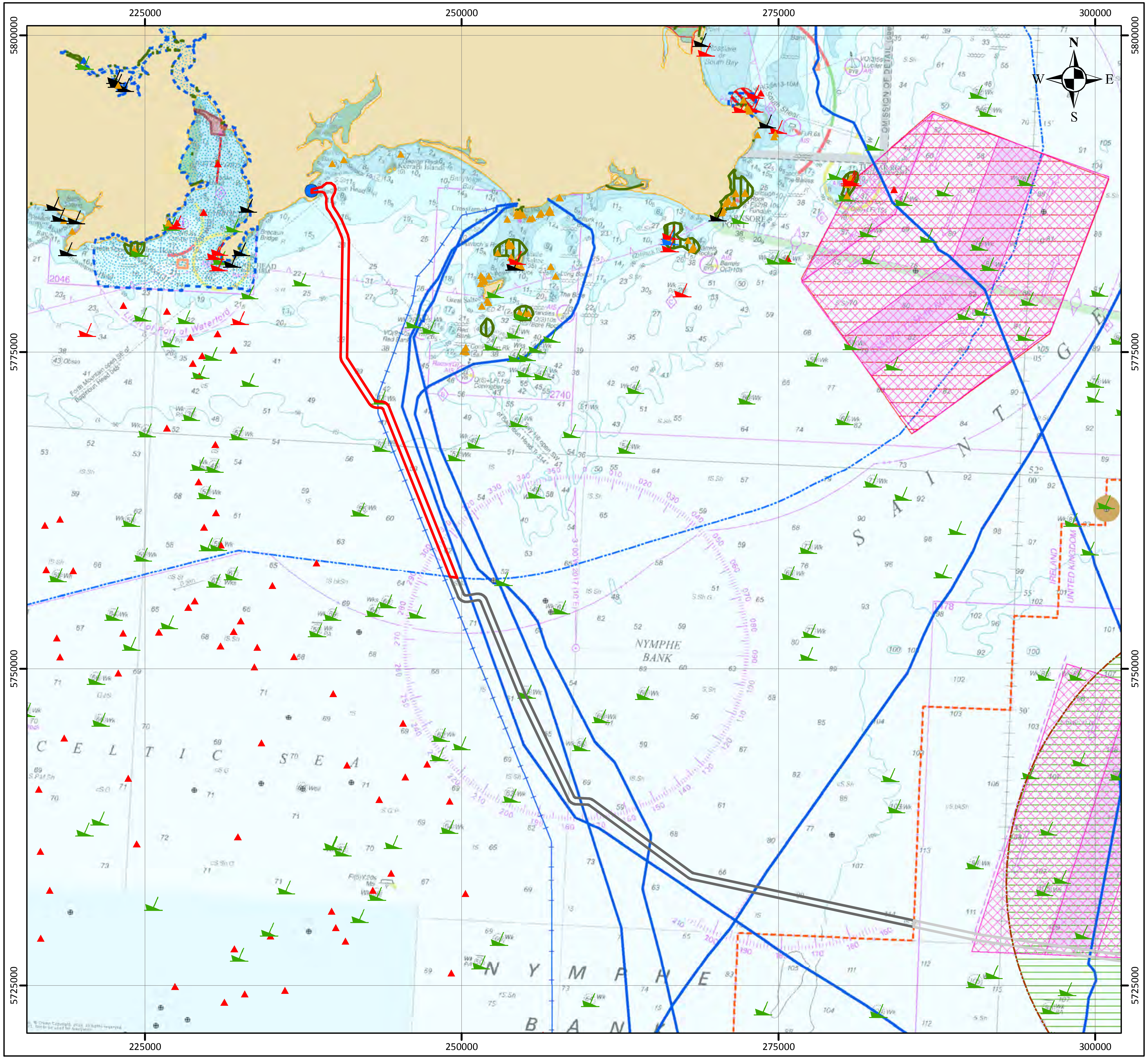
The area with the highest shipping traffic intensity is associated with the entrance to the Waterford estuary and Harbour. However, the Proposed Development is running approximately 10km parallel to this high-density shipping area avoiding most of the traffic within the area (Figure 13-5, Drawing P1975-AIS-004).

Defined anchoring areas are restricted to the nearshore areas (Figure 13-4, Drawing P1975-INFR-002) close to active ports. These areas have been avoided during the route selection process, thus there are no charted anchorage areas in the vicinity of the Proposed Development.

The Marine Irish Digital Atlas (2015) lists the closest Irish Sailing Association (ISA) sailing club as the Waterford Motorboat & Yacht Club located at Passage East. The closest slipways are located at Fethard and Slade, Co.Wexford. Kilmore Quay and Dunmore East are also important marinas in the area.

13.3.3 Natural evolution of the baseline

Traffic through Irish ports has seen an increase over the past decade, with 2017 seeing a 6% increase in traffic over the previous year and returning to levels last seen in 2007 (Irish Maritime Development Office 2018). These increases have led to investment in port infrastructure in Dublin, Cork and Shannon Foyes. Further increases in traffic are expected in the near future due to investments such as these as well as any opportunities Brexit may bring. As such it is expected that shipping traffic around the Proposed Development will continue to increase in the coming years.



GREENLINK INTERCONNECTOR

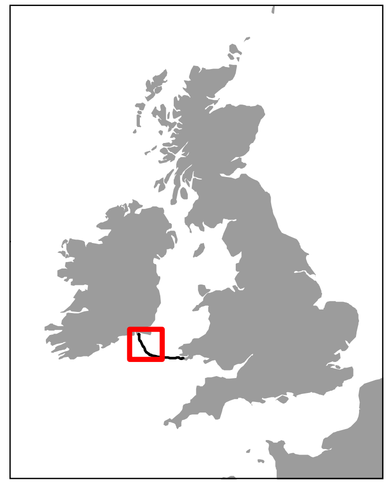
INFRASTRUCTURE
Other Marine Users - ROI Waters

Drawing No: P1975-INFR-002 | **A**

Legend
- Baginbun Beach
- Proposed Development
- Irish Offshore
- Wales Marine
- ROI 12nm Territorial Sea Limit
- UK 12nm Territorial Sea Limit
- Median Line

Wrecks and Obstructions
- Dangerous Wreck
- Distributed Remains of Wreck
- Non-Dangerous Wreck
- Wreck Showing Any Portion of Hull or Superstructure
- Foul Ground
- Undefined Obstruction
- Underwater Rock
- Foul area
- Foul ground
- Dangerous wreck
- Caution Area
- Restricted Area
- River Barrow Foreshore Licence Application

Infrastructure
- Well
- Telecom (Active)
- Telecom (Disused)
- Shoreline Construction
- Hydrocarbon Field
- Harbour Area (Administrative)
- Traffic Separation Zone
- Fishery Zone
- Dumping Ground



NOTE: Not to be used for Navigation

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Reviewed By	Emma Langley
Approved By	Anna Farley

Co-financed by the European Union
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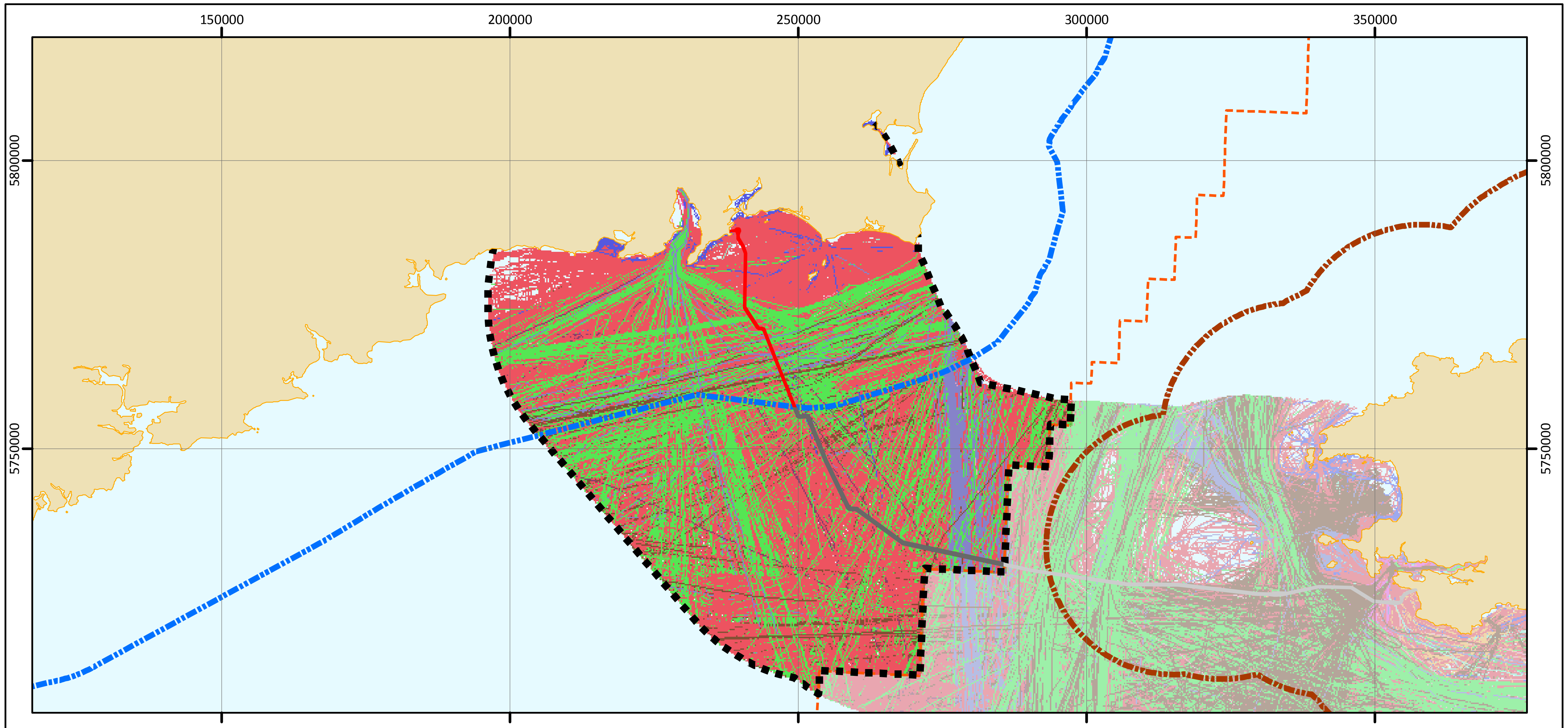
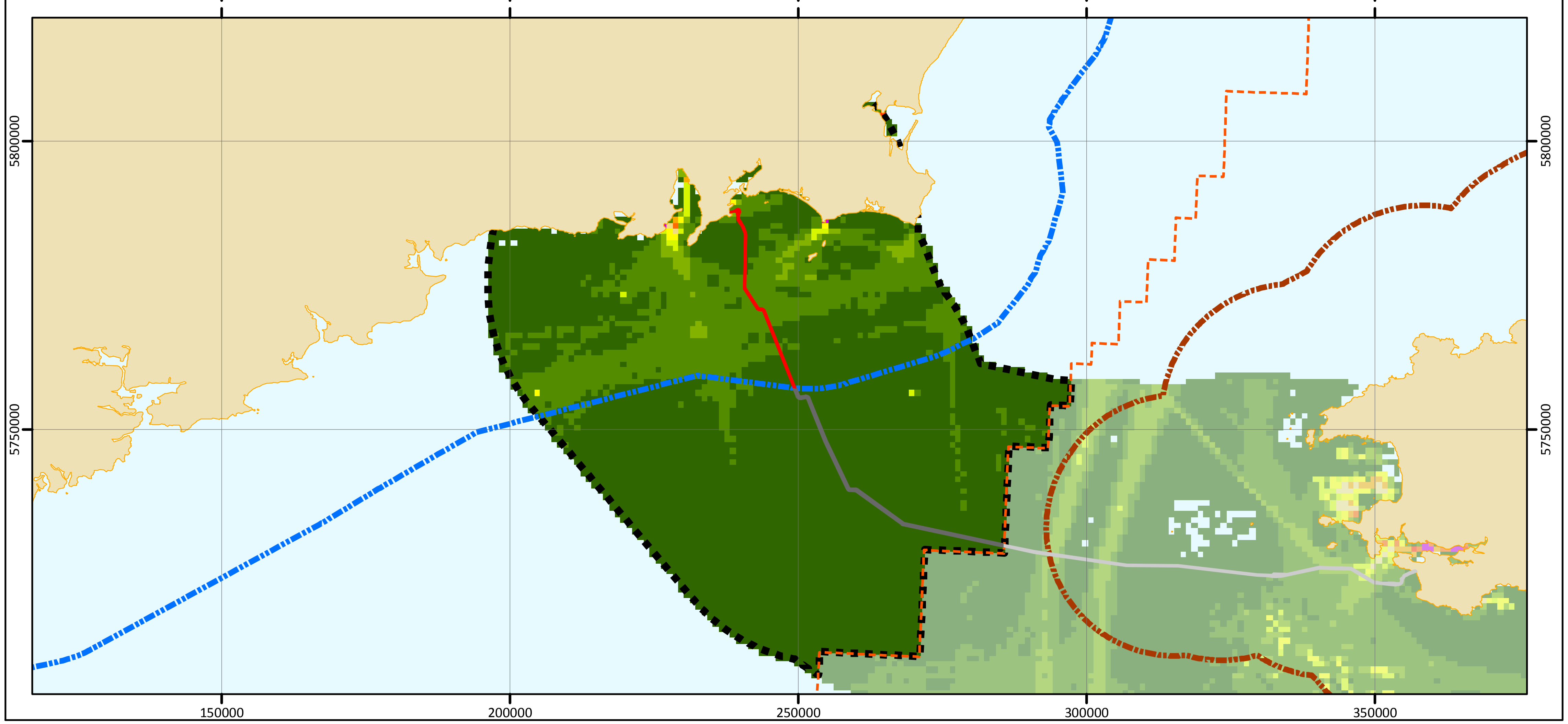
0 2.5 5 7.5 10 km





Contains data from UKOGD.; © The GEBCO Digital Atlas published by the British Oceanographic Data Centre on behalf of IOC and IHO, 2003; © Oceaneering AIS Data

GREENLINK INTERCONNECTOR

AIS DATA

Vessel Tracklines and Density - ROI Waters

Drawing No: P1975-AIS-004	A

Legend

- Proposed Development
- Irish Offshore
- Wales Marine
- Study Area (Irish Waters)
- ROI 12nm Territorial Sea Limit
- UK 12nm Territorial Sea Limit
- Median Line

AIS Tracklines

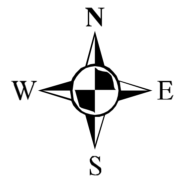
Vessel Type

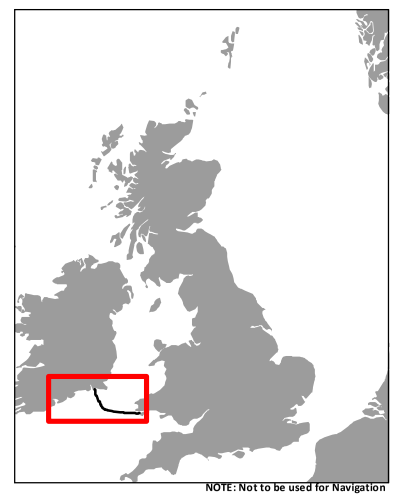
- Other (Unknown Vessel)
- Passenger
- Cargo
- High Speed Craft
- Law Enforcement
- Pilot Vessel
- Port Tender
- Search and Rescue
- Tanker
- Tug
- Wing In Ground

Vessel Density

Vessel Hours Per Year

- 0 - 5
- 5 - 20
- 20 - 50
- 50 - 100
- 100 - 250
- 250 - 500
- 500 - 1000
- 1000 - 5000
- 5000 - 10000
- 10000 - 50000





Date	Monday, April 8, 2019 12:29:22
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	CDA; GEBCO; Greenlink; Oceaneering; Intertek
File Reference	J:\P1975\Mxd\14_AIS\ P1975-AIS-004.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

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13.4 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.

- Risk of ship collisions; and
- Accidental anchoring or emergency anchoring on unburied / buried cable.

The pressures listed in Table 13-2 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 13-2.

Table 13-2 Pressure identification and zone of influence – shipping and navigation

Project Phase	Project Activity	Aspect	Potential Pressure	Receptor	Zone of Influence
Installation	Cable burial	Presence of Project vessels	Displacement of vessels	Commercial shipping, recreational boating, fishing vessels	1km wide x 12km along centreline (in any 24-hour period)
Operation	Repair & maintenance operations				
Decommissioning	Cable removal				
Operation	Cable protection	External cable protection	Change in water depth	Commercial shipping, recreational boating, fishing vessels	Two HDD exits = 0.7m high x 5.2m wide x 20m long Repair = 10m wide by 1.5m high
Operation	Operation of cable	Emission of EMF	Electromagnetic changes - deviation of magnetic compasses	Vessels operating with a magnetic compass	EMF reduces to background levels within 2m from bundled cables 10m from unbundled cables at HDD exit point
Operation	Operation of cable	Emission of EMF	Electromagnetic changes - interference with inertial navigation	Vessels operating with INS and GPS systems	

13.5 Embedded Mitigation

The project description, Chapter 4, provides the design. This includes mitigation measures which form part of the design and are therefore an inherent part of the project. The embedded mitigation relevant to shipping is provided in Table 13-3 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 13-3 Embedded mitigation

ID	Embedded mitigation
EM1	Early consultation with relevant contacts to warn of impending activity, with vessels requested to remain at least 500m away from cable vessels during installation, repair and decommissioning.
EM2	Project vessels will comply with the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) – as amended, particularly with respect to the display of lights, shapes and signals.
EM3	Project vessels will exhibit signals in accordance with the Irish requirements for marking and identification of offshore installations as specified in the Safety, Health and Welfare (Offshore Installations) Act, 1987.
EM10	Notice will be given to sea users in the area via Notices to Mariners, Kingfisher Bulletins, NAVTEX, and NAVAREA warnings. Particular attention will be paid to ensuring the following organisations receive the notifications: Irish Maritime Administration (including the Maritime Safety Policy Division, the Marine Survey Office, the Irish Coast Guard, the Maritime Transport Division, Maritime Services Division), Commissioners of Irish Lights, Royal National Lifeboat Institution (RNLI), the Irish Coast Guard (IRCG), Community Rescue Boats Ireland (CRBI), Harbour and Port authorities, Irish Ferries, Irish South and East Fish Producers Organisation, South East Regional Inshore Fisheries Forum, Irish Sea Fisheries Board individual local fishermen (as identified during marine survey campaign).
EM11	'As-laid' co-ordinates of the cable route will be recorded and circulated to the Irish Hydrographic Office (IHO), UK Hydrographic Office (UKHO), KIS-ORCA service and any other relevant authorities. Cables will be marked on Admiralty Charts and fisherman's awareness charts (paper and electronic format).
EM15	Submarine cables will be bundled together, which reduces which reduces the seabed footprint of installation activities and the electromagnetic field generated during operation, thus minimising any potential compass deviation effects.
EM16	Procedures to minimise disruption near high density shipping areas will include, for example, avoidance of anchoring near busy areas when Project vessels are waiting on weather; and the presence of a guard vessel in areas of significant vessel traffic. Installation vessels will have passage planning procedures, holding positions (e.g. if waiting on weather), traffic monitoring (e.g. radar, AIS, and visual), means of communication with third-party vessels, and emergency response plans in the event a third-party vessel approaches on a collision course.
EM22	Guard vessels will be used (subject to risk assessment) during installation activities to communicate with third party vessels within the vicinity of cable sections that remain unburied between cable lay and burial.
EM25	Effective channels of communication will be established and maintained between the Project and commercial fishing interests. This will include the appointment of a Fisheries Liaison Officer (FLO).
EM26	Post-installation inspection surveys will be conducted along the length of the cables on a regular basis.
EM27	Post-installation compass deviation surveys will be undertaken to confirm compass deviation levels and the results forwarded to the Irish Maritime Administration.
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.

13.6 Significance Assessment

13.6.1 Summary of Assessment

Table 13-4 presents the summary of the impact assessment conducted on the Proposed Development activities. Sections 13.6.2 to 13.6.4 provide the justification for these conclusions. Where the assessment concluded the effects are significant, Project Specific Mitigation has been proposed and is described in Section 13.7. Where there is potential for residual effects, this is discussed further in Section 13.8.

Table 13-4 Impact assessment summary – shipping and navigation

Determination of potential effect						Impact assessment			Consideration of mitigation	Residual Effect Assessment		
Section	Project Phase	Aspect	Embedded Mitigation (Table13-3)	Potential Pressure	Receptor	Magnitude	Sensitivity	Significance	Project Specific Mitigation	Magnitude	Sensitivity	Significance of Residual Effect
13.6.2	Installation Operation Decommissioning	Presence of Project vessels	EM1, EM2, EM3, EM10, EM15, EM16, EM22, EM25,	Displacement of vessels	Commercial shipping, recreational boating, fishing vessels	Low	Medium	Slight	-	-	-	-
13.6.3	Operation	External cable protection at HDD exit points External cable protection for repair	EM11, EM15, EM29	Change in water depth - affecting safe navigation	Commercial shipping, recreational boating, fishing vessels	Low	Low	Slight	-	-	-	-
13.6.4	Operation	Operation of cable	EM11, EM15, EM27	Electromagnetic changes - deviation in magnetic compasses	Vessels operating with a magnetic compass	Negligible	Low	Imperceptible	-	-	-	-
	Operation	Operation of cable	EM11, EM15, EM27	Electromagnetic changes - Interference with inertial navigation (INS) and global positioning systems (GPS)	Vessels operating with INS and GPS systems	-	-	No Effect	-	-	-	-

13.6.2 Displacement of vessels

13.6.2.1 Installation

As a worst case (in relation to maximum area for disruption) a cable trenching (jetting or installation in a pre-cut trench or backfill) could progress at approximately 500m/hour (12km per day). However, realistic speeds dependent on soil conditions and inclusive of maintenance and burial survey, are more usually ~5km/day for jetting, ~2 km/day in simultaneous lay-and-burial mode for ploughing and ~1.8km per day for cutting. Vessels will be requested to remain at least 500m from Project vessels whilst they are engaged in cable installation activities. This is due to the cable lay vessel's limited ability to manoeuvre whilst undertaking operations.

Therefore, as a worst case the maximum area for disruption would be 1km wide by 12km long per 24 hour period. The more likely area would be 1km wide by between ~2 and 5km long per 24 hour period.

Fishermen would be requested to clear grounds ahead of the vessel. Depending on the sediment type and the estimated rate of progression the amount of time they would need to be out of an area will vary. For example, in sandy sediments cable lay could progress quickly and we may only need the area to be clear for 3 days. Other times this could be longer (further assessment on effects on commercial fisheries is presented in Chapter 12, Section 12.7.1).

For assessment purposes it has been assumed that vessels will be requested to stay out of a particular zone for 5 days. In areas where hard substrate and difficult conditions for trenching make the installation slower the area to be cleared can be reduced but the number of days that the area is required to be cleared for may be greater.

All vessels associated with the project will display the required navigational lights and signals (EM2 and EM3). Notice will be given to sea users in the area via Notices to Mariners, Kingfisher Bulletins, NAVTEX, and NAVAREA warnings. Attention will be paid to ensuring the following organisations receive the notifications: Irish Maritime Administration, Commissioners of Irish Lights, Royal National Lifeboat Institution (RNLI), the Irish Coast Guard (IRCG), Community Rescue Boats Ireland (CRBI), Harbour and Port authorities, relevant fisheries associations and groups, individual local fishermen (as identified during marine survey campaign) (EM10).

Procedures to minimise disruption near high density shipping areas will include, for example, avoidance of anchoring near busy areas when project vessels are waiting on weather; and the presence of a guard vessel in areas of significant vessel traffic. Installation vessels will have passage planning procedures, holding positions (e.g. if waiting on weather), traffic monitoring (e.g. radar, AIS, and visual), means of communication with third-party vessels, and emergency response plans in the event a third-party vessel approaches on a collision course (EM16).

This restriction may cause disruption to shipping activity in the area by requiring alteration of planned/designated routes. This will apply to both commercial shipping (e.g. freighters, tankers, passenger vessels) and non-commercial vessels (e.g. recreational craft and fishing vessels).

It is expected that maximum displacement will occur during cable installation activities in the areas south of the marked TSS of Tuskar Rock, as these areas will contain the highest concentration of shipping activity. Since the project vessels will be moving along at the rate of cable lay (up to 500m per hour depending upon the installation method), any disruption will be temporary in any one location. However, this will depend on weather and seabed conditions which will affect installation progress. As shipping will have to make minor diversions to avoid the installation activity the sensitivity has been assessed as medium. The magnitude of the displacement has been assessed as low because it will be temporary. It is concluded that the overall significance of the effect will be **Slight** and is **Not Significant**.

13.6.2.2 Operation (including maintenance and repair)

During normal operation there may be limited effect on shipping from (though not frequent) survey of the buried cables, to monitor depth of burial. These surveys will be carried out by a vessel that would travel the entire submarine cable corridor.

In the unlikely event that a cable repair is required, the activity would typically be carried out by a single vessel. However, the vessel may be on site for several weeks, with limited ability to manoeuvre. Although it would display the required navigational lights and signals, depending on the location of the repair it could cause serious disruption i.e. if within a busy navigation channel.

Given the burial specification of the cable system, the likelihood of a fault occurring is very low. The magnitude of the effect will be low as any repair works are site specific and temporary. The sensitivity to shipping is medium as acceptable alternatives will available for shipping to re-route around the affected area. It is concluded that the overall significance of the effect will be **Slight** and is **Not Significant**.

13.6.2.3 Decommissioning

An option during the decommissioning phase of the Proposed Development will be to remove the cables (and any associated protection). 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 project will be of a comparable magnitude to those assessed above for cable installation and so the effect has been assessed as **Slight** and is **Not Significant**.

The alternative is to leave the cables in-situ, and if this option is selected there will be no displacement effect on shipping and navigation.

13.6.3 Change in water depth

13.6.3.1 Operation

If burial in sediment cannot be achieved at the two HDD exit points, external cable protection will be used. This will take the form of a rock berms at each exit with dimensions of 5.2m wide by 20m long with a height of 0.7m. The shallowest water depth it would be deployed in is 9m. The assessment has also considered the deposit of external cable protection at the third-party asset crossings and for the purposes of five discrete repair events. As a worst case it has been assumed that a deposit of 1km of external cable protection would be required at five locations, with a width of 10m and a height of 1.5m. However, given that seabed sediments in the Proposed Development and Irish Offshore are predominantly sand with sufficient depth to achieve full burial in sediment it is highly unlikely that external cable protection would be required during cable repairs.

The UK Maritime and Coastguard Agency (MCA) require that any cable protection works must ensure existing and future safe navigation is not compromised. Generally, they are prepared to accept a maximum of 5% reduction in surrounding depth referenced to chart datum (CD) if the depth reductions do not compromise safe navigation. Consultation with the Marine Survey Office and Marine Institute confirmed that there are no similar guidance or specific regulations in Ireland in relation to reducing chart datum. Therefore, to ensure consistency in assessment approach the UK guidelines have been used.

The presence of external cable protection in water depths less than 30m has the potential to change the chart datum by more than 5%.

All of the cable crossings are in water depths of greater than 30m so have been discounted from further assessment. As it is unknown where, if at all, external cable protection will be required for the purposes of repair, it has been assumed that it could be deposited between the HDD exit points at 9m out to 30m water depth.

To determine the potential effect on marine users for a change in water depth at the HDD exit points and for any repair location, an assessment was undertaken to determine (based on current use of the area) if the proposed reduction in water depth would significantly alter the under keel clearance depths available to marine users. A summary of this assessment is presented in Table 13-5.

AIS data from August 2017 to Jun 2018 was analysed to establish the maximum draught of vessels that crosses the location of the external cable protection as an indication of current and likely future use of the area.

The draught was used to calculate the under keel clearance. First the safety clearance was calculated based on a vessel dynamic draught i.e., the draught of the vessel once the impact of motion due to swell and waves is taken into consideration. Dynamic draught was assumed to 10% of the vessel draught (NOREL 2014). Guidance to developers in assessing minimum water depth of tidal devices (a comparable navigation hazard (NOREL 2014)), indicates that an additional 30% should be added on to the dynamic draught to calculate a safety clearance depth. As illustrated in Figure 13-2 the under keel clearance is then considered to be the distance from the safety clearance depth to the top of the obstruction, in this case the 1.5m high rock berm. For example, a vessel may only navigate a stretch of water if they are guaranteed an under keel clearance depth of 2m. Reducing the value of the under keel clearance could mean that they are unable to operate on routinely used shipping routes.

Figure 13-6 Under keel clearance

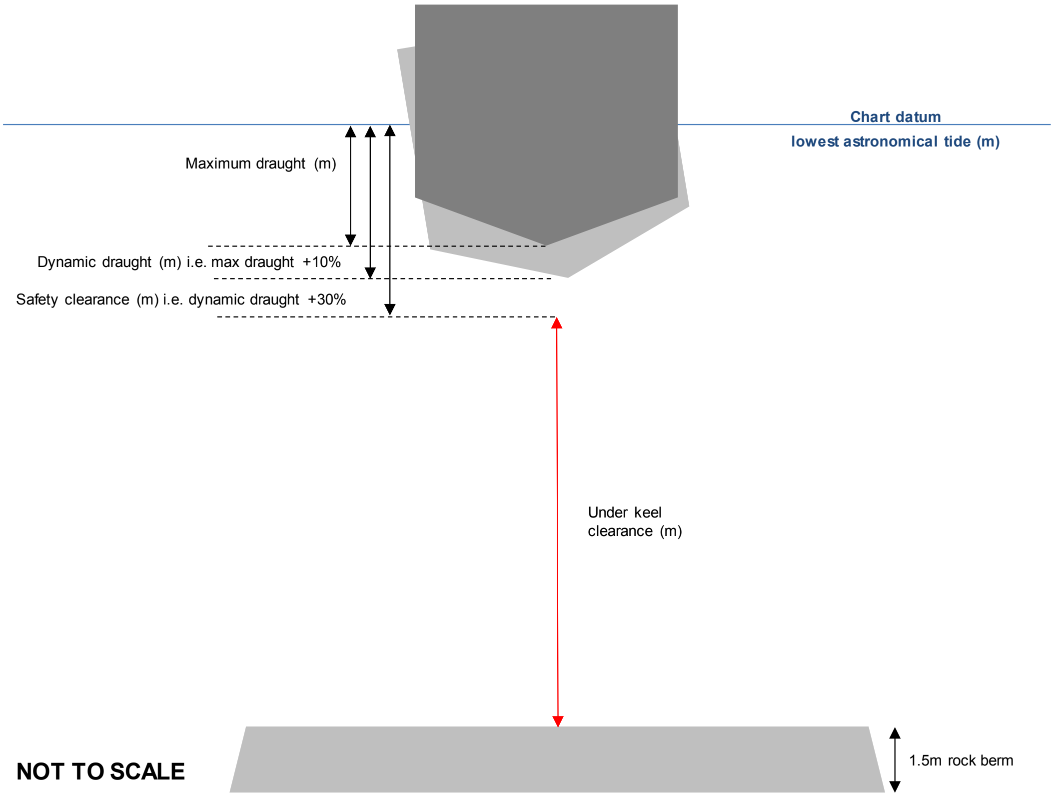


Table 13-5 Summary of change of water depth significance assessment

Rock berm location - KP Range		Water Depth range (m)		Reason for Rock Placement	Height of rock berm	Maximum Reduction of Water Depth	Maximum vessel draft crossing at location	Under keel clearance post-deposit	Safe Navigation?
From	To	From	To						
159.05	158.71	9.0	12.0	HDD	0.7m	6.7%	4.6m	1.7m	Yes
158.71	149.50	12.0	30.0	Cable repair	1.5m	12.5%	4.6m	3.9m	Yes

Four vessels were recorded in the AIS data as crossing the HDD exit areas. Three of the vessels were rigid inflatable boats (two D-class RNLI Lifeboats with a draft of 0.52m; and a Sea Fisheries Protection Agency RIB). The fourth vessel is a local fishing boat. There is no information on the draft of the fishing vessel and therefore it has been assumed that the maximum draft of a vessel crossing the area will be similar to that found further offshore. 135 vessels crossed the Proposed Development in water depths of less than 30m. The vessel with the largest draft is a passenger cruise ship, which is unlikely to come into the nearshore area, and therefore represents a worst-case.

Table 13-5 also demonstrates that there is sufficient under keel clearance (given the assumptions provide for a worst case assessment in the nearshore) for vessels to safely navigate any external cable protection required for installation and repair purposes if deployed in water depths less than 30m.

Based on the above, and the fact that there is sufficient under keel clearance for safe navigation the magnitude of the effect has been assessed as low and the sensitivity of the effect has also been assessed as low. In addition, there will be sufficient sea room within the channel and wider waters for an acceptable alternative route to be found around the obstructions. The overall significance of the effect for both scenarios has been assessed as **Slight** and is **Not Significant**.

13.6.4 Electromagnetic changes

13.6.4.1 Operation

Submarine HVDC cables generate magnetic fields due to the current flowing along the marine cables. The magnitude of the magnetic fields produced is directly dependent upon the amount of current flowing through the cables. The cable sheathing is used to prevent the propagation of electric fields into the surrounding environment. The movement of sea water or marine organisms through the static magnetic fields will create small, localised induced electric fields.

The submarine cables will be bundled together (embedded mitigation EM15), which reduces the electromagnetic field generated during operation. It is estimated that the electromagnetic field will be elevated above the background geomagnetic field up to 2m from the cables; for most of the cable route the cables will be buried to a minimum of 0.6m below the seabed. At the HDD exit point the cables will not be bundled for a short distance and the magnetic field will be slightly elevated above background levels up to 12m from the cables. The shallowest point the HDD ducts could exit is in 9m water depth meaning that there will be a slight change in magnetic field at the sea surface. This will only be for a short distance i.e. where the cables are not bundled.

Commercial vessels and military craft navigating using inertial navigation systems (INS) and global positioning systems (GPS) have negligible sensitivity to EMF emanating from the operational cables. One of the main advantages of marine gyrocompasses (used in INS) over magnetic compasses is that they are unaffected by external magnetic fields which can deflect normal compasses. Modern INS equipment generally uses laser technology and resonating quartz devices and are self-contained. As a result, EMF will have no effect, on their function. GPS use radio signals that, again, will be subject to no or negligible effects from EMF emanating from the marine cables. As these systems are unaffected by external magnetic fields, the overall significance of the effect for both scenarios has been assessed as No Effect.

The EMF that will be generated by the marine cables may have a small localised effect that could potentially cause compass deviation in vessels using magnetic compasses. Few vessels will operate solely using magnetic compasses but they may still be used as an auxiliary navigation system. The degree of compass deviation can vary depending on the alignment of the cable relative to the Earth's natural magnetic field, the proximity of the marine cables to each other, and the water depth. Given the short distance involved, the shallow water limiting the presence of commercial vessels, and the lack of traffic in the area concerned vessels navigating using magnetic compasses are considered able to make the necessary adjustments to a slight compass deviation reading and sensitivity has therefore been assessed as low as the EMF emanating from the cables will have temporary and localised effect on individual vessels. Therefore, the overall significance of the impact is assessed as **Imperceptible** and **Not Significant**.

As a matter of Best practice, post-installation compass deviation surveys will be undertaken to confirm this conclusion and the results forwarded to the Irish Maritime Administration (EM27).

13.7 Project Specific Mitigation

No project specific mitigation has been proposed.

13.8 Residual Effect

The assessment presented in Section 13.6 concluded there is no significant effects from installation, operation or decommissioning on shipping and navigation.

REFERENCES

1 FindMaps (2018). Admiralty charts, http://wmsgateway.findmaps.co.uk/wms/IntertecMetocCharts?

2 Intertek EWCS (2019a). Greenlink Interim Cable Burial Risk Assessment, Intertek EWCS Report no. P1975J1_R4574

3 Intertek EWCS (2019b). Greenlink Cable Route Report, Intertek EWCS Report no. P1975_BN4437

4 Irish Maritime Development Office (2018). The Irish Maritime Transport Economist [Online]. URL https://www.imdo.ie/Home/sites/default/files/IMDOFiles/950818%20IMDO%20IMTE%20Transport%20Economist%20Vol%2015-Web.pdf (accessed 6.11.19).

5 Marine Irish Digital Atlas (2015). Marine Irish Digital Atlas [online] Available at: http://mida.ucc.ie/contents.htm (Accessed April 2019)

6 Oceaneering (2018). AIS data from 1st of August 2017 to 30th of June 2018.

14. Offshore Infrastructure and Other Marine Users

This Chapter describes the existing baseline environment in terms of maritime assets and marine stakeholders, identifies the pressures associated with the Proposed Development on the receptors, presents the findings of the environmental impact assessment, and describes how significant effects (if any) will be mitigated.

The Proposed Development refers to the Irish Marine components of Greenlink from mean high-water springs (MHWS) at the Irish landfall at Baginbun Beach, Co. Wexford to the 12nm limit. 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.

This Chapter also provides information on the Irish Offshore components of Greenlink from the 12nm limit to the Republic of Ireland/UK median line.

14.1 Data Sources

Baseline conditions have been established by undertaking a desktop review of published information and through consultation with statutory consultees. The data sources used to inform the baseline description and assessment include, but are not limited to the following:

- Ireland's Marine Atlas (Marine Institute 2016);
- European Marine Observation and Data Network (EMODnet) Human Activities (EMODnet 2019);
- Foreshore Unit (2019).
- Other data sources as listed at the end of the Chapter.

14.2 Consultation

The steps taken to contact stakeholders for comments on the EIA scope is documented in Chapter 5. This included the Foreshore Unit, the Marine Institute and the Marine Survey Office. None of the stakeholders contacted raised any comments with respect to offshore infrastructure and other marine users.

14.3 Existing Baseline

The following receptors have been considered in this section:

- Oil and gas infrastructure;
- Military sites
- Dredging and disposal sites;
- Renewable energy and windfarm sites;
- Cables and pipelines; and
- Recreation.

Figure 13-4 (Drawing P1975-INFR-002; in the previous Chapter) provides an overview of marine users near the Proposed Development.

14.3.1 Oil and Gas Infrastucture

The Proposed Development is located within the North Celtic Sea basin, where there are a total of 14 active oil and gas licences (IPAS 2019). However, there is limited oil and gas activity near the Proposed Development. It does not cross any active petroleum exploration and development licences (Marine Institute 2016, DCCAE 2018). The closest active licence is Dunmore (Blocks 50/91 and 50/64), which is operated by Providence Resources Plc, approximately 20km south of the Proposed Development.

The closest wells are listed in Table 14-1. All wells have been plugged and abandoned. Abandoned wells are left capped with no structures above the seabed.

Table 14-1 Oil and gas wells close to the Proposed Development

Well number	Status	Distance to Proposed Development
50/3-3	Plugged & Abandoned	2.8km north-east
50/3-1	Plugged & Abandoned	7.5km east
50/3-2	Plugged & Abandoned	7.7km east
50/10-1	Plugged & Abandoned	8.9km north

Source: DCCAE (2018)

14.3.2 Military

There is no military practice area within the vicinity of the Proposed Development (see Figure 13-4 Drawing P1975-INFR-002, in previous Chapter).

The Naval Service carry out annual fleet exercises which in the past have included operations throughout the Celtic Sea and Saint George's Channel.

The UK Ministry of Defence, as part of the North Atlantic Treaty Organisation (NATO) hosts Joint Warrior, a UK-led multi-national naval exercise that takes place every two years. Although the exercise can use the whole of the UK waters, activity is generally focused off the north and north west of Scotland, Irish Sea and Moray Firth. The 2019 exercise, which took place between 30 March and 11 April 2019, concentrated in the waters West of Scotland, Irish Sea, Celtic Sea and Saint George's Channel. It is possible that exercises in 2021 and 2023 may also use the waters of the Marine Wales component of Greenlink. It is likely that the exercise will involve the use of sonar, mine countermeasure operations, gunnery and high-speed manoeuvres by ships or small craft (MoD 2019).

An unexploded ordnance (UXO) desk-based study was undertaken to inform the EIA process. Provided as Technical Appendix J (1st Line Defence 2018) it identified the following risks within the Proposed Development and Offshore Ireland:

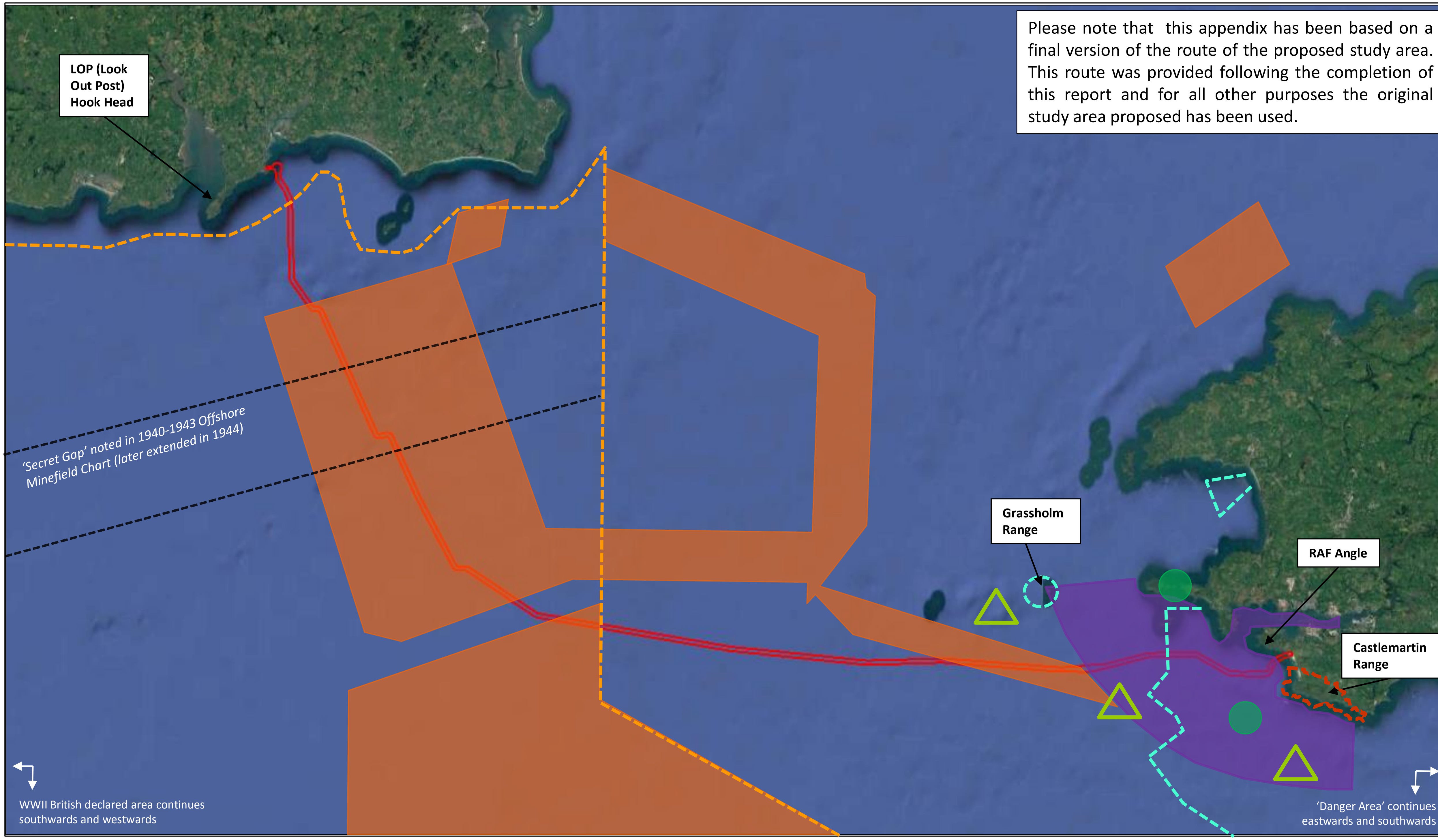
An extensive British mine area, believed to comprise over 6,000 mines and several significant minefields, was laid in the Saint George's Channel in 1940 to protect naval and merchant shipping in the Irish Sea from German U-boat attacks. Historical mine mapping of UK waters shows the former location of this mine area to include a significant portion of the Proposed Development and Offshore Ireland (Technical Appendix J - Annexes G1, G2 and Appendix ii).

A precise assessment of the current risk from mines within the Saint George's Channel is difficult to ascertain. Efforts were made by the Royal Navy at the end of the war to clear/make safe mined areas. However, such clearance tasks are not considered to guarantee the complete removal of all mines within a danger area, especially if such items have the potential to migrate or became covered due to sediment and tidal action over a period of time. It is therefore not possible to discount the possibility of encountering surface or submarine laid sea mines within the Proposed Development and Offshore Ireland.

The risk from items of air delivered UXO at Baginbun Beach is considered negligible. The Republic of Ireland was never subject to a targeted bombing campaign during WWII and instead only sustained bombing by the Luftwaffe on a handful of isolated occasions, none of which are recorded within the Proposed Development.

The significant UXO risks identified by 1st Line Defence (2018) are shown in Figure 14-1.

1st Line Defence (2018) concluded that there is no significant risk of UXO for the Irish mainland portion of the Proposed Development. For the remainder of the Proposed Development and Offshore Ireland, the primary risk is from larger items of ordnance, mainly sea mines.



Key:

- Reported WWI German Minefield. *Not geographically accurate. Extents based on historical literature and recorded wrecks caused by WWI German mines.*
- WWII British Minefield
- WWII Enemy Minefield
- WWII British Declared Areas
- Extent of WWII Armament 'Danger Area' Associated with Training
- Recorded Munitions Dumpsite

Client:	Intertek
Project:	Greenlink
Ref:	DA2985-01

Approximate study area

Source: 1st Line Defence

1ST LINE DEFENCE
Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 446 974

14.3.3 Dredging and disposal sites

Dumping grounds are shown on Figure 13-4 (Drawing P1975-INFR-002; in the previous Chapter); these areas can be open/current or closed/historic and are typically designated for dumping of dredged material or ship waste but can also include chemical or munition waste.

No dredging or disposal sites are located within the Proposed Development.

The closest dredging site to the Proposed Development is at Kilmore Quay in County Wexford, approximately 15m east of Baginbun Beach. Works will include dredging in the vicinity of the harbour entrance and disposal of the dredged material at a designated dump site.

There are several operational dredge spoil dumping sites along the coastline of Co. Waterford and Co. Wexford Counties (EMODnet 2019). The closest to the Proposed Development is within the Barrow River estuary, on the western coast of the Hook Head Peninsula. It is used by the Port of Waterford Company to dispose of dredged spoil from port operations.

There is no conventional, chemical or unknown munition in the vicinity of the Greenlink project. The closest occurrence to the project were recorded in the Irish sea and off County Cork (OSPAR Commission 2018).

no marine aggregate dredging currently occurs in the Republic of Ireland (DHPLG 2018a), however it is noted that there is potential off the eastern coastline near to the Proposed Development that is not currently undergoing development.

14.3.4 Renewable energy and wind farm sites

There are no proposed or existing offshore wave energy sites, offshore tidal energy sites or operational offshore windfarms within 40km of the Proposed Development (Marine Institute 2016, SEAI 2019a). There is no application relating to the installation of a new windfarm within 40km.

The closest Irish windfarm is Arklow Bank, approximately 100km to the north of the Proposed Development (Marine Institute 2016).

The Celtic Sea and the offshore waters in the vicinity of the Proposed Development and Ireland Offshore were covered under the Department of Communications, Climate Action & Environment (DCCAE) Offshore Renewable Energy Development Plan (OREDP) (DCCAE 2014) and were assessed for the development of offshore wind infrastructures. The OREDP assessed areas across Ireland for their suitability for offshore renewable energy, such as tidal, wave and wind.

SSE Renewables (Ireland) Ltd have submitted an application to carry out marine surveys to inform development of the Celtic Sea Array windfarm project (Foreshore Licence Reference FS006983). Geophysical, geotechnical and environmental survey is planned to identify seabed conditions of the site, helping to optimise any future development proposals. The survey is planned to take place between April and

October within five years of Foreshore Licence determination (if approved). Part of the geophysical survey area would overlap with the Proposed Development.

In addition, the DHPLG has confirmed that a pre-application to carry out marine surveys to inform the development of the Inis Ealga floating offshore wind (FOW) project has been submitted (not currently available on website). The Inis Ealga FOW project is located off Co. Cork. approximately 85km south-west of the Proposed Development, and is being proposed by DP Energy.

14.3.5 Cables and pipelines

The Proposed Development and Ireland Offshore cross five telecommunication cables, as detailed in Table 14-2.

Table 14-2 Telecommunication cable crossings

Owner & Asset Name	Status	Crossing Point (KP)	Greenlink component	Asset Description
BT: Celtic	Inactive	139.098	Proposed Development	275km telecommunication cable between Kilmore Quay in Ireland and Sennan Cove in the UK
Vodafone: Solas	Active	121.535	Ireland Offshore	232km telecommunication cable between Kilmore Quay in Ireland and Oxwich Bay in the UK.
BT: ESAT-1	Active	102.5	Ireland Offshore	261km telecommunication cable between Kilmore Quay in Ireland and Sennan Cove in the UK
Century Link: Pan European Crossing 1	Active	95.935	Ireland Offshore	495km telecommunication cable between Ballinesker/Ballygrangans in Ireland and Bude/Whitesands in the UK
GTT Communications: Hibernia Atlantic	Active	86.7	Ireland Offshore	12,000km transatlantic cable between Coleraine (UK), Southport (UK), Dublin (Ireland), Nova Scotia (Canada) and Massachusetts (USA).

The crossing of third-party infrastructure is made with agreement of the owner following a negotiated formal Crossing Agreement. The Crossing Agreement describes the rights and responsibilities of the parties and the detailed physical design of the crossing.

A review of the DHPLG Foreshore Unit website identified:

A Foreshore Licence (Reference FS006691) was approved in 2018 for site investigation works for a proposed fibre optic cable between Crooke, Co. Waterford to Duncannon, Co. Wexford; across the River Barrow estuary (Eir 2018). Installation dates of the proposed fibre optic cable are not known.

A Foreshore Licence application (Reference FS006766) was submitted on 21 June 2017 to carry out survey works in order to select an optimum route for the proposed Ireland France IFC-1 subsea fibre optic cable system. The route is from Clonea, Co.

Waterford (close to Dungarvan) to the 12nm limit. Public consultation was carried out from 18 August 2017 to 18 September 2017. The geophysical surveys were intended to be carried out between September 2017 and August 2018 for three months, however, the DHPLG website indicates that the application is still in the 'Consultation' phase which would indicate that permission has not yet been granted. This is located approximately 43km west of the Proposed Development landing.

There is no pipeline within the vicinity of the Proposed Development (Marine Institute 2016).

14.3.6 Recreation

Two thirds of Ireland's population live within 10km of the coast, and approximately 50%, 1.48 million, persons participated in some form of water-based activity in 2003 (MI 2006). The Hook Head Peninsula is a popular location for coastal leisure with planned events such as the Hook Sprint Triathlon in August attracting visitors.

Sailing is a major coastal activity in the areas bordering the Proposed Development. There are approximately 62 sailing clubs affiliated with the Irish Sailing Association (ISA) in the counties along the Irish coast adjacent to the Proposed Development, the closest being at Dunmore East harbour (ISA 2017), alongside approximately 30 marinas and mooring areas.

The coastal and nearshore areas are of most importance to sea angling, which takes place along the coastline near the Proposed Development. Shore angling from beaches, rocks, estuaries, quays and piers is the most widely practised form of sea angling, being popular from May to September (Inland Fisheries Ireland 2019).

Diving and snorkelling are pursued by thousands of people along the southern and eastern shores of Ireland, particularly the inshore areas around Hook Head (MI 2006).

Wildlife, including marine mammal watching, bird watching and visiting nature reserves is the subject of growing recreational pursuit in waters off the Irish coast. There are a number of designated reserves and conservation interests along the coast near the Proposed Development. Of these, whale and dolphin watching activities are most likely to take place aboard vessels within close proximity to the Proposed Development (Hook Tourism 2019).

The beaches of the Hook Peninsula are popular for water sports such as bathing, kitesurfing, power kite and paddle boarding. Beaches in the area are busy during the summer season.

The landfall site at Baginbun Beach contains beach areas which provide amenity and health benefits to users. The beach is used in a number ways such as bathing, dog walking, fishing and water sports. It is used as a launch site for sea kayaking trips around the Hook Peninsula by a local Fethard company.

A snapshot of the use of Baginbun Beach during the summer of 2018 is presented in Table 14-3.

Table 14-3 Use of Baginbun Beach in summer 2018

Date	Time	People	Vehicles	Kayaks	Boats at Anchor	Other Comments
27/06/18	13:30	68	33	9	2	Warm sunshine. Low tide at 12:12
04/07/18	14:30	70	35	10	2	Warm sunshine – 13 lobster pots
31/07/18	12:30	20	12	12	Not recorded	Also a number of dog-walkers in the vicinity
01/08/18	13:20	5	2	0	2	Drizzly rain – 3 lobster pots
27/08/18	14:50	2	4	0	0	Warm sunshine – three lobster pots

Irish Water Safety (IWS) runs swimming lessons during July and August at beaches across Co. Wexford. Publicly available information is limited but Baginbun Beach was included in the programme during 2017 (IWS 2017). Responses gathered during the Greenlink public consultations (2019) noted that Baginbun Beach is used on an annual basis by the IWS.

It was also highlighted during public consultations that commemorations will be held at Baginbun Beach in 2020 to mark the 350th anniversary of the Anglo-Norman landings. Commemorations are likely to occur during the first bank holiday weekend in May 2020.

14.3.7 Natural evolution of the baseline

The Irish government have recently published an integrated marine plan titled ‘Harnessing Our Ocean Wealth’ which sets out a roadmap for the future of Ireland’s marine waters (DCCAE 2015). The plan sets out the future roadmap for industries that utilise Ireland’s seas, with some activities expanding in scope and others potentially reducing in scale. An increase in renewable energy developments is one such initiative, with Ireland’s Offshore Renewable Energy Development Plan highlighting the need for marine renewable energy developments to allow the country to reach its goal of 40% energy generation from renewable sources by 2020 (DCCAE 2014). To reach such targets it is possible that there may be an increase in renewable energy development around the Proposed Development over its’ lifetime. Other sectors such as marine aggregate extraction have decreased in recent years due to slowdowns in the construction industry. Should the industry begin to expand again however it is possible that more areas of aggregate extraction may open up around the Irish coast (DCCAE 2015).

14.4 Potential Pressure Identification and Zone of Influence

A scoping exercise undertaken to inform the content of the EIAR has excluded the following pressures from further consideration in this topic Chapter. Explanation for the exclusion is provided in Chapter 5, Table 5-2.

- Accidental anchoring or emergency anchoring on unburied / buried cable
- Damage to or interference of an external cable asset

The pressures listed in Table 14-4 will be assessed further. For each pressure, the assessment considered the different aspects of the Proposed Development 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 14-4.

Table 14-4 Pressure identification and zone of influence – offshore infrastructure and other marine users

Project phase	Project Activity	Aspect	Potential Pressure	Receptor	Zone of influence
Installation	Cable installation	Presence of project vessels	Displacement of vessels	Recreational boating, other survey vessels	1km wide x 12km along centreline (in any 24 hour period)
Operation	Repair and maintenance operations				
Decommissioning	Cable removal				
Installation	Cable installation	Presence of project vessels in nearshore	Visual disturbance	Bathers, surfers, and other beach users. Recreational boating	Nearshore
Operation	Repair and maintenance operations	Presence of worksite in intertidal area	Restricted access on the beach	Bathers, surfers, and other beach users. Recreational boating	Intertidal area
Operation	Operational cables	External cable protection	Change in water depth	Recreational boating	Two HDD exit points = 0.7m high x 5.2m wide Repair = 10m wide by 1.5m high
Operation	Operational cables	Emission of EMF	Electromagnetic changes - deviation of magnetic compasses	Vessels operating with a magnetic compass	2m (bundled cables) 12m unbundled cables at HDD exit
			Electromagnetic changes - interference with inertial navigation	Vessels operating with INS and GPS systems	
Installation	Operational cables	Presence of installed cables	Restricted development options	SSE Renewables (Ireland) Ltd Prospective Windfarm	Proposed Development

Note: it was determined that the other marine activities identified in the area were of sufficient distance from the Proposed Development that there would be no interaction.

14.5 Embedded Mitigation

The project description, Chapter 4, provides the design. 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 other marine users is provided in Table 14-5 below. When undertaking the EIA, it has been assumed that these measures will be complied with either as a matter of best practice or to ensure compliance with statute and consents.

Table 14-5 Embedded mitigation

ID*	Embedded mitigation
EM1	Early consultation with relevant contacts to warn of impending activity, with vessels requested to remain at least 500m away from cable vessels during installation, repair and decommissioning.
EM2	Project vessels will comply with the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) – as amended, particularly with respect to the display of lights, shapes and signals.
EM3	Project vessels will exhibit signals in accordance with the Irish requirements for marking and identification of offshore installations as specified in the Safety, Health and Welfare (Offshore Installations) Act, 1987.
EM10	Notice will be given to sea users in the area via Notices to Mariners, Kingfisher Bulletins, NAVTEX, and NAVAREA warnings. Particular attention will be paid to ensuring the following organisations receive the notifications: Irish Maritime Administration (including the Maritime Safety Policy Division, the Marine Survey Office, the Irish Coast Guard, the Maritime Transport Division, Maritime Services Division), Commissioners of Irish Lights, Royal National Lifeboat Institution (RNLI), the Irish Coast Guard (IRCG), Community Rescue Boats Ireland (CRBI), Harbour and Port authorities, Irish Ferries, Irish South and East Fish Producers Organisation, South East Regional Inshore Fisheries Forum, Irish Sea Fisheries Board individual local fishermen (as identified during marine survey campaign).
EM11	'As-laid' co-ordinates of the cable route will be recorded and circulated to the Irish Hydrographic Office (IHO), UK Hydrographic Office (UKHO) and KIS-ORCA Service. Cables will be marked on admiralty charts and fisherman's awareness charts (paper and electronic format).
EM12	Crossing Agreements will be produced with cable owners. The Crossing Agreement describes the rights and responsibilities of the parties and also the design of the crossing. Crossing design will be in line with industry standards, using procedures and techniques agreed with the cable owners
EM13	HDD will be used for the cable landfalls to avoid disturbance of sensitive habitats (e.g. intertidal reef habitat) and disruption on beaches.
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.
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.

14.6 Significance Assessment

14.6.1 Summary of assessment

Table 14-6 presents the summary of the EIA conducted on the Proposed Development. Sections 14.6.2 to 14.6.7 provide justification for the conclusions. Where the assessment concluded the effects are significant, Project Specific Mitigation has been proposed and is described in Section 14.7. Where there is still potential for residual effects this is discussed further in Section 14.8.

Table 14-6 Impact assessment summary – offshore infrastructure and other marine users

Determination of Potential Effect						Impact Assessment			Consideration of Mitigation	Residual Effect Assessment		
Section	Project Phase	Aspect	Potential Pressure	Embedded Mitigation (Table 14-5)	Receptor	Magnitude	Sensitivity	Significance	Project Specific Mitigation (Table 14-7)	Magnitude	Sensitivity	Significance of Residual Effect
14.6.3	Installation Operation (including repair & maintenance) Decommissioning	Presence of project vessels in nearshore	Visual disturbance	EM13	Bathers, surfers, and other beach users. Recreational boating	Low	High	Moderate	PS15, PS16	Low	Medium	Slight
14.6.4	Installation Operation (including repair & maintenance) Decommissioning	Cable installation Cable repair Cable removal	Restricted access on the beach		Bathers, surfers, and other beach users.	-	-	No effect	-	-	-	-
14.6.7	Operation	Presence of cables	Restricted development options		SSE Renewables (Ireland) Ltd Prospective Windfarm	Low	Low	Slight	PS17	-	-	-

Note: The conclusions for Displacement of vessels, electromagnetic changes and changes in water are presented in Chapter 13.

14.6.2 Displacement of vessels

This pressure on military vessels, recreational boating and other survey vessels effects the crafts ability to navigate. The embedded mitigation, listed in Table 14-5, associated with this pressure is EM1, EM2, EM3 and EM10. The significance of the effect has been assessed as part of the Navigation Risk Assessment, provided in Chapter 13.

Section 13.6.2 concluded vessels will have to make minor diversions to avoid the installation activity. However, individual occasions will be brief to temporary with cumulative effects from repeated project activities short-term. The overall significance of the effect is assessed as **Slight** and is **Not Significant**.

14.6.3 Visual disturbance

14.6.3.1 Installation

During seabed preparation and installation works one or two vessels will be present in the nearshore area off Baginbun Beach. It is possible a jack-up barge may be positioned at the HDD exit points ahead of cable installation to excavate the borehole and support the cable pull-in process.

The project vessels will typically be at least 400m from the low-water mark but will be visible from the beach in an area not usually subject to shipping. Although the presence of the vessels will not restrict beach use, the amenity value of the beach will be temporarily adversely affected.

Visual disturbance will be temporary, with amenity value restored once the vessels have completed their activities. There is the potential for a cumulative effect as different aspects of the installation work will require the presence of different vessels in the area at different times. Vessels may be present for a period of weeks on multiple occasions. However, there will be no visible physical change at Baginbun Beach once installation is complete.

There is also the potential for an intra-project effect if works in the nearshore area occur at the same time as works at the Irish Onshore HDD compound. Concurrent works would also temporarily elevate the visual disturbance to recreational users of Baginbun Beach.

Embedded mitigation EM13 (listed in Table 14-5), applies directly to this pressure and has been taken into consideration in the assessment.

The magnitude of the effect has been assessed as low. Generally, the sensitivity of the receptor is low as the Proposed Development does not directly restrict the use of the beach. However, it is recognised that the sensitivity will be dependent on the timing of the works. For example, if works coincided with the Anglo-Norman commemoration in May 2020 or occurred during the peak tourist season (i.e. July and August) public sensitivity could be perceived as higher, with the public choosing to use alternative locations. As a worst-case, the EIA has assumed that works in both the Proposed Development and Irish Onshore component of Greenlink could occur during a period of increased sensitivity. Therefore, the overall significance of the effect is assessed as **Moderate** and is **Significant**. Project Specific Mitigation has therefore been proposed (see Section 14.7).

14.6.3.2 Operation (including maintenance and repair)

Effects during any unforeseen maintenance and repair works will be of a smaller magnitude when compared to cable installation, and the effect of visual disturbance has been assessed as **Slight** and is **Not Significant**.

14.6.3.3 Decommissioning

Effects during decommissioning will be of a similar magnitude when compared to cable installation, and the effect of visual disturbance has been assessed as **Moderate** and is **Significant**. Project Specific Mitigation proposed for the installation phase will also apply during decommissioning.

14.6.4 Restricted access on the beach

14.6.4.1 Installation

In line with embedded mitigation EM13 (Table 14-5), the 'base-case' for cable installation is to use horizontal directional drilling (HDD). The drill will start on agricultural fields above Baginbun Beach and exit seaward of the low-water mark. Access to the beach will not be restricted during installation. There will be **No Effect**.

14.6.4.2 Operation (including maintenance and repair)

Repairing cables within a HDD duct is technically extremely challenging. During installation, three boreholes will be drilled; two for the installed cables and a third for redundancy in the case of cable failure. Including this contingency during installation means no further drilling would be required. The third borehole would be used to make the cable repair without disturbing or restricting access to the beach. There will be **No Effect**.

14.6.4.3 Decommissioning

It is expected that the HDD ducts and cables will be left in-situ under the beach. Access to the beach will not be restricted during decommissioning. There will be **No Effect**.

14.6.5 Change in water depth

This pressure on military vessels and recreational boating effects the craft ability to navigate. The embedded mitigation, listed in Table 14-5, associated with this pressure is EM29. The significance of the effect has been assessed as part of the Navigation Risk Assessment, provided in Chapter 13.

Section 13.6.3 concluded that the external cable protection will be a new permanent feature. There will be sufficient under keel clearance at the proposed external cable protection locations to ensure safe navigation. The assessment considered the scenario that external cable protection would be required for the purposes of cable repair in water depths of less than 30m, although this is considered unlikely. The assessment concluded that the overall significance of the effect is **Slight** and is **Not Significant**.

14.6.6 Electromagnetic changes – deviation of magnetic compasses and interference with inertial navigation systems.

This pressure on military vessels and recreational boating effects the craft ability to navigate. The significance of the effect has been assessed as part of the Navigation Risk Assessment, provided in Chapter 13.

It is estimated that the electromagnetic field will be elevated above the background geomagnetic field up to 2m from the bundled cables and 12m for the unbundled cables at the HDD exit points. A slight elevation in the background geomagnetic field may be noticed at the HDD exit point for a short distance prior to the cables being bundled together. Section 13.6.4 concluded that the effect on magnetic compasses will be **Imperceptible** and **Not Significant** and there will be **No Effect** on navigational systems.

14.6.7 Restricted development options

Operation (including maintenance and repair)

The Proposed Development overlaps with a potential export cable corridor that SSE Renewables (Ireland) Ltd are proposing to survey. The export cable corridor is one of two corridors that SSE are planning to investigate. Once the Proposed Development installed there will be a zone around the cables in which no other development activity can be undertaken, so as not to risk damage to the Proposed Development. This work restriction zone is a legal area that will be defined and controlled by GILs Foreshore Licence. Typically in water depths up to 55m below chart datum the exclusion zone is 250m either side of the centre line; extending to 500m either side, in water depths greater than 55m. If a third party wishes to undertake works within the exclusion zone then a Proximity Agreement will need to be agreed with GIL.

The survey is to be carried out at some point during the next five years. Three scenarios are possible: the survey will be undertaken prior to installation of the Proposed Development; the survey will overlap with the installation period for the Proposed Development; and the survey will be undertaken once the Proposed Development is installed. The potential for cumulative effects between the two projects has been assessed in Chapter 16.

The installation of the Proposed Development will potentially cause a local change to SSEs plans, as it will necessitate engineering a crossing, if the export route is chosen and the offshore windfarm proposal progress past the survey stage. However, there are acceptable alternatives in the region in terms of landfall sites, and route options and therefore the sensitivity of the receptor has been assessed as low. The magnitude of the effect has been assessed as low given the localised change. The assessment concluded the effect of the Proposed Development on the receptor will be **Slight** and is **Not Significant.** However, as a matter of best practice Project Specific Mitigation (PS17) has been proposed to ensure mutually compatible development takes place, if the SSE project proceeds through to development.

14.7 Project Specific Mitigation

In addition to the embedded mitigation outlined in Section 14.5, Table 14-7 presents measures that GIL is committed to adopting.

Table 14-7 Project Specific Mitigation – offshore infrastructure and other marine users

ID*	Project Specific Mitigation
PS15	All works in the nearshore will be avoided during July and August.
PS16	GIL will liaise with the local council and councillors with regards the Anglo-Norman commemoration event to confirm location and viewing points. Efforts will be made to reduce presence of vessels within the nearshore area during the selected weekend.
PS17	If necessary, GIL to cooperate in reaching mutually agreeable terms for proximity agreements with SSE Renewables (Ireland) Ltd

14.8 Residual Effect

The results of the EIA indicated that one pressure could potentially have a significant effect. The significance of this pressure was re-assessed taking into consideration the Project Specific Mitigation outlined in Section 14.7 to determine if a significant residual effect remains.

14.8.1 Visual disturbance

The assessment identified that beach users are likely to be sensitive to visual disturbance from the Proposed Development and intra-project effects if the Irish Onshore works occurred at the same time as the nearshore works. Review of the baseline identified two periods of particular concern: a weekend during May 2020 for the 350th anniversary of the Anglo-Norman landings and July and August when visitor numbers peak due to the holiday season. Mitigation has therefore been proposed, PS15 and PS16 to minimise visual disturbance at these times. Re-assessment of the effect taking the mitigation into consideration concludes that the sensitivity will reduce to low and the assessment of effect reduced to **Slight** and **Not Significant**.

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15. Marine Archaeology

This Chapter describes the existing baseline environment in terms of marine archaeology, 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 refers to the Irish Marine components of Greenlink from mean high-water springs (MHWS) at the Irish landfall at Baginbun Beach, Co. Wexford to the 12nm limit. 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.

This chapter also provides information on the Irish Offshore components of Greenlink from the 12nm limit to the Republic of Ireland/UK median line.

15.1 Data Sources

GIL commissioned Cotswold Archaeology to undertake a desk-based assessment of the environmental baseline for marine archaeology to inform the EIA process. The marine archaeological technical report (Cotswold Archaeology 2019; Technical Appendix F) consulted a number of primary sources and synthesised information in order to describe the baseline. Information taken from the earlier marine archaeology desk-based assessment (DBA) (Cotswold Archaeology 2018a) and the data gathered through marine geophysical and geotechnical cable route surveys were key components of the report.

Only information pertaining to the data sources and previous work undertaken for the scheme in Irish waters will be referred to below. The full assessments (also covering the full scheme in Welsh Marine) are provided in Technical Appendix F.

15.1.1 Desk-based studies

15.1.1.1 Marine Archaeology DBA & Marine Archaeological Technical Report

The marine archaeology DBA for the Proposed Development included an assessment of the marine and coastal cultural assets potentially affected by Greenlink (Cotswold Archaeology 2018a). The purpose of the assessment was to identify any sites and features of cultural heritage significance within and in proximity to the Proposed Development, up to MHWS (unless otherwise stated), that may be affected. The results of the DBA outlined the archaeological potential of the marine environment and included information on sites and areas of archaeological significance identified within and in proximity to Greenlink.

The DBA focused on three route options (A, B and E), of which one (E) has been taken forward for EIA with a slight variation.

The DBA included a documentary and cartographic search utilising a variety of sources in order to locate all known cultural heritage assets within a cable study corridor (CSC) (a 1km swath of the seabed). Each possible route of the Proposed Development was assessed, and the archaeological potential of the area was evaluated. Sources considered for this assessment included, where relevant:

- Information held by the Underwater Archaeology Unit (UAU) of the Department of Culture, Heritage and the Gaeltacht (DCHG);
- Information held by Heritage Ireland on protected wrecks;
- Wrecks database of Ireland (WIID);
- Information held on the Record of Monuments and Places (RMP) website, maintained by the National Monuments Service;
- Information held by Integrated Mapping for the Sustainable Development of Ireland’s Marine Resources (INFOMAR);
- National Museum of Ireland archives;
- National Library of Ireland (for historic charts and maps only);
- UKHO review of cartography, historic charts and sailing directions;
- Ministry of Defence (military remains only);
- UK Receiver of Wreck (RoW);
- Records held with the Archaeology Data Service (ADS);
- Marine Environment Data Information Network (MEDIN);
- Readily accessible published sources and grey literature (e.g. results from previous studies);
- Relevant external marine historic environment specialists;
- Relevant dive groups and local interest groups;

- Relevant external marine historic environment specialists (e.g. palaeo-environmental); and
- Relevant Strategic Environmental Assessment (SEA) reports (e.g. UK Continental Shelf SEA archaeological baseline) and Coastal Survey Assessment reports.

Of those listed above, the key data sources were the UAU and INFOMAR.

The DBA included all known and potential maritime cultural heritage assets identified in the course of the assessment. These were each assigned a unique Cotswold Archaeology (CA) number for ease of identification in illustrations and throughout the text. These CA numbers have been replicated in this document, with reference only to those which may be affected by the Proposed Development.

The wreck types were defined as follows:

- 'Live' - those for which there is a known location which has been verified by recent surveys;
- 'Dead' - sites that have been recorded in a certain location, but which have not been detected by repeated or the most recent surveys; and
- Lifted - those which have been removed from their recorded location.

Where a live wreck has been identified this information is provided in the baseline; a wreck in a known location that has not been identified is referred to as unidentified. Where the status of a wreck discussed in the baseline is given as 'unknown', this means that it is not recorded whether the wreck is live, dead or lifted.

The baseline information established through the collation and interpretation of the relevant information available through these sources formed the primary source of background detail for the marine archaeological technical report (Technical Appendix F), alongside the results of recent geophysical surveys (discussed below). The detail presented in the marine archaeological technical report is the existing baseline assessed below (Section 15.3).

Full details of the methodologies applied in the marine archaeology DBA and re-laid in the marine archaeological technical report are available in Technical Appendix F.

15.1.1.2 Limitations of desk-based studies and their data sources

One of the greatest limitations when researching known and potential offshore cultural heritage is the difficulty of locating recorded maritime losses. For many losses the location of the sinking of the vessel can be in the form of a general area description, as 'not confirmed as present at this location, but may possibly be in the vicinity', which is not useful practically for the purpose of accurate assessment, except to show the potential exists to encounter lost cultural remains.

Many wrecks have been identified through sonar survey but this too presents difficulties as many of these wrecks have been located using GPS, which until relatively recently was only accurate to 100m (Baird 2009; see also Satchell 2012); or by DECCA which can give locations accurate to only one kilometre. In addition, recorded maritime losses are heavily biased towards the 19th and 20th centuries when more comprehensive records of losses began to be compiled by some authorities.

The details for specific offshore cultural heritage assets in the study area were acquired from the three main sources cited above. All these databases are each derived, in turn, from a variety of sources including various published lists of marine losses and marine surveys. Consequently, there are considerable overlaps and discrepancies between the datasets.

The figures are projected in WGS_1984_UTM_Zone_30N.

The status of wrecks ('live', 'dead', or lifted) was determined based on the information available at the time of writing.

The various datasets used in the compilation of the DBA have been amalgamated to remove duplicate entries.

The wrecks discussed related to the Proposed Development and covered all relevant and accessible sources. Dead entries were included, if applicable, because although wrecks may not have been detected in recent surveys the recorded locations may still contain remains of cultural heritage interest. Given locational discrepancies (Satchell 2012) the possibility that wrecks lie outside previous search areas cannot be discounted.

Dead entries were included, if applicable, because although wrecks may not have been detected in recent surveys the recorded locations may still contain remains of cultural heritage interest. Given locational discrepancies (Satchell 2012) the possibility that wrecks lie outside previous search areas cannot be discounted.

The old archaeological adage that absence of evidence is not evidence of absence was deemed appropriate in the context of the desk-based assessment. In some cases, however, it was clear from the details of data entries that there is no reason to believe that there are now or ever have been archaeological remains. These entries were discussed in the assessments, if appropriate, on a case-by-case basis.

All of the data held by UAU and INFOMAR – the primary historic data repositories for the desk-based studies - was considered, and for completeness, listed and cross-referenced.

15.1.2 Geophysical survey data

Geophysical and geotechnical survey data acquired during the Greenlink cable route survey by MMT during September 2018 – December 2018 has been reviewed by Cotswold Archaeology and our colleagues at COARS (University of Southampton) (Cotswold Archaeology 2018b) (discussed in Technical Appendix F); the information from this assessment has informed this chapter.

The results of the survey have been incorporated into the marine archaeological technical report and the baseline which follows below. Full details of the survey equipment specifications and the survey methodology are contained in the technical report (Technical Appendix F).

15.1.2.1 Limitations of geophysical survey

As outlined in the technical report (Technical Appendix F) the marine geophysical survey utilised the three main geophysical techniques, including sidescan sonar (SSS), magnetometry, and sub-bottom profiler (SBP), as well as bathymetric survey data collected using a multibeam echo sounder (MBES). Whilst three of these techniques, SSS, MBES, and magnetometry, are useful prospection tools scanning wide swaths of the seabed, the SBP data is collected over only a very narrow field. Consequently, the ability to detect non-ferrous buried remains, with little or no surficial signature, is very limited.

Equally, the range of geophysical techniques that can be deployed on terrestrial sites, to detect a wide variety of site types and archaeological features, are far less effective in the saline environment of the foreshore and intertidal zones. Consequently, although the techniques employed in this environment are effective and have produced some very interesting results, the results are not as finely nuanced as they would be if a wider range of techniques could be deployed, so some potentially archaeological features may not be detected.

15.2 Consultation

Table 15-1 summarises the relevant consultation responses on marine archaeology. The steps taken to contact stakeholders for comments on the EIA scope is documented in Chapter 5.

Table 15-1 Consultation responses – marine archaeology

Stakeholder	Summary of Consultation Response	How response has been addressed
The Department of Culture, Heritage and the Gaeltacht	It was requested that the EIAR should include a section dedicated to Cultural Heritage, including Underwater Cultural Heritage (UCH). Suggested mitigation measures have been requested for direct and indirect impacts.	This chapter addresses UCH as requested.

15.3 Existing baseline

This section provides a summary of the baseline environment as understood through the results of previous work within the 1km CSC. In-depth details of the marine historic environment can be sought from the data sources provided in Technical Appendix F.

15.3.1 Offshore route context

The Irish landfall site has been plotted over existing INFOMAR and UKHO swath bathymetry covering the proposed cable route, with background bathymetry derived from the EMODnet regional Digital Terrain Models (DTM), which is at a resolution of 0.125 minute * 0.125 minute. The bathymetry clearly shows the presence of the main deep associated with St George’s Channel between Wales and Ireland, which reaches a maximum depth of -140m chart datum (CD).

Modelling presented by Chiverell et al. (2013) suggests that the Irish Sea Ice Sheet (ISIS) would have retreated to the north of the Celtic Sea area by 23.7 to 23.0 ka. The expansion and retreat of the ISIS along St George’s Channel and into the Celtic Sea resulted in the deposition of thick Pleistocene deposits (e.g. Blundell et al. 1968; Garrad 1977).

Scourse & Furze (2001) present the results of a series of boreholes from the centre of St George’s Channel, showing that, in the upper 5-10m of those intersecting with the Indicative Greenlink Interconnector Route, a series of glacio-fluvial and glacio-lacustrine deposits are overlain by late-glacial / Holocene marine gravel and marine sand. The boreholes containing Pleistocene Tills are present in the deeper central section of St George’s Channel.

Evans (1990) suggests that much of the seabed of the Celtic Sea consists of a thin lag deposit reworked from pre-existing deposits. No borehole data were available to assess the likely sediments present below the seabed from the Irish side of St George’s Channel.

The retreat of the ISIS coupled with sea level rise led to the submersion of coastal areas. The rate of change of this relative sea-level (RSL) has been constrained by studies using sea level index points (SLIPs). The most recent review of SLIPs for the British Isles has been presented by Shennan et al. (2018). On the Irish coast, fifteen SLIPs were used to define the RSL curve for south Wexford, with the closest point derived from Woodvillage, Fethard-on-sea, located c. 2.5km north of the Baginbun Beach landfall (Dresser 1980). These Irish SLIPS date to between 7.3 to 2.3 ka and range in elevation from -6.8 to 0.61m relative to mean sea level (MSL).

The modelled RSL suggests that, after the retreat of the ISIS, a land bridge no longer existed between Wales and Ireland in St George’s Channel, and it is therefore improbable that palaeoenvironmental material associated with submerged palaeo-landscapes exists in the main channel area (see Westley & Edwards 2017).

15.3.1.1 Geophysical survey results

The offshore geophysical surveys were undertaken in order to determine whether there would be any effect on potential archaeological features during proposed coring in advance of the construction phase of the scheme. During the survey, multibeam echosounder (MBES), sidescan sonar (SSS), magnetometer and sub-bottom profiler (SBP) data were collected.

Analysis of the marine geophysical datasets identified 64 anomalies with archaeological potential (CA2001-2061, CA2141-2143). Other geophysical anomalies identified within the survey data, notably the side scan sonar, consisted of small (<2m) boulders, sometimes with associated scour, within areas where bedrock was not exposed on the surface. These anomalies did not have an associated magnetic signal so are interpreted as being natural in origin and not listed as having archaeological potential (see Figures 17 and 18 and Table 4 in Technical Appendix F).

Of the 64 anomalies identified, none were identified as wreck sites. None of these anomalies were identified as having high archaeological potential. 39 were deemed to have medium potential, typically consisting of magnetic anomalies exceeding 25 nanotesla (nT) and sometimes associated bathymetric or SSS anomalies. These might suggest metallic object upon, or just under the seabed. No corresponding anomalies were identified within the neighbouring sub-bottom surveys, though survey lines rarely directly coincided with the position of these anomalies visible in the surface datasets. The remaining 25 anomalies were identified as having low archaeological potential. The geophysical survey report proposed that these should be protected by AEZs in order to prevent development effects to the potential marine archaeological resource in these areas.

A review of the sub-bottom seismic survey data has identified 11 areas where features of archaeological potential are present along the route corridor in Irish waters. The distribution of these areas is shown in Technical Appendix F, Figure 21.

Illustrations of a selection of these areas, including corresponding sub-bottom seismic lines, are provided in Appendix 4 of the Technical Appendix F. The geophysical survey report proposed that these should be protected by archaeological exclusion zones (AEZs) in order to prevent development effects to the potential marine archaeological resource in these areas.

15.3.2 Landfall site context – Baginbun Beach

There are no records of deposits with palaeoenvironmental importance having been encountered at the proposed Irish landfall site in Baginbun Beach. The presence of tree roots in grey wedges of glacial deposits, however, has been reported between the high and low water marks on the beach at Woodvillage (Dresser 1980). These roots might indicate the last vestiges of an eroded submerged forest, with a radiocarbon date on the roots producing a date of 2890-2210 calibrated (cal.) BC (D-119; 4030±120 before present (BP) (Dresser 1980)). It is therefore possible that remnants of submerged forest deposits and their associated palaeo-soils could be present in the Baginbun Beach area.

The available INFOMAR bathymetry shows the Proposed Development aligned with a channel orientated north-south at circa 1.2km offshore. This channel dissects the exposed bedrock and can be traced for approximately 3.5km before opening up into a wider expanse of seabed, below approximately -23m lowest astronomical tide (LAT), where the underlying bedrock geology is less discernible. The formation process and sediment fill of this channel is unknown but is likely to be dominated by glacially-derived material and could exhibit some similarities to the palaeo-channel identified at the mouth of Waterford Harbour (Gallagher et al. 2004). This extends 22km south to approximately -56m Ordnance Datum (OD) where it terminates in an area of possible glacio-genic sediments. Using a variety of geophysical survey methods, Gallagher et al. (2004) suggested that this channel formed in an ice-marginal environment, with the various bedforms attributed to sedimentation at the margins of ice progressively retreating from the nearshore shelf of the Celtic Sea during the last glacial maximum. The presence of later Holocene deposits in, or on the margins of, this channel has not, however, been fully established.

15.3.2.1 Landfall survey results

The landfall surveys comprised walk-over, hand-held metal detector and terrestrial geophysical (electrical conductivity) surveys.

The survey at Baginbun Beach revealed a landscape in which the near-surface bedrock appeared to restrict the drainage of the beach. The orientation of the visible bedrock deposits appeared to continue beneath the sand. Although the bedrock is not visible in the northern section of the beach the data indicates that it is likely to be relatively close to the surface.

No features of archaeological potential were identified at the landfall location.

15.3.3 Maritime cultural heritage

15.3.3.1 Palaeoenvironmental deposits

As discussed above, there is evidence to suggest that palaeoenvironmental material exists in proximity to the landfall location, and along the offshore route.

15.3.3.2 Wrecks and obstructions

The details of each recorded wreck/obstruction have been collated in a series of tables and assigned ‘CA’ reference numbers (Table 15-2). The location of these wrecks/obstructions are shown in Figures 15-1 to Figure 15-3. Table 15-2 shows the wrecks/obstructions which were identified in the DBA within the 1km wide CSC. Full descriptions of the records can be found in Section 6 of the DBA (Cotswold Archaeology 2018a).

Numbers missing from the table include those:

1. in the Greenlink Marine Environmental Statement - Wales, which covers the Welsh Marine components;
2. which were assessed at the DBA stage for alternative routes which have not been taken forward; or

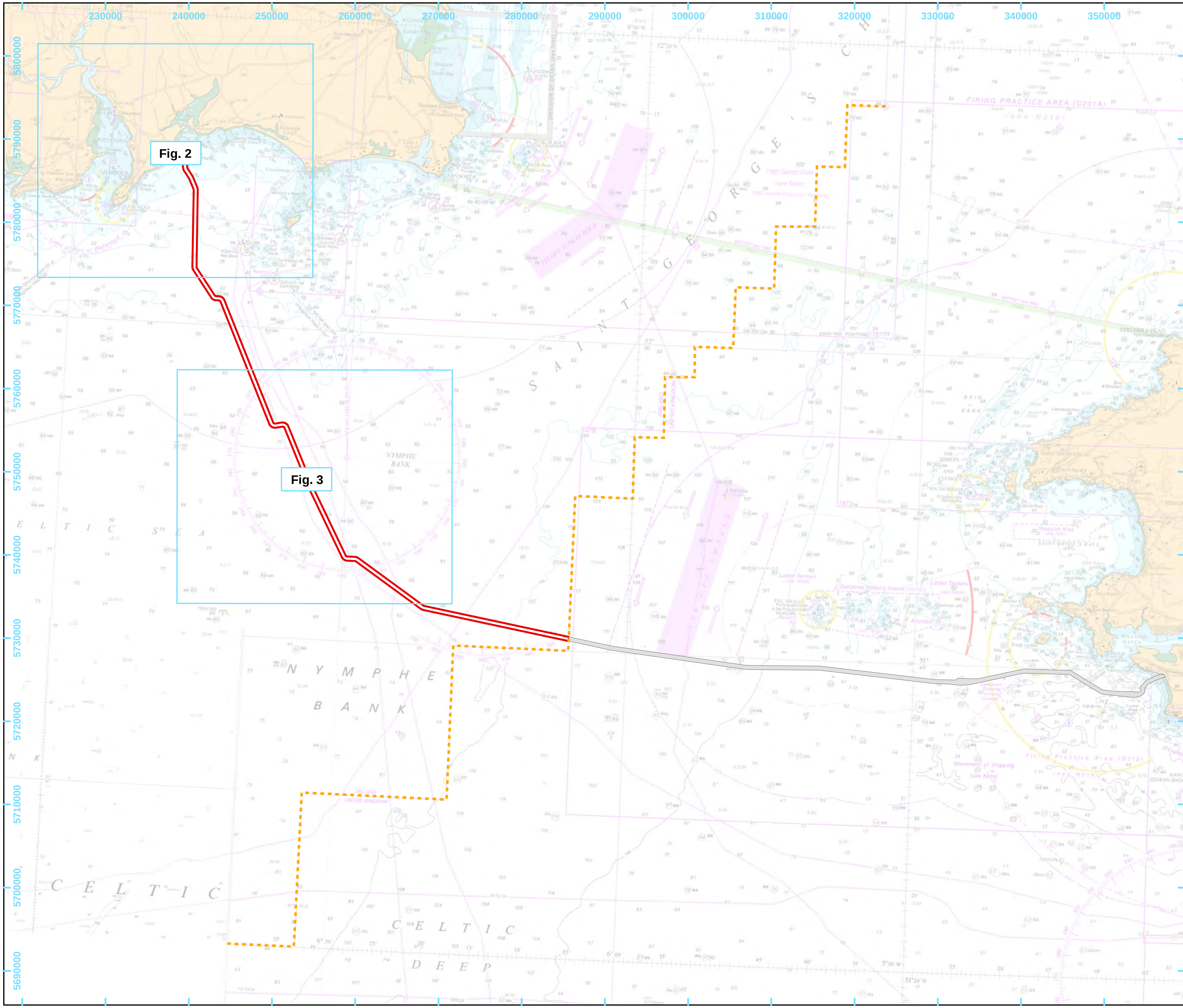
3. which are addressed in the EIAs for Wales Onshore or Irish Onshore as they are above MHWS and therefore beyond the scope of this marine archaeology chapter.

Table 15-2 Wrecks/obstructions recorded within the 500m radius CSC

CA no.	Name	Type	Date	Status	Source & ref. no.
CA1	Candidate	Wreck	Modern (1915)	Live	OceanWise 1001695985 WIID W03284
CA15	Find near promontory fort	Findspot	Unknown	Lifted	NMI WX050-015001

All the wrecks/obstructions identified above have been recorded beyond 300m of the Proposed Development. Each of the above wrecks/obstructions are described in detail in Technical Appendix F.

Potential effects on the settings of assets in proximity to the Proposed Development but above MHWS are addressed in the Ireland Onshore EIAR.



Legend

- Irish Proposed Development
- Greenlink Welsh Marine & Welsh Offshore components
- Median line

N

0 17.5km

Coordinate System: WGS 1984 UTM Zone 30N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -3.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

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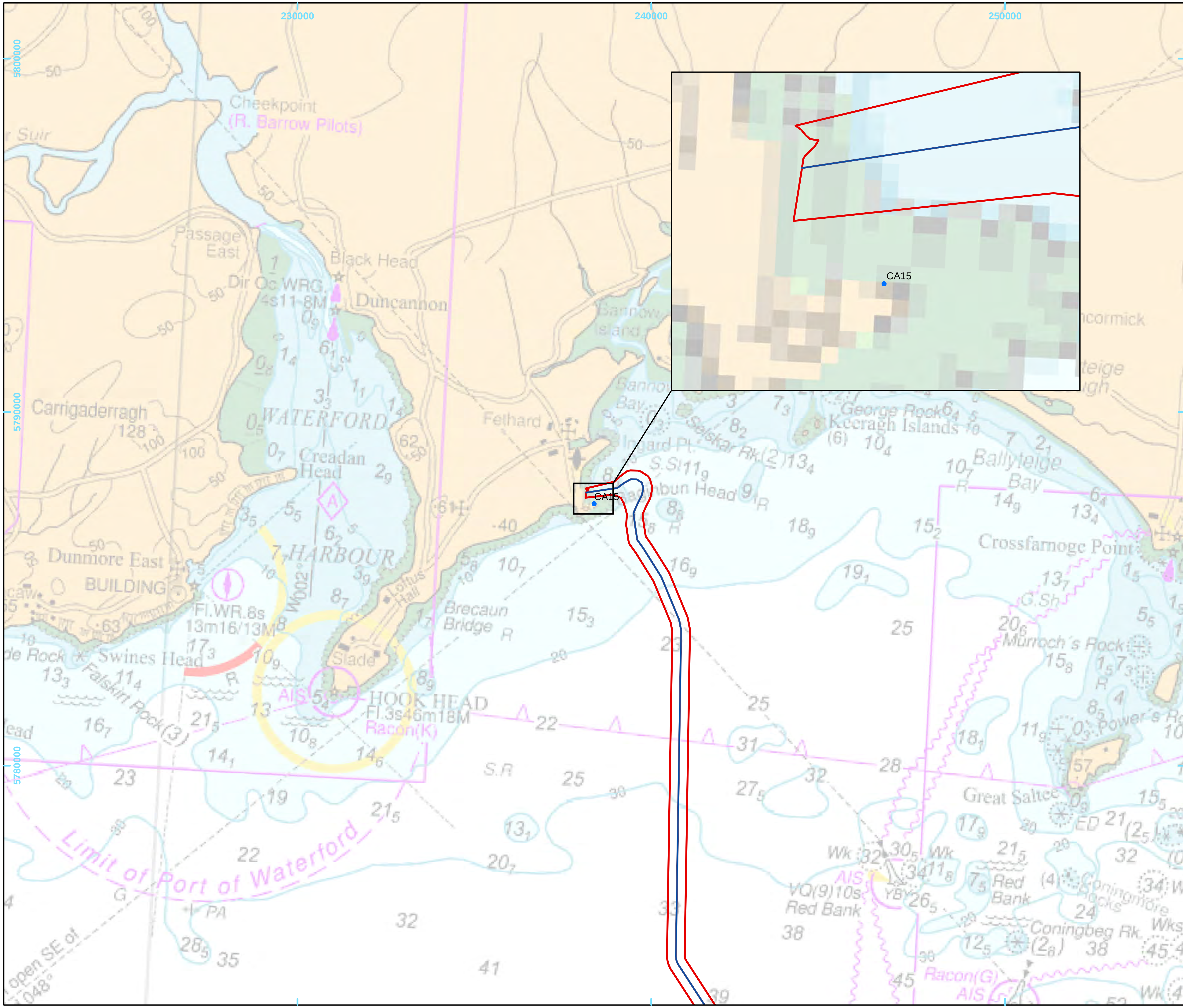
PROJECT TITLE
Greenlink Interconnector

FIGURE TITLE
Proposed development

DRAWN BY	RLF	PROJECT NO	770349	FIGURE NO.
CHECKED BY	ZA	DATE	29/04/2019	15-1
APPROVED BY	MTW	SCALE@A3	1:425,000	



Legend

- Wrecks and obstructions
- Greenlink Route Centreline (Indicative)
- Proposed Development

N

0 4.25km

Coordinate System: WGS 1984 UTM Zone 30N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -3.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

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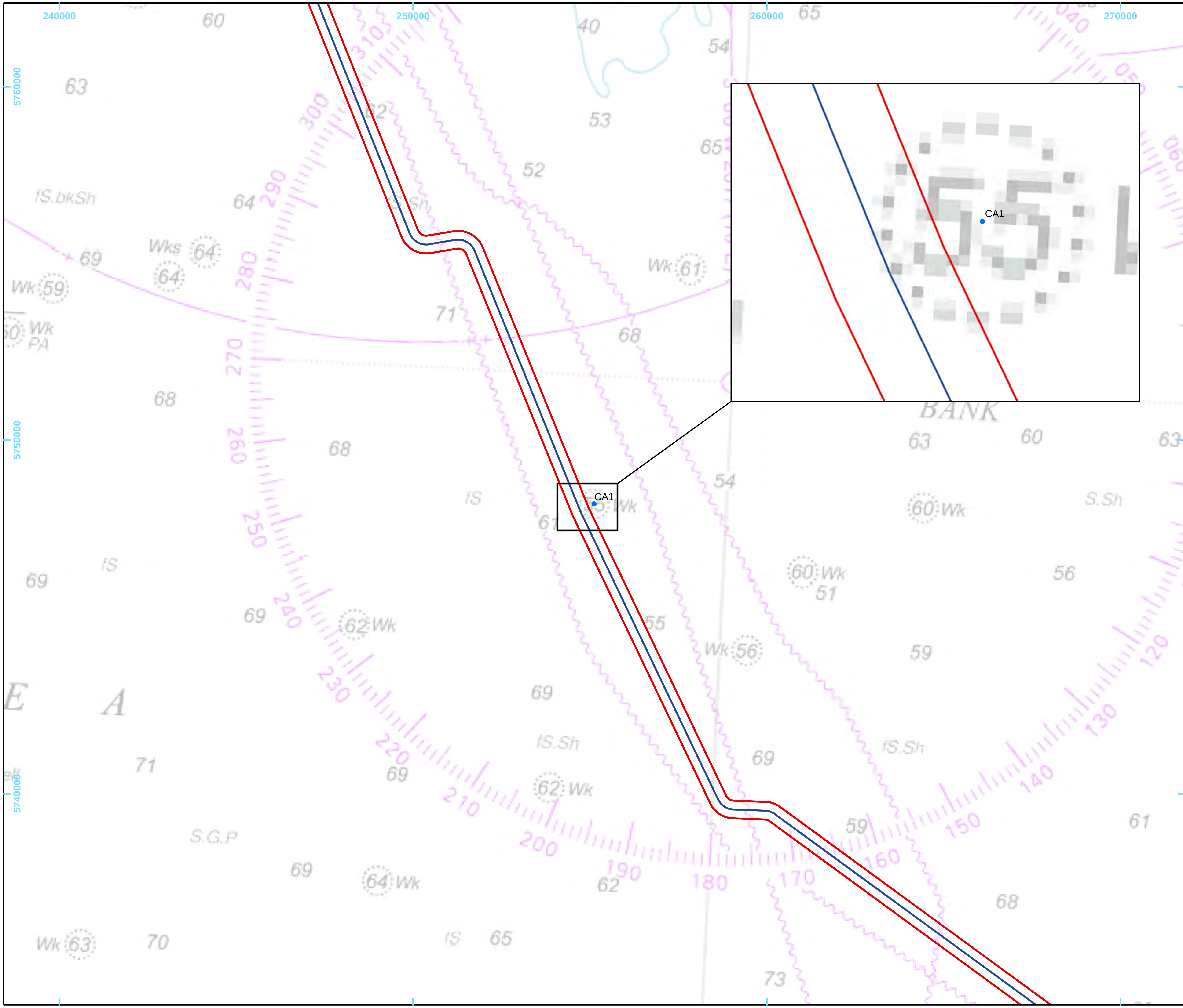
PROJECT TITLE
Greenlink Interconnector

FIGURE TITLE
Wrecks and obstructions

DRAWN BY	RLF	PROJECT NO	770349	FIGURE NO.
CHECKED BY	ZA	DATE	29/04/2019	15-2
APPROVED BY	MTW	SCALE@A3	1:100,000	



Legend

- Wrecks and obstructions
- Greenlink Route Centreline (Indicative)
- Proposed Development

N

0 4.25km

Coordinate System: WGS 1984 UTM Zone 30N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -3.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

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PROJECT TITLE
Greenlink Interconnector

FIGURE TITLE
Wrecks and obstructions

DRAWN BY	RLF	PROJECT NO	770349	FIGURE NO.
CHECKED BY	ZA	DATE	29/04/2019	15-3
APPROVED BY	MTW	SCALE@A3	1:100,000	

15.4 Potential Pressure Identification and Zone of Influence

A scoping exercise undertaken to inform the content of the EIA identified that all pressures associated with the receptor marine archaeology should be taken forward for further assessment.

The pressures listed in Table 15-3 will be assessed. For each pressure the assessment considered the different aspects of the Proposed Development during installation, operation (including repair & maintenance) and decommissioning. In order to evaluate the most significant effects, the largest zone of influence from these aspects were selected. The zones of influence are presented in Table 15-3.

Any wrecks/obstructions identified in the DBA beyond the zone of influence have not been assessed further in this Chapter.

Table 15-3 Pressure identification and zone of influence – Marine archaeology

Project Phase	Project Activity	Aspect	Potential Pressure	Receptor	Zone of Influence
Installation	Seabed preparation, Cable burial	HDD, boulder clearance, pre-sweeping, pre-lay grapnel run, plough & jet trenching, cable protection, anchors	Direct damage to wrecks and obstructions, and archaeological sites	Potential palaeoenvironmental deposits Currently unknown/unrecorded wrecks and obstructions, and archaeological sites and artefacts directly on the route of the proposed cable	100m
Installation	Seabed preparation, cable burial	Pre-sweeping, plough and jet trenching, cable protection	Indirect damage to wrecks and obstructions, and archaeological sites - caused by potential scour and plume effects resulting in increased protection to, or deterioration of, assets in the vicinity.	Potential palaeoenvironmental deposits Currently unknown/unrecorded wrecks and obstructions, and archaeological sites and artefacts directly on the route of the proposed cable	100m
Operation	Maintenance and repair	Plough and jet trenching, cable protection			
Installation	Cable lay	Intertidal works			
Operation	Maintenance and repair				
Decommissioning	Cable removal				

15.5 Embedded Mitigation

The project description, Chapter 4, provides the design. 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 marine archaeology is provided in Table 12-5 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 15-4 Embedded mitigation

ID	Embedded mitigation measure
EM13	HDD will be used for the cable landfalls to avoid disturbance of sensitive habitats (e.g. intertidal reef habitat) and disruption on beaches.
EM17	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed.
EM28	A protocol will be established for reporting unexpected archaeological discoveries. This protocol will be designed to enable project staff to report any finds made in a manner that is convenient and effective. Should such finds be considered to indicate the presence of a site of archaeological interest, a temporary archaeological exclusion zone (AEZ) may be implemented until more data is available.
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.
EM30	A scheme-specific Underwater Archaeology Impact Assessment (UAIA) will be prepared in consultation with the Underwater Archaeology Unit and the National Monuments Service (NMS). This will set out when, how and why archaeological mitigation measures recommended in Chapter 15 are to be implemented and will be prepared in line with the Framework and Principles for the Protection of the Archaeological Heritage (Department of Culture, Heritage and the Gaeltacht 1999).

15.6 Significance Assessment

15.6.1 Summary of assessment

Table 15-5 presents the impact assessment conducted on the Proposed Development activities. Sections 15.6.2 and 15.6.3 provide justification for these conclusions. Where the assessment concluded the effects are significant, Project Specific Mitigation has been proposed and is described in Section 15.8. Where there is potential for residual effects, these are discussed further in Section 15.7.

Table 15-5 Impact assessment summary – marine archaeology

Determination of Potential Effect						Impact Assessment			Consideration of Mitigation	Residual Effect Assessment		
Section	Project Phase	Aspect	Potential pressure	Embedded Mitigation (Table15-4)	Receptor	Magnitude	Sensitivity	Significance	Project Specific Mitigation (Table15-5)	Magnitude	Sensitivity	Significance of Residual Effect
15.6.2	Installation	HDD, pre-lay grapnel run, plough & jet trenching, cable protection, anchors	Direct damage to wrecks and obstructions, and archaeological sites	EM13, EM17 EM28, EM29, EM30	Potential palaeoenvironmental deposits	Low	Medium	Slight	-	-	-	-
					Known wrecks and obstructions, and archaeological sites and artefacts directly within the Proposed Development, including areas of archaeological potential identified in geophysical survey results	Low-Medium	High	Slight	PS18	Negligible	High	Not Significant
					Currently unknown/unrecorded wrecks and obstructions, and archaeological sites and artefacts directly on the route of the Proposed Development	Low-Medium	High	Slight	-	-	-	-
15.6.3	Installation	Plough and jet trenching, cable protection	Indirect damage to wrecks and obstructions, and archaeological sites - caused by potential scour and plume effects resulting in increased protection to, or deterioration of, assets in the vicinity.	EM13, EM17 EM28, EM29, EM30	Potential palaeoenvironmental deposits	Negligible	Medium	Not Significant	-	-	-	-
					Known wrecks and obstructions, and archaeological sites and artefacts directly within the Proposed Development, including areas of archaeological potential identified in geophysical survey results	Low - Medium	High	Slight	PS18	Negligible	High	Not Significant
					Currently unknown/unrecorded wrecks and obstructions, and archaeological sites and artefacts directly on the route of the Proposed Development	Low - Medium	High	Slight	-	-	-	-

15.6.2 Direct damage to archaeological assets

15.6.2.1 Installation

Palaeoenvironmental deposits

A study of the foreshore at the potential landfall location has identified deposits that have the potential to provide palaeoenvironmental evidence, which could enhance our understanding of the prehistoric period in the area, and may be of medium value. It is reasonable to assume that such deposits, if present, represent a tiny fraction of a much more extensive landscape. Therefore, the localised effect of the proposed work (c 10m deep HDD) across the foreshore associated with the Proposed Development would have a direct effect on only a miniscule proportion of it. The magnitude value of this receptor will be low, if present, resulting in an overall effect that is Slight which is Not Significant.

Wrecks, obstructions and geophysical anomalies

There is also some potential for the presence of previously unrecorded wrecks/obstructions within the Proposed Development. Although no anomalies were identified in the geophysical survey data, the absence of archaeological sits cannot be guaranteed. Any unknown sites that might be encountered would be of high sensitivity.

Any known and potential wrecks/obstructions on the indicative cable route centreline would be sensitive to the direct effects of the Proposed Development and would result in the complete removal of any potential assets along the Proposed Development, with no potential recoverability. However, the embedded mitigation in place ensures that any assets which may be subject to these effects will be appropriately managed through the implementation of a temporary AEZ (EM28). As such, the magnitude of the effect has been assessed as negligible, taking into consideration the assets across the wider area which contribute further to retaining the character of the existing marine historic environment which will not be subject to effects. In conclusion, the significance of effect upon the potential marine archaeology resource is **Slight**; an effect which is **Not Significant**.

15.6.2.2 Operation (including repair and maintenance)

No seabed disturbance will occur from the operation of the cables. Effects during any unforeseen repair and maintenance works will be of smaller magnitude to those for the cable installation. Given the sensitivity of archaeological assets within the Proposed Development to intrusive seabed works, however, the significance of the effect remains **Slight** and is **Not Significant**.

15.6.2.3 Decommissioning

Two options will be considered at decommissioning; leaving the cables in-situ or removing them. If the cables are left in-situ there will be no effect on archaeological assets during decommissioning. If the option to remove the cables (and any associated protection) is selected, however, this process would essentially be the same as installation activities but in reverse. Any effects that might arise due to the decommissioning phase of the Proposed Development will therefore be of a comparable magnitude to those assessed above for cable installation and so the effect has been assessed as **Slight** and is **Not Significant**.

15.6.3 Indirect damage to archaeological assets

15.6.3.1 Installation

Palaeoenvironmental deposits
A study of the foreshore at the potential landfall location has identified deposits that have the potential to provide palaeoenvironmental evidence, which could enhance our understanding of the prehistoric period in the area, and may be of Medium Value. Palaeo-landscapes are potentially very extensive landscapes so the foreshore deposits probably represent a very small fraction. The indirect effects of the Proposed Development, a circa 10m deep HDD, are therefore unlikely to result in substantial change to the greater palaeoenvironmental landscape and the evidence it contains. If present, the magnitude value of the indirect impacts associated with this receptor is considered to be negligible, resulting in an effect which is Not Significant.

Wrecks, obstructions and geophysical anomalies
At this stage, it is considered unlikely that there will be any effects to heritage assets within the zone of influence, except in the unlikely event that the final Greenlink route centreline approaches the border of the Proposed Development. However, an assessment of potential indirect effects within the zone of influence will be made in order to illustrate the worst-case outcome, as follows.

Site investigations have identified no wrecks, obstructions, and records of archaeological features within the zone of influence. However, the presence of previously unrecorded wrecks/obstructions cannot be ruled out entirely.

Any known or potential wrecks/obstructions within the zone of influence may be subject to indirect effects during the installation, operation, and decommissioning of the proposed cable. These effects may be caused as a result of potential scouring or plume effects as identified in Table 15-3, which may cause some exposure or coverage of assets, resulting in potential deterioration or increased protection of assets in the vicinity. Each metre of trench will result in the displacement of 1.5m^3 of sediment, with the majority returning directly to the trench (80% for jetting and 95% for ploughing), and the remainder being released. Gravel will settle within 2.09m with median depth of layer being 108mm. Sand will settle within 19m of the trench with median depth of layer 16mm and silt will settle within 5.3km with median depth of layer 0.039mm. With the embedded mitigation in place, only the settlement of silt could potentially impact known assets, but the projected variation in seabed level (0.039mm) is minimal. The magnitude of indirect effects would therefore be negligible, given that the scouring effects are very localized, and that burial would have a minor beneficial effect.

The assets may be of evidential and historical value, given the information which they may retain about the past. This equates to a high receptor value, relative to the seascape-wide heritage resource of comparable features.

However, the embedded mitigation in place ensures that any assets which may be subject to indirect impact will be appropriately managed through the implementation of a temporary AEZ (EM28). As such, the magnitude of impact would be low, taking into consideration the assets across the wider area which contribute further to retaining the character of the existing marine historic environment which will not be subject to effects. In conclusion, the significance of effect upon the potential marine archaeology resource is **Slight** and is **Not Significant**.

15.6.3.2 Operation (including maintenance and repair)

No seabed disturbance will occur from the operation of the cables. Effects during any unforeseen repair and maintenance works will be of smaller magnitude to those for the cable installation. The assessment considered five discrete repair events and concluded, given the sensitivity of archaeological assets within the Proposed Development to intrusive seabed works, the significance of the effect remains **Slight** and is **Not Significant**.

15.6.3.3 Decommissioning

Two options will be considered at decommissioning; leaving the cables in-situ or removing them. If the cables are left in-situ there will be no effect on archaeological assets during decommissioning. If the option to remove the cables (and any associated protection) is selected, however, this process would essentially be the same as installation activities but in reverse. Therefore, any effects that might 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 **Slight** and is **Not Significant**.

15.7 Project Specific Mitigation

In addition to the embedded mitigation outlined in Table 15-4, Table 15-6 presents measures that GIL is committed to adopting.

Table 15-5 Project specific mitigation – marine archaeology

ID	Project Specific Mitigation
PS16	GIL will liaise with the local council and councillors with regards the Anglo-Norman commemoration event to confirm location and viewing points. Efforts will be made to reduce presence of vessels within the nearshore area during the selected weekend.
PS18	AEZs will be applied to cover the locations with archaeological potential, as suggested in the geophysical survey report. The specific location and extent of these AEZs is provided in Technical Appendix F, Table 4. By avoiding these locations entirely, there will be no adverse effects to any potential receptors present.

15.8 Residual Effect

By establishing AEZs around known locations of archaeological potential (PS18) and by following embedded mitigation such as establishing a Protocol for Archaeological Discoveries (EM28), the residual effects of the Proposed Development upon the marine historic environment will be Not Significant.

REFERENCES

1 Cotswold Archaeology. (2018). Greenlink Interconnector Project: Marine Archaeology Desk-Based Assessment. CA Report 18254

2 Cotswold Archaeology. (2019). Greenlink Interconnector Project: Archaeological Assessment of Marine Geophysical Data. CA Report number TBC

3 Department of Culture, Heritage and the Gaeltacht. (1999). Framework and Principles for the Protection of the Archaeological Heritage

4 Satchell, J. (2012). Maritime Archives and the Crown Estate Project Report

16. Cumulative Effects Assessment (CEA)

16.1 Introduction

This Chapter presents the assessment of cumulative effects from the Proposed Development with other past, present and reasonably foreseeable plans, projects or licensed activities.

The Proposed Development refers to the Irish Marine components of Greenlink from mean high-water springs (MHWS) at the Irish landfall at Baginbun Beach, Co. Wexford to the 12nm limit. 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.

The Campile Estuary component of Greenlink lies along the onshore cable route. Horizontal directional drilling (HDD) will be used to cross the River Campile. The bores (at a depth of >10m below the river bed) are included within the scope of this Environmental Impact Assessment Report (EIAR), but the HDD compounds (from which drilling will initiate and terminate) are covered under the scope of the Irish Onshore EIAR. This chapter includes the potential for intra-project cumulative effects.

Potential cumulative effects (PCE) are assessed using the methodology described in the sections below. The methodology uses the definitions as defined in the EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA 2017).

- **Cumulative effects** are "The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects."

  While a single activity may result in an effect that is Not Significant, when combined with other effects (Not Significant or Significant), collectively it can result in a cumulative effect that is Significant.

- **Intra-project effects** are the cumulation of effects from activities within the Proposed Development with activities in the other components of Greenlink i.e. Onshore Wales, Onshore Ireland, Campile Estuary, Marine Ireland and Offshore Ireland.
- **Transboundary effects** are effects that cross from one jurisdiction into another.

16.2 Part 1 – Intra-project effects

Typically, intra-project effects can occur between different components of the same project from activities which are geographically close to each other and have the potential for the pressures they exert on receptors to overlap spatially and temporally. For a linear interconnector cable project such as Greenlink, the scope of intra-project effects is limited to the interfaces between onshore and offshore project components e.g. between the Proposed Development and Irish Onshore at the intertidal area; where two different activities could be occurring at the same time. Although there is an interface between the EIARs for the planning documents at the Campile Estuary e.g. between this EIAR and the Irish Onshore EIAR, the works proposed is an isolated singular event that spans the two boundaries. It doesn't have the potential to add to other project components and therefore there is no potential for intra-project effects.

At the marine interfaces e.g. between the Proposed Development and Offshore Ireland, the effects from the cable installation will move with the installation spread and therefore there is no spatial or temporal overlap; it is a continuation of the effects along the linear project. The significance of effects on receptors is therefore considered by the individual EIAs. Taking into consideration the potential for both direct and indirect effects on all receptors including pressures such as changes in noise and changes in air quality, no effects have been identified within the Proposed Development, Offshore Ireland and Marine Wales that could accumulate to have a significant effect.

Table 16-1 identifies the potential pressure-receptor pathways at the interface between the Proposed Development and Onshore Ireland which have been identified and considered by the EIA process. No other intra-project effects have been identified. The significance of effects have been assessed in the relevant topic chapters, with the conclusions summarised in Table 16-1.

Table 16-1 Potential intra-project effects

Interface		Receptor	Pressure	Potential effect	Significance of effect	Project Specific Mitigation	Significance of residual effect	Section
PD	IOn	Recreation	Visual Disturbance	There is the potential that if works in the nearshore area occur at the same time as works at the Irish Onshore HDD compound there could be a temporary elevation in the visual disturbance to recreational users of Baginbun Beach. The significance of the effect reflects the potentially high sensitivity of the receptor at certain times of the year i.e. May 2020, July and August. However Project Specific Mitigation in the form of seasonal restrictions have been proposed in both the Irish Onshore EIAR and this EIAR to reduce the significance of the effect.	Moderate	PS15, PS16	Slight	14.6.3
PD	IOn	Birds	Visual Disturbance	The Campile estuary is spatially too far apart from the Proposed Development for there to be intra project effects on birds between these two project components. The area identified as having potential for intra project effects is at the interface between onshore works at the Baginbun landfall and nearshore works in the Proposed Development. However, due to a lack of temporal and spatial overlap between the two project components activities which could affect birds and due to the difference in bird species which have the potential to be affected by the different project components, it has been concluded there will be no significant intra project effects.	Slight		Slight	9.6.2.2

Key:
PD = Proposed Development; IOn = Irish Onshore

16.3 Part 2 – CEA with other projects/plans & activities

16.3.1 Data Sources

Projects, plans and licensed activities considered in the cumulative effects assessment (CEA) include, but are not limited to, marine renewable energy sites, offshore wind farms, marine aggregate sites, disposal sites, cables and pipelines, port and harbour activities, oil and gas activities and military areas.

Data on such projects, plans or licensed activities have been established through a desktop review of published information and through consultation with stakeholders e.g. Department of Housing, Planning and Local Government's Foreshore Unit, Marine Institute and the Marine Survey Office. The data sources used to inform the CEA include but are not limited to the following:

- Ireland's Marine Atlas (Marine Institute 2016);
- European Marine Observation and Data Network (EMODnet) Human Activities (EMODnet 2019);
- Foreshore Unit (2019).
- Other data sources as listed at the end of the Chapter.

16.3.2 Consultation

The steps taken to contact stakeholders for comments on the EIA scope is documented in Chapter 5. This included the Foreshore Unit, the Marine Institute and the Marine Survey Office. None of the stakeholders raised any comments with respect to the scope of the CEA, but information regarding potentially relevant projects was provided by the Foreshore Unit.

16.3.3 Summary of CEA Methodology

The CEA methodology is based on the UK Marine Management Organisation's Strategic Framework for Scoping Cumulative Effects (Marine Management Organisation 2014). The Marine Management Organisation is responsible for marine licensing in English and Northern Irish waters. Under the UK Marine Policy Statement, the Marine Management Organisation has an obligation to ensure potential cumulative effects are taken into account in decision making. NIRAS Consulting Ltd, supported by AMEC, was commissioned by the Marine Management Organisation to develop a consistent approach to the identification and consideration of cumulative effects that can be applied across all relevant Marne Management Organisation functions. The project aimed to look at cumulative effects of marine activities across the strategic, regional and individual project level. The framework for scoping cumulative effects outlined in the 2014 report provides Marine Management Organisation staff with a step-by-step methodology for identifying and scoping cumulative effects as part of their day-to-day operations. As there is no defined methodology for undertaking CEA in Ireland, the

UK method has been used to provide consistency across the marine components of Greenlink.

The steps to implement the CEA are noted below and described in the following sections.

Step 1: Complete an activity / pressure / receptor matrix for each phase of the Proposed Development and where a pressure-receptor pathway is present, identify the spatial and temporal extents of pressures (e.g. the maximum zone of influence for each pressure and the temporal extent of each Proposed Development phase).

Step 2: Define a study area around the Proposed Development and identify projects, plans and licensed activities within that area.

Step 3: Complete an activity / pressure / receptor matrix for each type of project, plan and licensed activity within the study area to identify common pressures on each receptor.

Step 4: Identify if the maximum zone of influence of the pressures of the Proposed Development overlaps spatially with those from other projects or plans. If there is no spatial overlap, that specific pressure-receptor pathway will be screened out. If there is a spatial overlap, the pathway continues to the next step in the process.

Step 5: Identify if the pressures of the Proposed Development phases overlap temporally with the pressures of the scoped-in projects. If there is no temporal overlap the specific pressure-receptor pathway will be screened out. If there is a temporal overlap the pathway continues to the next step.

Step 6: Undertake the assessment on Screened projects/plans/activities, where both a spatial and temporal overlap has been identified.

16.3.4 Step 1: Activity / Pressure / Receptor Matrix

The first step in the CEA is to create a matrix for the Proposed Development that identifies activities (during each phase) and their resultant pressures on individual environmental receptors. The EIA process established for each pressure the worst-case zone of influence (or the spatial extent over which a pressure effects a receptor); which has been used in the assessment.

The activity / pressure / receptor matrix for the Proposed Development is presented in Table 16-2 below:

Table 16-2 Activity / pressure / receptor matrix for the Proposed Development

Development Phase I	O	D	Activity	Pressure source	Pressure	Receptor	Zone of influence (m)
			Pre-installation survey Inspection survey Pre-decommissioning survey	Continuous sound: geophysical survey	Underwater noise changes: Injury	Marine mammals	180
					Underwater noise changes: Disturbance	Marine mammals	2600
						Fish (clupeids: herring, sprat, twaite shad)	2200
			Seabed preparation	Impulsive sound: UXO detonation	Underwater noise changes: Injury	Marine mammals	27000
					Underwater noise changes: Disturbance	Marine mammals	54000
						Fish (clupeids: herring, sprat, twaite shad)	54000
			Survey Cable burial Cable repair & maintenance Cable removal	Presence of project vessels and equipment	Disturbance (physical)	Birds	4000
						Beach users (e.g. bathers, surfers, dogs, walkers)	Immediate
					Underwater noise changes: Injury	Marine mammals	No effect
					Underwater noise changes: Disturbance	Marine mammals	130
						Fish (clupeids: herring, sprat, twaite shad)	50
					Disturbance / Disruption to planned routes and working areas	Commercial fisheries: Static gear fishery	1000 by 12000
						Commercial fisheries: Mobile gear	500 (radius)
						Recreational sailing	
						Recreational and other water users; Surfing/swimming/coasteering etc.	
						Commercial shipping	
						MOD exercise area	
						Marine renewable test site	
			Seabed preparation Cable burial Cable repair & maintenance Cable removal	Pre-sweeping Pre-lay grapnel run, ploughing and jetting.	Penetration and/or disturbance including abrasion	Sediments	20
						Marine archaeology	20
						Benthic communities	20
						Fish (species with demersal life stages)	20

Development Phase I	O	D	Activity	Pressure source	Pressure	Receptor	Zone of influence (m)
					Changes in suspended solids (water clarity)	Water quality	100
			Seabed preparation Cable burial Cable removal	Pre-lay grapnel run, ploughing and jetting.	Siltation rate changes	Benthic communities	40
						Marine archaeology	40
					Temporary habitat disturbance affecting commercial stocks	Commercial fisheries	40
					Indirect effects on commercial target species from changes in water clarity	Commercial fisheries	100
			Cable repair	External cable protection (contingency)	Permanent habitat loss affecting recruitment to commercial stocks	Commercial fisheries	10
			Cable burial Cable repair & maintenance Cable removal	Jetting and ploughing. External cable protection (contingency)	Introduction or spread of invasive non-native species	Benthic communities	15
			Cable burial Cable repair & maintenance Cable removal	Presence of exposed cable on the seabed; External cable protection; anchor mounds	Snagging	Commercial fisheries	Immediate
			Cable protection	External cable protection	Physical change (to another seabed type)	Sediments	10 (radius of protection)
						Benthic communities	10 x length of external cable protection*
						Fish (species with demersal life stages)	
					Snagging	Commercial fisheries	
					Change in water depth	Commercial fisheries	
						Recreational sailing	
						Commercial shipping	
					Water flow (tidal changes) - local	Sediment transport	Immediate

Development Phase			Activity	Pressure source	Pressure	Receptor	Zone of influence (m)
I	O	D					
			Cable operation	Emission of EMF	Disturbance to navigation	Fish (clupeids: herring, sprat, twaite shad) and shellfish	2
						Marine mammals	2
					Compass deviation effects	Commercial fisheries	No effect
						Recreational sailing	No effect
						Commercial shipping	No effect

Development Phases I = Installation; O = Operation; D = Decommissioning. All zones of influence are defined in the relevant topic chapters.

* Worst case assumption for cable crossings and works associated with cable repairs, noting that if external rock protection at HDD exit point is used the rock berm will be narrower.

16.3.5 Define the Project Phases

The temporal extent is the time period covered by each phase of the Proposed Development. The Proposed Development will have three phases: installation; operation, during which maintenance and repair operations may take place; and decommissioning.

The installation phase for the Proposed Development is currently planned between 2020 and 2023.

The operational phase considered by the CEA is 40 years (the expected design life of an interconnector cable), nominally between 2023 and 2063. Pressures during the typical operation of submarine cables are restricted to the emission of electromagnetic fields (EMF) and presence of the external cable protection.

Once installed, submarine cables are not expected to require routine maintenance. Should a cable fault be detected, maintenance and repair activities will be on a smaller and more localised scale than the installation operations and as such are not expected to have any significant effects. Pressures from maintenance and repair operations are considered by the CEA; however, as any future requirements for repair and maintenance are unknown, timings cannot be included in the assessment.

It has been assumed for the purposes of this CEA that decommissioning will take place at the end of expected design life (40 years), nominally between 2063 and 2066 (depending on when commissioning occurs). At the end of the cable's life the options for decommissioning will be evaluated. The two options for decommissioning are leave the cables in situ or remove the cables. In some circumstances, the least environmentally damaging option may be to leave the cable in-situ. This option raises the issue of liability for any claims from fishermen or other third parties that come in contact with the cables. This issue will be addressed in the planning stage of cable decommissioning. For the purposes of the CEA the worst case option for each receptor has been assessed. This changes depending on the receptor, for example for benthic communities, removing the cables represents the worst case scenario in terms of environmental effects, whilst for commercial fishing, leaving the cables in-situ is the worst case option. Given the lack of certainty over other plans and projects 40 years into the future, only a high-level assessment has been conducted.

Unplanned events are incidents or non-routine events that have the potential to trigger effects that would otherwise not be anticipated during the normal course of installation or operation. By their nature, unplanned events have no temporal scope, as they could occur at any phase and any location of the Proposed Development. The probability of an unplanned event occurring is very low. Unplanned events have been scoped out of the CEA in line with the EIA methodology. Justification for this decision is provided in Chapter 5.

16.3.6 Step 2: Define Study Area and Identify Projects

The nature of linear interconnector cable projects mean that the majority of potential pressures result in temporary or 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 cable trench. 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 the CEA. At the landfall, the study area includes up to MHWS.

Known types of projects, plans and licensed activities considered by the CEA 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.

Known projects, plans and licensed activities within the 10km study area have been identified and mapped using a geographical information system (GIS). These are listed in Table 16-3 and where information is publicly available illustrated in Figure 16-1 (Drawing P1975-CUMU-002).

Consultation with appropriate authorities and a desk-top review of published literature and websites has not identified any additional plans for consideration within 10km of the Proposed Development.

Commercial fisheries and shipping interests have been scoped out of the list of projects within 10km of the Proposed Development for consideration in the CEA, unless they are a licensable activity (e.g. aquaculture development, change to port infrastructure), but are still included as potential receptors. These activities are considered to represent baseline conditions, and are not considered as projects, plans or licensed activities having the potential to result in a PCE in-combination with the Proposed Development. Any projects that require a license will be assessed.

No known military practise areas, dredging or licenced disposal sites are currently located within the vicinity of the Proposed Development; further information is provided in Chapter 14. It is noted that there is potential for military practise exercises to be undertaken around the coast, no current locations for future exercises have been made public at the time of this report. Also, no marine aggregate dredging currently occurs in the Republic of Ireland (DHPLG 2018a), however it is noted that there is potential off the eastern coastline near to the Proposed Development that is not currently undergoing development.

Recreational use of the nearshore of the Proposed Development is noted, with planned events such as the Hook Sprint Triathalon in August by Triathlon Ireland

(2019), regular coasteering, walkers, bathers, surfers etc.. These activities are considered to represent baseline conditions and have been scoped out of the list of projects within 10km of the Proposed Development, but are still included as potential receptors.

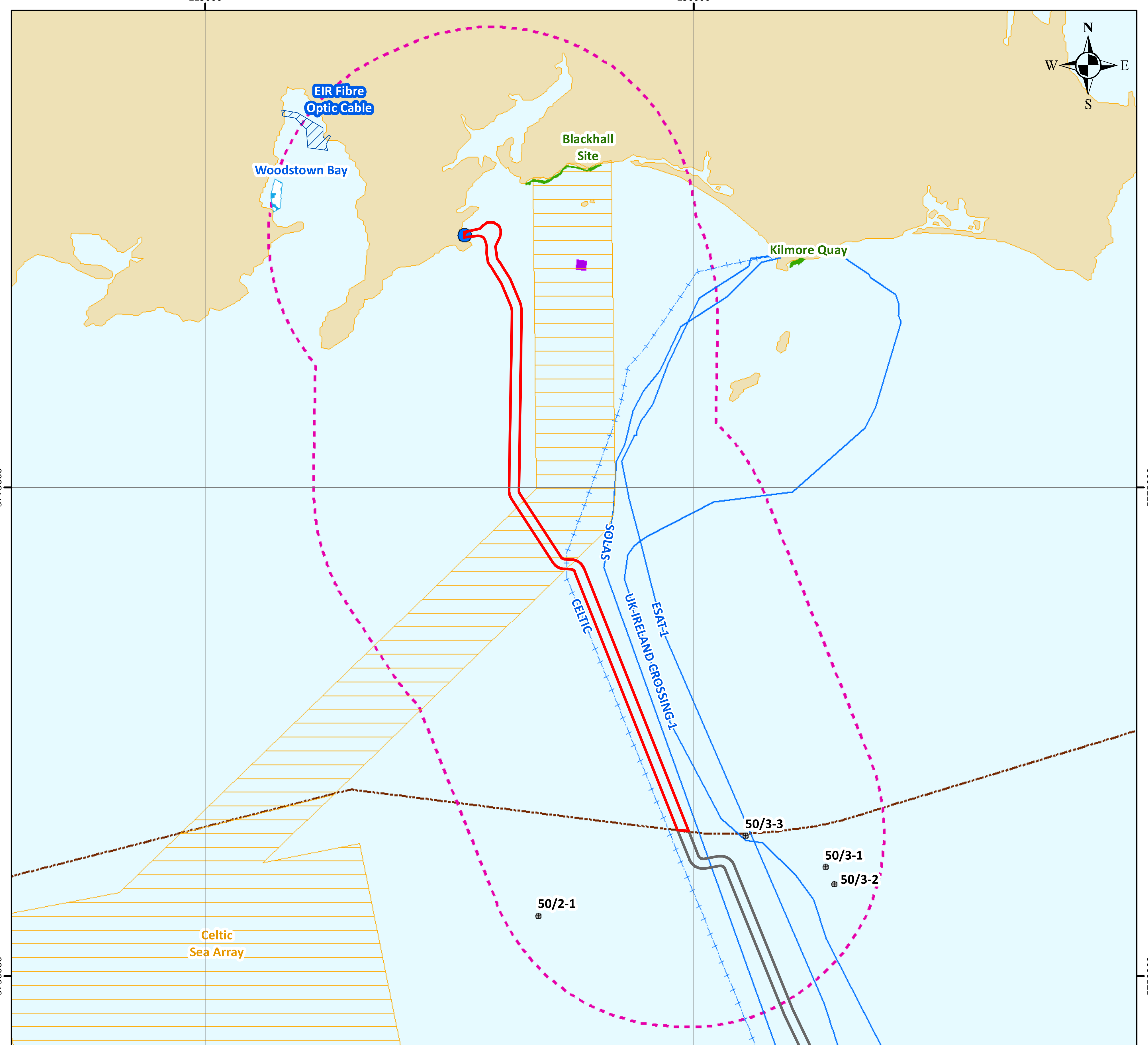
No other known projects are known to be occurring in the Campile Estuary.

Table 16-3 Projects within 10km of the Proposed Development for consideration within the CEA

Project Category	Name / Type of Project	Status	Operator/Owner/ Other Details	Closest Distance to the Project (km)
Disposal site	Kilmore Quay Disposal Site	Application	Wexford County Council	3
Cables	Celtic (Telecom)	Disused	BT	0
	Solas (Telecom)*	Active	Vodafone	0.8
	Pan European Crossing 1 (Telecom)* **	Active	LEVEL 3	1.3
	ESAT 1 (Telecom)*	Active	BT	2.7
	Eir (Fibre Optic)	Application/Consultation	Eir	8
Oil and gas	Wellhead 50/3-3	Abandoned		2.8
	Wellhead 50/3-1	Abandoned		7.5
	Wellhead 50/3-2	Abandoned		7.7
	Wellhead 50/2-1	Abandoned		8.9
Aquaculture	Seaweed harvesting	Consultation	K & M Aquatic Plant Enterprises Ltd t/a Ocean Leaves	3
	Oyster beds	Active	Woodstown Bay Shellfish Ltd (plus other companies)	9
Scientific survey	ADCP deployment	Consultation	TechWorks Marine Ltd	7
Offshore wind	Celtic Sea Array	Application / Consultation	SSE Renewables (Ireland) Ltd	0

* The cables intersect Greenlink outside of the Proposed Development in the Irish Offshore area, therefore the distance to the cable from the Proposed Development is provided here. It is worth noting that Solas crosses Greenlink within the 10km buffer, however this is a discrete location and the two cables running parallel for 20 km was deemed more significant.

** Previously known as UK-Ireland Crossing 1



GREENLINK INTERCONNECTOR

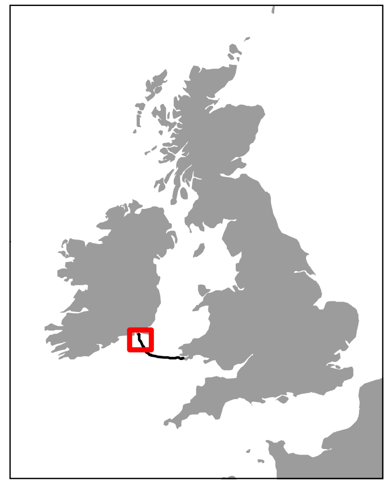
CUMULATIVE EFFECTS

Projects, Plans, and LIcenced Activities within 10km of Proposed Development - ROI Waters

Drawing No: P1975-CUMU-002	A

Legend

- Proposed Development
- Irish Offshore
- ROI 12nm Territorial Sea Limit
- 10km Buffer
- Well
- Telecom Cable
- Telecom Cable (Disused)
- EIR Fibre Optic Cable
- Oyster Bed
- Seaweed Harvesting
- Kilmore Quay Dump Site
- Celtic Sea Array



NOTE: Not to be used for Navigation

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Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	DCCAE; KISORCA; GEBCO; DHPLG
File Reference	J:\P1975\Mxd\17_CUMU\ P1975-CUMU-002.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Anna Farley

Co-financed by the European Union
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0 2.5 5 7.5 10 km

16.3.7 Step 3: Activity / Pressure / Receptor Matrix for Identified Projects

Table 16-3 identified that projects within 10km of the Proposed Development include disposal sites, oil and gas wellheads, aquaculture, scientific survey, several in-service submarine cables and a proposed offshore windfarm development area. No marine aggregate extraction sites, military practice areas were identified within 10km of Proposed Development.

Step 3 requires that an activity / pressure / receptor matrix is developed to define the common activities associated with these project types, and their respective pressures on receptors. Provided as Table 16-4, this was used to identify the type of activities that could result in similar effects on receptors as the Proposed Development.

To identify typical pressures, licence documents from Department of Housing, Planning and Local Government (DHPLG), and EIARs and comparable Environmental Statements (ES) identified through National Infrastructure Planning websites, for current and past projects have been reviewed.

The activity / pressure / receptor matrix is presented as Table 16-4. If a common pressure-receptor pathway exists between the project and Proposed Development, that project is carried forward in the screening process. If there is no common pressure-receptor pathway the activity is scoped out of the assessment (but not the project). Activities scoped out are highlighted in grey in Table 16-4.

Table 16-4 Activity / pressure / receptor matrix for Projects within 10km

Key				Cells highlighted in Grey are scoped out of assessment - no common pressure-receptor pathway			
Project category	Development Phase			Activity	Pressure source	Pressure	Receptor
	I	O	D				
Cables				Pre-installation survey Inspection survey Pre-decommissioning survey	Continuous sound: geophysical survey	Underwater noise changes: Injury	Marine mammals
						Underwater noise changes: Disturbance	Marine mammals
							Fish (clupeids: herring, sprat, twaite shad)
				Seabed preparation	Impulsive sound: UXO detonation	Underwater noise changes: Injury	Marine mammals
						Underwater noise changes: Disturbance	Marine mammals
							Fish (clupeids: herring, sprat, twaite shad)
				Survey Cable burial Cable repair & maintenance Cable removal	Presence of project vessels and equipment	Disturbance (physical)	Birds
							Beach users (e.g. bathers, surfers, dogs, walkers)
						Underwater noise changes: Injury	Marine mammals
						Underwater noise changes: Disturbance	Marine mammals
							Fish (clupeids: herring, sprat, twaite shad)
						Disturbance / Disruption to planned routes and working areas	Commercial fisheries: Static gear fishery
							Commercial fisheries: Mobile gear
							Recreational sailing
							Recreational and other water users; Surfing/swimming/coasteering etc.
							Commercial shipping
							MOD exercise area
							Marine renewable test site

Key				Cells highlighted in Grey are scoped out of assessment - no common pressure-receptor pathway			
Project category	Development Phase			Activity	Pressure source	Pressure	Receptor
	I	O	D				
				Seabed preparation Cable burial Cable repair & maintenance Cable removal	Pre-sweeping Pre-lay grapnel run, ploughing and jetting.	Penetration and/or disturbance including abrasion	Sediments
							Marine archaeology
							Benthic communities
							Fish (species with demersal life stages)
						Changes in suspended solids (water clarity)	Water quality
				Seabed preparation Cable burial Cable repair & maintenance Cable removal	Pre-sweeping Pre-lay grapnel run, ploughing and jetting.	Siltation rate changes	Benthic communities
							Marine archaeology
						Temporary habitat disturbance affecting recruitment to commercial stocks	Commercial fisheries
							Fish and shellfish
							Benthic community
						Permanent habitat loss affecting recruitment to commercial stocks	Commercial fisheries
							Fish and shellfish
							Benthic community
						Indirect effects on commercial target species from changes in water clarity	Commercial fisheries
							Birds
				Cable burial Cable repair & maintenance Cable removal	Jetting and ploughing. External cable protection.	Introduction or spread of invasive non-native species	Benthic communities
				Cable burial Cable repair & maintenance Cable removal	Presence of exposed cable on the seabed; formation of berms and anchor mounds	Snagging	Commercial fisheries
				Cable protection			Sediments

Key				Cells highlighted in Grey are scoped out of assessment - no common pressure-receptor pathway			
Project category	Development Phase			Activity	Pressure source	Pressure	Receptor
	I	O	D				
					External cable protection	Physical change (to another seabed type)	Benthic communities
							Fish (species with demersal life stages)
						Snagging	Commercial fisheries
						Change in water depth	Commercial fisheries
							Recreational sailing
							Commercial shipping
						Water flow (tidal changes) - local	Sediment transport
							Commercial shipping
Disposal site				Sediment disposal	Presence of project vessels	Disturbance (physical)	Birds
						Underwater noise changes: Injury	Marine mammals
						Underwater noise changes: Disturbance	Marine mammals
							Fish (clupeids: herring, sprat, twaite shad)
						Disturbance / Disruption to planned routes and working areas	Commercial fisheries: Static gear fishery
							Commercial fisheries: Mobile gear
							Recreational sailing
							Recreational and other water users; Surfing/swimming/coasteering etc.
							Commercial shipping
							MOD exercise area
							Marine renewable test site
					Sediment release	Siltation rate changes	Benthic communities
							Marine archaeology

Key				Cells highlighted in Grey are scoped out of assessment - no common pressure-receptor pathway			
Project category	Development Phase I	O	D	Activity	Pressure source	Pressure	Receptor
						Temporary habitat disturbance affecting recruitment to commercial stocks	Commercial fisheries
							Fish and shellfish
							Benthic community
						Permanent habitat loss affecting recruitment to commercial stocks	Commercial fisheries
							Fish and shellfish
							Benthic community
						Indirect effects on commercial target species from changes in water clarity	Commercial fisheries
							Birds
				Inspection survey Pre-decommissioning survey	Continuous sound: geophysical survey	Underwater noise changes: Injury	Marine mammals
						Underwater noise changes: Disturbance	Marine mammals
							Fish (clupeids: herring, sprat, twaite shad)
Oil and Gas				Inspection survey Prospecting survey	Continuous sound: geophysical survey	Underwater noise changes: Injury	Marine mammals
						Underwater noise changes: Disturbance	Marine mammals
							Fish (clupeids: herring, sprat, twaite shad)
					Presence of project vessels and equipment	Disturbance (physical)	Birds
						Underwater noise changes: Injury	Marine mammals
						Underwater noise changes: Disturbance	Marine mammals
							Fish (clupeids: herring, sprat, twaite shad)
						Disturbance / Disruption to planned routes and working areas	Commercial fisheries: Static gear fishery
							Commercial fisheries: Mobile gear
							Recreational sailing

Key				Cells highlighted in Grey are scoped out of assessment - no common pressure-receptor pathway			
Project category	Development Phase			Activity	Pressure source	Pressure	Receptor
	I	O	D				
							Commercial shipping
							MOD exercise area
Aquaculture				Placement of aquaculture equipment Collection of aquaculture produce	Presence of employees and equipment	Disturbance (physical)	Birds
							Beach users (e.g. bathers, surfers, dogs, walkers)
							Commercial fisheries: Static gear fishery
							Commercial fisheries: Mobile gear
							Recreational sailing
							Recreational and other water users; Surfing/swimming/coasteering etc.
						Permanent habitat loss (intertidal)	Commercial fisheries
							Fish and shellfish
							Benthic community
Scientific survey				Equipment deployment Equipment presence Equipment retrieval	Presence of project vessels and equipment	Disturbance (physical)	Birds
							Benthic community
						Underwater noise changes: Injury	Marine mammals
						Underwater noise changes: Disturbance	Marine mammals
							Fish (clupeids: herring, sprat, twaite shad)
						Disturbance / Disruption to planned routes and working areas	Commercial fisheries: Static gear fishery
							Commercial fisheries: Mobile gear
							Recreational sailing
							Recreational and other water users; Surfing/swimming/coasteering etc.
							Commercial shipping

Key				Cells highlighted in Grey are scoped out of assessment - no common pressure-receptor pathway			
Project category	Development Phase			Activity	Pressure source	Pressure	Receptor
	I	O	D				
							MOD exercise area
Offshore Wind				Geophysical, geotechnical and benthic survey	Presence of project vessels and equipment	Disturbance (physical)	Birds
							Benthic community
						Underwater noise changes: Injury	Marine mammals
						Underwater noise changes: Disturbance	Marine mammals
							Fish (clupeids: herring, sprat, twaite shad)
						Disturbance / Disruption to planned routes and working areas	Commercial fisheries: Static gear fishery
							Commercial fisheries: Mobile gear
							Recreational sailing
							Recreational and other water users; Surfing/swimming/coasteering etc.
							Commercial shipping

16.3.8 Step 4: Identify Spatial Overlaps

For there to be a PCE, 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.

The zone of influence for each pressure from the Proposed Development was identified during the EIA and presented in the specific topic Chapters. The zones of influence are summarised in Table 16-2.

The zone of influence for each pressure for the Proposed Development was compared with the distance to each plan or project screened in during Step 2. The results are presented in Table 16-5. Each pressure is categorised as follows:

- The Proposed Development (Greenlink) and plan/project have no common pressure-receptor pathway – pressure is screened out;
- There is a potential common pressure-receptor pathway between the Proposed Development (Greenlink) and plan/project, but the plan/project is outside the Proposed Development's zone of influence - pressure is screened out; and
- There is a potential common pressure-receptor pathway between the Proposed Development (Greenlink) and plan/project and the plan/project is within the Proposed Development's zone of influence – pressure is screened in and taken to Step 5.

Table 16-5 identifies that no common pressures with a spatial overlap were identified between the Proposed Development, the Eir fibre optic cable, and the aquaculture project of oyster farming; the ADCP deployment survey and three of the oil and gas wells (50/3-1, 50/3-2 and 50/2-1). Therefore, these projects have been screened out of the assessment at this stage.

Table 16-5 Spatial overlap assessment

Key: Grey = no common pressure-receptor pathway – screened out | Blue = potential common pressure-receptor pathway but outside the Project's zone of influence – screened out | Red = common pressure-receptor pathway and within the Project's zone of influence – screened in

Project Category	Project	Closest Distance to Project (km)	Proposed Development pressures & zone of influence (km)															Underwater noise changes:						
																		Injury		Disturbance				
			Disturbance (physical)	Siltation rate changes	Penetration and/or disturbance including abrasion	Changes in suspended solids (water clarity)	Physical change	Temporary habitat disturbance (commercial)	Permanent habitat loss (commercial)	Indirect effects on commercial target species from changes in water clarity	Introduction or spread of invasive non-native species	Snagging	Change in water depth	Water flow (tidal changes) - local	Disturbance to navigation (EMF)	Disturbance / Disruption to planned routes and working areas		Survey	UXO	Survey		UXO	Vessels	
			4	0.04	0.02	0.1	0.01	0.04	0.01	0.01	0.015.	Immediate	0.01	Immediate	0.002	1 x 12 (static)	0.5 (mobile))	0.18	27	2.6 (M)	2.2 (F)	54	0.13 (M)	0.05 (F)
Disposal Sites	Kilmore Quay Disposal Site	3	Red	Blue	Grey	Grey	Blue	Blue	Blue	Blue	Grey	Grey	Grey	Grey	Grey	Blue	Blue	Blue	Grey	Blue	Blue	Grey	Blue	Blue
Cables	Celtic	0	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Grey	Red	Red	Red	Grey	Red	Red	Grey	Red	Red
	Solas	0	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Grey	Red	Red	Red	Grey	Red	Red	Grey	Red	Red
	UK-Ireland Crossing 1	1.3	Red	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Grey	Blue	Blue	Blue	Grey	Red	Red	Grey	Blue	Blue
	ESAT 1	2.7	Red	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Grey	Blue	Blue	Blue	Grey	Blue	Blue	Grey	Blue	Blue
	Eir Fibre Optic	8	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Grey	Blue	Blue	Blue	Grey	Blue	Blue	Grey	Blue	Blue
Oil and Gas	50/3-3	2.8	Red	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Blue	Blue	Blue	Grey	Blue	Blue	Grey	Blue	Blue
	50/3-1	7.5	Blue	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Blue	Blue	Blue	Grey	Blue	Blue	Grey	Blue	Blue
	50/3-2	7.7	Blue	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Blue	Blue	Blue	Grey	Blue	Blue	Grey	Blue	Blue

Key:			Grey = no common pressure-receptor pathway – screened out												Blue = potential common pressure-receptor pathway but outside the Project's zone of influence – screened out									Red = common pressure-receptor pathway and within the Project's zone of influence – screened in	
Project Category	Project	Closest Distance to Project (km)	Proposed Development pressures & zone of influence (km)														Underwater noise changes:							
																	Injury		Disturbance					
			Disturbance (physical)	Siltation rate changes	Penetration and/or disturbance including abrasion	Changes in suspended solids (water clarity)	Physical change	Temporary habitat disturbance (commercial)	Permanent habitat loss (commercial)	Indirect effects on commercial target species from changes in water clarity	Introduction or spread of invasive non-native species	Snagging	Change in water depth	Water flow (tidal changes) - local	Disturbance to navigation (EMF)	Disturbance / Disruption to planned routes and working areas		Survey	UXO	Survey		UXO	Vessels	
			4	0.04	0.02	0.1	0.01	0.04	0.01	0.01	0.015.	Immediate	0.01	Immediate	0.002	1 x 12 (static)	0.5 (mobile))	0.18	27	2.6 (M)	2.2 (F)	54	0.13 (M)	0.05 (F)
	50/2-1	8.9	Blue	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Blue	Blue	Blue	Grey	Blue	Blue	Grey	Blue	Blue
Aquaculture	Seaweed harvesting	3	Red	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Blue	Blue	Grey	Grey	Grey	Grey	Grey	Grey	Grey
	Oyster beds	9	Blue	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Blue	Blue	Grey	Grey	Grey	Grey	Grey	Grey	Grey
Scientific survey	ADCP deployment	7	Blue	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Blue	Blue	Grey	Grey	Grey	Grey	Grey	Blue	Blue
Offshore wind	Celtic Sea Array	0	Red	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Red	Red	Red	Grey	Red	Red	Grey	Red	Red

v = variable length along the cable route; M = marine mammals; F = fish and shellfish

16.3.9 Step 5: Identify Temporal Overlaps

For there to be a PCE, effects from the Proposed Development and other plans and projects must overlap temporally as well as spatially. For all pressures that were screened in during Step 4 the next phase is to identify the time period over which the activities are likely to be carried out. If there is a temporal overlap with the Proposed Development project phases, the project or plan will continue to the next step of the CEA.

To identify potential temporal overlap, a project timeline has been developed. This timeline aims to compare the Proposed Development installation, operation and decommissioning periods with current and future activities of the plans and projects identified in Table 16-5.

Information regarding timelines has been obtained through consultation with developers and operators and review of EIARs, license applications and websites.

The timeline presented in Table 16-6 classifies projects, plans and licenses as follows:

- Pre-construction – this involves surveying activities and design of the project;
- Construction;
- Operational;
- Closed or non-operational (e.g. constructed but not in use); and
- No known timeline.

As summarised in Chapter 14, there are no active petroleum exploration and development licenses, however Blocks Dunmore and Dragon are the closest. Well 50/3-3 is an abandoned wellhead that has been plugged with no structures above the seabed. Table 16-6 indicates that there is no current planned activity related to this item and so it has been screened out of the assessment at this stage.

There are currently three operational telecom cables and one disused telecom cable already in place within 10km of the Proposed Development, no planned maintenance or repairs are currently publicised on these cables, and communications with the owners have not identified any future plans, therefore any works on these would be in relation to the operation for the Proposed Development only. All cables are crossed by Greenlink, however only two cable crossings are located within the 10km buffer around the Proposed Development; one is for the disused telecom cable, where the telecom cable will be cut, and the second is another telecom cable beyond the 12 nautical mile (nM) territorial limit. Further information is provided in Chapter 4, Project Description. The effects from these cable crossings are assessed as part of the EIAR, no additional assessment is required. All four cable have therefore been screened out at this stage.

Any maintenance or repair activities on the existing telecom cable routes would be unforeseen and therefore cannot be assessed, however the operations will be localised and of short duration.

Table 16-6 Project timeline

Key:	No known timeline	Pre-construction	Construction	Operational	Closed or non-operational	Greenlink Project Installation Phase	* Denotes up to 40 years planned design life for Greenlink Project		
Project Category	Name / Type of Project	Status	2019	2020	2021	2022	2023	2024	2064 *
Disposal sites	Kilmore Quay Disposal Site	Application/ Consultation							
Cables	Solas	Active							
	UK-Ireland Crossing 1	Active							
	ESAT 1	Active							
	Celtic	Inactive							
Oil and Gas	50/3-3	Abandoned							
Aquaculture	Seaweed Harvesting	Application/ Consultation							
Offshore wind	Celtic Sea Array	Application/ Consultation							

16.3.10 Pathways Screened In

Following consideration of the spatial and temporal overlaps, the pressure-receptor pathways presented in Table 16-7 have been screened in as PCE and will be considered in Step 6.

Table 16-7 Summary of pathway screened in

Key:			Pressure-Receptor Pathway Screened Out												Pressure-Receptor Pathway Screened In for Assessment					
Project Category	Project	Closest Distance to Project (km)	Proposed Development Pressures & ZOI (km)																	
			Disturbance (physical)	Siltation rate changes	Penetration and/or disturbance including abrasion	Changes in suspended solids (water clarity)	Physical change	Temporary habitat disturbance (commercial)	Permanent habitat loss (commercial)	Indirect effects on commercial target species from changes in water clarity	Introduction or spread of invasiv non-native species	Snagging	Change in water depth	Water flow (tidal changes) - local	Disturbance / Disruption to planned routes and working area	Underwater noise changes: Injury: Survey	Underwater noise changes: Injury: UXO	Underwater noise changes: Disturbance: Survey	Underwater noise changes: Disturbance: UXO	Vessels
			4	0.04	0.02	0.1	0.01	0.04	0.01	0.01	0.015.	Immediate	0.01	Immediate	1 x 12 (static)	0.18	27	2.6 (M)	54	0.13
Disposal Sites	Kilmore Quay Disposal Site	3																		
Aquaculture	Seaweed Harvesting	3																		
Offshore wind	Celtic Sea Array	0																		

16.3.11 Step 6: Cumulative Effects Assessment

16.3.11.1 Introduction

Common pressure-receptor pathways between the Proposed Development and a plan or project have been assessed for the potential for cumulative effect. If there is a common pressure-receptor pathway for more than one plan or project, the timeline for each plan or project has been reviewed to identify if any of the projects or plans temporally overlap. The cumulative effects from the combined projects would be assessed i.e. rather than just the cumulative effects of the Proposed Development and an individual plan or project. Consideration is given to whether the pressures identified occur once or are repeated in a manner that could have an additive effect.

Whilst there are shared receptor-pressure pathways between the Proposed Development and projects, there are currently few known combined spatial or temporal overlaps with the Proposed Development. This is discussed further below.

The assessment follows the EIA methodology established in Chapter 5, which considers the magnitude of the pressure on a receptor and the sensitivity of the receptor to the pressure to evaluate the significance of the effect. For consistency with the EIA, cumulative effects are listed by receptor and by project phase.

Information on the significance of effects from other plans and projects has been taken from their respective publicly available documentation. If an assumption has been made, this is made clear in the assessment.

16.3.11.2 Assessment

Table 16-8 presents a summary of the cumulative effect's assessment conducted using the pressures linked with the Proposed Development. Brief justification for the conclusion has been provided in the table. Where a conclusion of Minor significance or above has been reached this is discussed in Section 16.3.12.3 onwards.

In Table 16-8, where no PCE has been identified and the justification is stated as no overlap, this statement is due to no activities occurring contemporaneously that either directly overlap spatially or overlap within the receptor group.

Table 16-8 Summary of assessment

Determination of Potential Cumulative Effect				Cumulative Effect Assessment			
Receptor	**Pressure**	**Project Phase***	**Project Screened in**	**Magnitude**	**Sensitivity**	**Significance**	**Justification**
Physical conditions and marine processes	Physical change (to another seabed type)	I; O	None	-	-	**No PCE**	No overlap. Changes linked to Proposed Development only
	Changes in suspended solids (water clarity)	I; O; D	None	-	-	**No PCE**	No overlap. Changes linked to Proposed Development only
	Penetration and/or disturbance including abrasion	I; O; D	Celtic Sea Array	Negligible	Low	**Imperceptible**	Section 16.3.12.3
Benthic and intertidal ecology	Penetration and/or disturbance including abrasion	I; O; D	Celtic Sea Array	Negligible	Low	**Imperceptible**	Section 16.3.12.3
	Siltation rate changes	I; O; D	None	-	-	**No PCE**	No overlap. Changes linked to Proposed Development only
	Introduction or spread of invasive non-native species	I; O; D	None	-	-	**No PCE**	No overlap. Pressure linked to Proposed Development only
	Physical change (to another seabed type)	I; O	None	-	-	**No PCE**	No overlap. Pressure linked to Proposed Development only
Fish and shellfish	Penetration and/or disturbance including abrasion	I; O; D	None	-	-	**No PCE**	No overlap. Pressure linked to Proposed Development only
	Physical change (to another seabed type)	I; O; D	None	-	-	**No PCE**	No overlap. Changes linked to Proposed Development only
	Underwater noise changes: Disturbance	I; O; D	Celtic Sea Array	Low	Medium	**Slight**	Section 16.3.12.4
Marine birds	Disturbance (Physical)	I; O; D	Kilmore Quays Disposal site Seaweed Harvesting Celtic Sea Array	Negligible	Medium	**Slight**	Section 16.3.12.5
Marine mammals	Underwater noise changes: Disturbance or injury	I; O; D	Celtic Sea Array	Low	Medium	**Slight**	Section 16.3.12.6
Commercial fisheries	Permanent habitat loss affecting commercial stocks	I; O; D	None	-	-	**No PCE**	No overlap. Pressure linked to Proposed Development only

Determination of Potential Cumulative Effect				Cumulative Effect Assessment			
Receptor	**Pressure**	**Project Phase***	**Project Screened in**	**Magnitude**	**Sensitivity**	**Significance**	**Justification**
	Temporary habitat disturbance affecting commercial stocks	I; O; D	None	-	-	**No PCE**	No overlap. Pressure linked to Proposed Development only
	Indirect effects on commercial target species from changes in water clarity	I; O; D	None	-	-	**No PCE**	No overlap. Pressure linked to Proposed Development only
	Snagging	I; O	None	-	-	**No PCE**	No overlap. Pressure linked to Proposed Development only
	Change in water depth	I; O	None	-	-	**No PCE**	No overlap. Changes linked to Proposed Development only
	Disturbance / Disruption to planned routes and working areas	I; O; D	Celtic Sea Array	Low	Low	**Slight**	Section 16.3.12.7
Shipping and navigation	Disturbance / Disruption to planned routes and working areas	I; O; D	Celtic Sea Array	Low	Medium	**Slight**	Section 16.3.12.7
	Change in water depth	I; O	None	-	-	**No PCE**	No overlap. Changes linked to Proposed Development only
Offshore infrastructures and other sea users	Disturbance / Disruption to planned routes and working areas	I; O; D	None	-	-	**No PCE**	No overlap. Pressure linked to Proposed Development only
Recreation	Disturbance / Disruption to planned routes and working areas	I; O; D	None	-	-	**No PCE**	No overlap. Pressure linked to Proposed Development only
	Change in water depth	I; O	None	-	-	**No PCE**	No overlap. Changes linked to Proposed Development only
Marine archaeology	Penetration and/or disturbance including abrasion	I; O; D	None	-	-	**No PCE**	No overlap. Pressure linked to Proposed Development only

Where a PCE has been identified in Table 16-8 between the Proposed Development and projects, further detail has been discussed below.

16.3.11.3 Penetration and/or disturbance or the substrate below the surface of the seabed, including abrasion – Physical conditions and Benthic ecology

Table 16-9 Screening Summary - Penetration and/or disturbance including abrasion

ZOI (km)	Activity Screened in	Projects screened in
0.02	Offshore Wind	Celtic Sea Array

Installation

It has been identified that Celtic Sea Array survey is scheduled to occur within a similar time window as the Proposed Development installation. Chapters 6 and 7 concluded that installation activities for the Proposed Development that penetrate the substrate will not have a significant effect on physical conditions or benthic habitats, due to the primarily sediment-based nature allowing habitats to return to baseline conditions following disturbance. There exists, however, the potential for a spatial and temporal overlap with the geotechnical surveys that are due to be conducted for the Celtic Sea Array. Standard equipment such as vibrocores and grab samples will be used to collect sediment samples. Vibrocores and grab samples take small samples (less than 1m^3) and do not typically cause large-scale disturbance to the seabed, which along with the area's sediment-based nature and strong tides, will allow for any sample sites to be quickly return to their baseline state. As such, the magnitude of the cumulative effect is low due to the temporary nature of the disturbance and the environments ability to return to its baseline condition. The sensitivity has been assessed as low as the site consists predominantly of sand and coarse sediment with associated subtidal habitats. Therefore, the significance of the cumulative effect is assessed as **Imperceptible**.

Operation

No disturbance or habitat loss will occur from the operating cables and therefore unlikely to produce a PCE.

Decommissioning

It is currently unknown if any other development or decommissioning will be occurring at the same time as the Proposed Development's decommissioning activities. PCEs cannot be defined without knowing which other operations will be occurring during the decommissioning phase of the Proposed Development.

16.3.11.4 Underwater noise changes: Disturbance – Fish and shellfish

Table 16-10 Screening Summary – Underwater noise changes: Disturbance – Fish and Shellfish

ZOI (km)	Activity Screened in	Projects screened in
2.2	Offshore Wind	Celtic Sea Array

Installation

The potential effect from disturbance by noise generated by installation activities on fish was assessed as **Slight** in Chapter 8. This is due to the slight effect that noise may have on herring should the installation activities occur during the same time as the herring spawning season. It is possible that noise generated from the Celtic Sea Array geophysical survey will occur at the same time as the Proposed Development, however given the uncertainties around scheduling on both projects it is difficult to confirm if there will be a temporal overlap.

There is the potential for a temporal overlap with two surveys occurring concurrently or two surveys occurring consecutively. However, data acquisition can be impaired if two geophysical surveys occur at the same time in close proximity due to equipment interference. It is therefore more likely that the surveys would occur consecutively. This would result in an extension of the time period that fish would be disturbed.

For both projects the zone of influence will move as activity progresses along the cable route or along the survey corridor. Fish will avoid the noisy activity once operations have started and are extremely unlikely to move towards the sound source. However they will return to the area once the activities have passed through. Therefore, it is unlikely that fish will experience a significant effect other than temporary displacement from the immediate area surrounding the activities. The magnitude of the cumulative effect has been assessed as low given the effects are temporary, localised and reversible. The sensitivity of the receptor has been assessed as medium reflecting that the area is known to be important for herring which are sensitive to underwater noise changes. The significance of the cumulative effect has been assessed as **Slight** and is **Not Significant**.

Operation

No noise emissions are expected from the operating cable. Noise emissions during the operational phase may be produced from survey and maintenance activities. Any effects will be similar to the installation phase and unlikely to produce PCE.

Decommissioning

It is currently unknown if any other development or decommissioning will be occurring at the same time as the Proposed Development's decommissioning activities. The worst case underwater noise generated by the Proposed Development's activities is the use of sub bottom profiler during geophysical survey.

The PCE cannot be defined without knowing which other operations will be occurring for the Proposed Development and for other projects.

16.3.11.5 Disturbance (physical) – Marine Birds

Table 16-11 Screening summary – Disturbance (physical) – Marine Birds

ZOI (km)	Activity Screened in	Projects screened in
4	Disposal site	Kilmore Quay Disposal Site
	Aquaculture	Seaweed harvesting
	Offshore Wind	Celtic Sea Array

Installation

Chapter 9 identified that disturbance is predicted to be limited to that initiated by the movement of the project vessels or intra-project cumulative effects from noise in the nearshore area (should they overlap temporally). 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.

The most disruptive activities are those that are sudden, noisy or fast. 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 screening process has identified three projects which could result in a PCE on marine birds; the Kilmore Quay disposal site, seaweed harvesting in the nearshore and the proposed Celtic Sea Array survey. All three projects have submitted applications but have not yet been approved. However, they have been assessed as if consented. The Celtic Sea Array is due to undertake geophysical and geotechnical surveys that overlap with the Proposed Development within the next 5 years.

It is considered that effects from activities associated with these projects would be transient, temporary and localised. Seaweed harvesting is based nearshore and the disposal site further offshore and both are located over 3km from the Proposed Development. Therefore, it’s unlikely that project vessels from each project will be in the area at the same time and its unlikely that disturbance will be felt against background vessel activity in the area. There is potential that vessels for the Proposed Development and those for the Celtic Sea Array could be in the same area for a short period of time (temporal and spatial overlap). However, both projects are transient with vessels that are slow moving and disturbance is unlikely to be felt beyond existing disturbance sources in the area.

One of the proposed export cable corridors to be surveyed for the Celtic Sea Array project passes close to the Keeragh Islands SPA. There is the potential that if works along the Proposed Development and Celtic Sea Array occur near to the Keeragh Islands SPA at the same time there may be a temporary elevation in visual disturbance to breeding cormorant in the Keeragh Islands SPA. Cormorants breeding season ranges from February to September, so there is potential for the Celtic Sea Array works and the Proposed Development activities to occur during this time. The sensitivity of the receptor has been assessed as medium due to their high susceptibility for disturbance. However, due to the breeding colonies distance from the Proposed Development and the temporary nature of the vessel's presence the magnitude of this effect has been assessed as low. The significance of the potential cumulative effect has been assessed as **Slight** and is **Not Significant**.

Decommissioning

It is currently unknown if any other development or decommissioning will be occurring at the same time as the Proposed Development's decommissioning activities. PCEs cannot be defined without knowing which other operations will be occurring during the decommissioning phase of the Proposed Development.

16.3.11.6 Underwater noise changes: Disturbance or injury – Marine Mammals

Table 16-12 Screening Summary - Underwater noise changes: Disturbance or injury – Marine Mammals

Activity		Zone of influence (km)	Activity Screened in	Projects screened in
Continuous sound: Vessels	Injury	None	None	None
	Disturbance	0.13	Offshore wind	Celtic Sea Array
Continuous sound: geophysical survey	Injury	0.18	Offshore wind	Celtic Sea Array
	Disturbance	2.6		
UXO	Injury	27	None	None
UXO	Disturbance	54	None	None

The common pressure-receptor pathway that could result in PCE during each phase of the Proposed Development is the generation of underwater noise which could potentially disturb or injure marine mammals. Project activities such as the movement and presence of vessels (all project phases), detonation of UXO (if required) and geophysical survey (all phases) will generate underwater noise emissions.

One project, the proposed Celtic Sea Array geophysical survey, has been identified which could also generate underwater noise and that has the potential to temporally and spatially overlap with the Proposed Development resulting in a PCE.

Installation

Chapter 10 concluded that the significance of the effect on marine mammals is imperceptible for injury level effects from continuous noise sources (vessels and geophysical survey). Although it concluded that the significance of disturbance effects is Slight, when considered alongside other activities occurring within the same region it may give rise to a significant PCE.

Any disturbance and subsequent displacement of animals from an area surrounding a development has the potential to affect communication, feeding and foraging opportunities and may restrict migration routes. An animal may swim away from the zone of discomfort and be excluded until the activities have passed. Marine mammals are wide ranging across the Celtic Sea but their range could be restricted if a number of similar noisy activities in a region reduced the suitable available habitat.

Cumulative effects are likely to result where localised disturbance from more than one activity either occurs simultaneously resulting in a wider zone of disturbance restricting foraging, migratory or breeding behaviour; or consecutively within a restricted area resulting in an extended period of disturbance producing a barrier.

The EIA established that disturbance could occur within a radius of 2.6km of the sound source. The survey scope for the Celtic Sea Array geophysical survey will be similar to that proposed for the Proposed Development and underwater noise modelling presented in the Celtic Sea Array application indicates a similar zone of disturbance.

There is the potential for a temporal overlap with two surveys occurring concurrently or two surveys occurring consecutively. However, data acquisition can be impaired if two geophysical surveys occur at the same time in close proximity due to equipment interference. It is therefore more likely that the surveys would occur consecutively. This would result in an extension of the time period that marine mammals would be disturbed.

For both projects the zone of influence will move as activity progresses along the cable route or along the survey corridor. Marine mammals will avoid the noisy activity once operations have started and are extremely unlikely to move towards the sound source. However they will return to the area once the activities have passed through. Therefore, it is unlikely that marine mammals will experience a significant effect other than temporary displacement from the immediate area surrounding the activities. The magnitude of the cumulative effect has been assessed as low given the effects are temporary, localised and reversible. The sensitivity of the receptor has been assessed as medium reflecting the sensitivity of species to underwater noise changes. The significance of the cumulative effect has been assessed as **Slight** and is **Not Significant**.

Operation

No noise emissions are expected from the operating cable. Noise emissions during the operational phase may be produced from survey and maintenance activities. Any effects will be similar to the installation phase and unlikely to produce PCE.

Decommissioning

It is currently unknown if any other development or decommissioning will be occurring at the same time as the Proposed Development’s decommissioning activities. The worst case underwater noise generated by the Proposed Development’s activities is the use of sub bottom profiler during geophysical survey.

The PCE cannot be defined without knowing which other operations will be occurring for the Proposed Development and for other projects.

16.3.11.7 Disturbance / Disruption to planned routes and working areas – Shipping and Navigation & Commercial Fishing

Table 16-13 Screening Summary - Disturbance / Disruption to planned routes and working areas – Shipping and Navigation & Commercial Fishing

ZOI (km)	Activity Screened in	Projects screened in
1 x 12 (Static) 0.5 (Mobile)	Offshore Wind	Celtic Sea Array

Installation and Operation

For the Proposed Development, fishing vessels will be requested to stay at least 500m radius away from vessels during installation, maintenance and future decommissioning activities. This will temporarily displace fishing activity from traditional grounds. The zone of influence will move as activity progresses along the cable route. Ahead of the installation, fishermen will be asked to move their static fishing gear away from the Proposed Development. Fishermen will be asked to remain out of the Proposed Development for up to three days before installation. The zone of influence is 1km x 12km (see Chapter 12). Chapter 13 identified the effect of the Proposed Development on local shipping and navigation to be **Slight** and **Not Significant**, as while vessels may be required to make minor diversions to their route, such effects would be temporary.

The Celtic Sea Array survey is likely to have similar restrictions to the Proposed Development. This could result in a PCE should surveys for the Celtic Sea Array occur during the same timeframe that installation vessels are present for the Proposed Development. However, both projects are anticipated to be of a short timescale and at discrete locations. The magnitude of the effect has been assessed as low and the sensitivity of commercial fisheries is low, resulting in an effect that is Slight and **Not Significant**.

Decommissioning

It is currently unknown if any other development or decommissioning will be occurring at the same time as the Proposed Development's decommissioning activities. The PCE cannot be defined without knowing which other operations will be occurring for the Proposed Development and for other projects.

16.3.11.8 Protected Sites

A cumulative effects assessment has been conducted as part of the Greenlink Marine Natura Impact Statement to assess whether effects from other plans and project in-combination with the potential effects of the Proposed Development may lead to a likely significant effect (LSE) on Natura 2000 sites.

The assessment followed the same approach as outlined above and assessed the same plans and projects. It concluded that two projects, the Kilmore Quay Disposal site and Celtic Sea Array survey have common pressure-receptor pathway which could have an effect on a Natura 2000 Qualifying Interest. It concluded that:

- For Kilmore Quays as there is no temporal overlap in activities there is no PCE on any Natura 2000 sites.
- For the Celtic Sea Array there is the potential for a PCE from underwater noise on the Saltee Islands SAC. The PCE was assessed as Slight and Not Significant and will not affect the integrity of the SAC.

16.4 Part 3 – Transboundary Effects

The Convention on Environmental Impact Assessment in a Transboundary Context 1991 sets out the obligations of parties to assess the transboundary environmental effect of certain activities at an early stage of planning. It also lays down the general obligations of states to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental effect across boundaries.

It is anticipated that transboundary effects will be limited to sediment dispersion and underwater noise. These effects will be limited in spatial extent in close proximity to the jurisdictional boundary. For example, underwater noise could disturb marine mammals within 2.6km of the median line in an adjacent territory as the pre-installation geophysical survey moves along the cable route and reaches the median line administrative boundary. The EIAs for the Proposed Development and Welsh Marine concluded that the effects from the pressure underwater noise changes are not significant and therefore transboundary effects will also be not significant.

REFERENCES

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17. Schedule of Mitigation

This Chapter presents the Embedded Mitigation and Project Specific Mitigation to be incorporated into the design, installation, operation (including repair and maintenance) and decommissioning of the Proposed Development. These measures have been transposed from Chapter 4 and Chapters 6 to 17 of this EIAR and a Schedule of Mitigation prepared (Tables 17-1 and 17-2). For each measure, the receptor for which it is proposed and the Chapter it can be found in is listed.

The Schedule of Mitigation will form the basis of an Environmental Management Plan (EMP) to be implemented in all project phases. In stating the Embedded Mitigation (Table 17-1) and Project Specific Mitigation (Table 17-2) within the EIAR, GIL and their appointed Contractor are committed to the effective implementation of all those measures in the EMP.

The EMP will be prepared by the appointed Contractor and will form the basis of the approach to mitigating potential effects on the natural and human environment and local community. The EMP will be supported by a number of additional documents including: Cable Burial Plan; Waste Management Plan; and Oil Spill Contingency Plan and will address any additional requirements and conditions identified during the Foreshore licensing process.

The EMP (including additional supporting plans) will be submitted to the DHCLG - Foreshore Unit and relevant consultees for approval prior to commencement of installation activities.

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Table 17-1 Embedded Mitigation

ID	Chapter	Embedded mitigation measure
EM1	12, 13, 14	Early consultation with relevant contacts to warn of impending activity, with vessels requested to remain at least 500m away from cable vessels during installation, repair and decommissioning.
EM2	12, 13, 14	Project vessels will comply with the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) – as amended, particularly with respect to the display of lights, shapes and signals.
EM3	12, 13, 14	Project vessels will exhibit signals in accordance with the Irish requirements for marking and identification of offshore installations as specified in the Safety, Health and Welfare (Offshore Installations) Act, 1987.
EM4		Project vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.
EM5	8, 9	Control measures and shipboard oil pollution emergency plans (SOPEPs) will be in place and adhered to under MARPOL Annex I requirements for all project vessels.
EM6	7	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.
EM7	9	Chemicals will be stored in a secure, designated area in line with appropriate regulations and guidelines. A Chemical Risk Assessment will be prepared for the use of chemicals. A chemical inventory shall be kept of all chemicals and oils used.
EM8	7	The latest guidance from the GB non-native species secretariat (2015) will be followed and a Biosecurity Plan produced pre-installation.
EM9		An Environmental Management Plan (EMP) and an Emergency Spill Response Plan will be developed and implemented for the installation phase.
EM10	12, 13, 14	Notice will be given to sea users in the area via Notices to Mariners, Kingfisher Bulletins, NAVTEX, and NAVAREA warnings. Particular attention will be paid to ensuring the following organisations receive the notifications: Irish Maritime Administration (including the Maritime Safety Policy Division, the Marine Survey Office, the Irish Coast Guard, the Maritime Transport Division, Maritime Services Division), Commissioners of Irish Lights, Royal National Lifeboat Institution (RNLI), the Irish Coast Guard (IRCG), Community Rescue Boats Ireland (CRBI), Harbour and Port authorities, Irish Ferries, Irish South and East Fish Producers Organisation, South East Regional Inshore Fisheries Forum, Irish Sea Fisheries Board individual local fishermen (as identified during marine survey campaign).
EM11	12, 13, 14	'As-laid' co-ordinates of the cable route will be recorded and circulated to the Irish Hydrographic Office (IHO), UK Hydrographic Office (UKHO) and KIS-ORCA Service. Cables will be marked on admiralty charts and fisherman's awareness charts (paper and electronic format).
EM12	14	Crossing Agreements will be produced with cable owners. The Crossing Agreement describes the rights and responsibilities of the parties and also the design of the crossing. Crossing design will be in line with industry standards, using procedures and techniques agreed with the cable owners.

ID	Chapter	Embedded mitigation measure
EM13	6, 7, 14, 15	HDD will be used for the cable landfalls to avoid disturbance of sensitive habitats (e.g. intertidal reef habitat) and disruption on beaches.
EM14	6, 7	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	6, 7, 8, 12, 13	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.
EM16	13	Procedures to minimise disruption near high density shipping areas will include, for example, avoidance of anchoring near busy areas when Project vessels are waiting on weather; and the presence of a guard vessel in areas of significant vessel traffic. Installation vessels will have passage planning procedures, holding positions (e.g. if waiting on weather), traffic monitoring (e.g. radar, AIS, and visual), means of communication with third-party vessels, and emergency response plans in the event a third-party vessel approaches on a collision course.
EM17	6, 7, 8, 12, 15	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed.
EM18	8, 9, 10	Project vessels will not exceed 14 knots within the Proposed Development.
EM19	10	GIL will require that the appointed contractor(s) follow the Department of Arts Heritage and the Gaeltacht (DAHG) 'Guidance to Manage the Risk to Marine Mammals from Man-made sound sources in Irish Waters' (DAHG 2014); in particular Section 4.3.4
EM20	12	Cable protection material (rock berms and mattresses) will be designed to be over-trawlable.
EM21	8, 10	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.
EM22	12, 13	Guard vessels will be used (subject to risk assessment) during installation activities to communicate with third party vessels within the vicinity of cable sections that remain unburied between cable lay and burial.
EM23	10	GIL will require that the appointed UXO contractor follows the follow the Department of Arts Heritage and the Gaeltacht (DAHG) 'Guidance to Manage the Risk to Marine Mammals from Man-made sound sources in Irish Waters' (DAHG 2014); in particular Section 4.3.5 'Blasting' including (but not limited to): • At least one qualified and experienced marine mammal observer (MMO) shall be appointed to monitor for marine mammals. • Only the minimum quantity of explosives to achieve the desired result must be used.

ID	Chapter	Embedded mitigation measure
		• Establishing a default 1km mitigation zone for marine mammal observation, measured from the explosive source and with a circular coverage of 360 degrees. • Only commence explosive detonations during daylight hours and good visibility. • 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. • In waters up to 200m deep, the MMO shall conduct a pre-start up constant effort monitoring at least 30 minutes before the detonation. Sound-producing activity shall not commence until at least 30 minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO.
EM24	6, 12	A cable burial plan will be produced which outlines proposed method statements and cable protection measures for approval by the Foreshore Unit and discussion with fisheries stakeholders
EM25	12, 13	Effective channels of communication will be established and maintained between the Project and commercial fishing interests. This will include the appointment of a Fisheries Liaison Officer (FLO).
EM26	6, 12, 13	Post-installation inspection surveys will be conducted along the length of the cables on a regular basis.
EM27	12, 13	Post-installation compass deviation surveys will be undertaken to confirm compass deviation levels and the results forwarded to the Irish Maritime Administration.
EM28	15	A protocol will be established for reporting unexpected archaeological discoveries. This protocol will be designed to enable project staff to report any finds made in a manner that is convenient and effective. Should such finds be considered to indicate the presence of a site of archaeological interest, a temporary Archaeological exclusion Zone (AEZ) may be implemented until more data is available.
EM29	6, 12, 13, 14, 15	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.
EM30	**15**	A scheme-specific UAIA will be prepared in consultation with the UAU and the National Monuments Service (NMS). This will set out when, how and why archaeological mitigation measures recommended in Chapter 15 are to be implemented and will be prepared in line with the Framework and Principles for the Protection of the Archaeological Heritage (Department of Culture, Heritage and the Gaeltacht 1999).

Table 17-2 Project Specific Mitigation

ID	Chapter	Project Specific Mitigation
PS1	6	The preference is to bury the two HDD duct exits and all cables in sediment to the required depth of lowering. To achieve this the Installation Contractor should seek to engineer the HDD to exit in thick sediment in order that the ducts can be trenched back down to beneath the seabed level. If the required depth of burial cannot be achieved in sediment, then some external protection will be required. Taking into consideration the exact HDD exits, the footprint of external protection should be the minimum required for burial. To achieve this, consideration should be given to undertaking part sediment burial. and part external protection; use of concrete mattresses (i.e. to reduce berm height), or other engineering solutions that reduce the footprint of external cable protection (both vertically and horizontally). If there is no technically feasible alternative the exact position, nature of and final defined size of external cable protection will be communicated to the Foreshore Unit, NPWS and Irish Maritime Administration and local fishermen.
PS2	6 & 7	Exclusion zones have been established around Annex I bedrock reef features; shown on Figure 7-18, Drawing P1975-INST-008). No intrusive works (e.g. cable installation, deposit of external cable protection material) will be undertaken within these exclusion zones.
PS3	6 & 7	There will be no intrusive works undertaken on Baginbun Beach between mean high water springs and the low water mark
PS4	7	If the contingency external cable protection is used at the HDD exits, then the an environmental monitoring plan will be established to monitor colonisation of the external cable protection. It is proposed that this be conducted using drop-down video transects. A control transect should be established on the adjacent Annex I reef to establish a baseline for community diversity. The length of the external cable protection will also be surveyed. 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 confirm (or otherwise) the conclusion that the deposition of the external protection material adds to the Reef habitat within the Hook head SAC. Th results of the monitoring will be sent to NPWS.
PS5	8	Avoid intrusive works (e.g. those that disturb the seabed) within Dunmore East Herring Spawning area during peak spawning period (October to January).
PS6	9	Mandatory separation distance between construction works and the high water mark at Campile Estuary is to be observed as follows: 75m at the northern side, and 50m at the southern side.
PS7	9	No works will be carried out at the Campile Estuary during the period: 1 October to 31 March (inclusive).
PS8	9	No works will be carried out within 100m of the high tide line (landward side) to prevent flight response.
PS9	10	If UXO detonation is required, Passive Acoustic Monitoring (PAM) will be used during periods of darkness and poor visibility (e.g. fog and increased sea states) when marine mammal observer (MMO) watches may be reduced in their effectiveness and in order to permit 24-hour monitoring.

ID	Chapter	Project Specific Mitigation
PS10	10	Activation of an acoustic deterrent device (ADD) for 20 to 60 minutes prior to UXO detonation dependent on UXO charge size. The selection process of the ADD will be done in consultation with the DHPLG - Foreshore Unit and NPWS.
PS11	10	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.
PS12	12	Review of operational phase asset management surveys will be undertaken and any areas of exposure/reduced depth of burial communicated to the fishing industry via Notice to Mariners.
PS13	12	Approval of decommissioning plan which will manage risks. If risks cannot be managed appropriately the cable, or sections of would need to be removed.
PS14	12	Any works associated with installation, O&M and decommissioning to occur outside the herring spawning season (October/November and December/January) with the region of the Dunmore East grounds.
PS15	14	All works in the nearshore will be avoided during July and August.
PS16	14	GIL will liaise with the local council and councillors with regards the Anglo-Norman commemoration event to confirm location and viewing points. Efforts will be made to reduce presence of vessels within the nearshore area during the selected weekend.
PS17	14	If necessary, GIL to cooperate in reaching mutually agreeable terms for proximity agreements with SSE Renewables (Ireland) Ltd
PS18	15	AEZs will be applied to cover the locations with archaeological potential, as suggested in the geophysical survey report. The specific location and extent of these AEZs is provided in Technical Appendix F, Table 4. By avoiding these locations entirely, there will be no adverse effects to any potential receptors present.

18. Summary and Conclusions

Greenlink is a proposed subsea and underground electricity interconnector cable between the existing electricity grids in the Republic of Ireland and Great Britain with a nominal capacity of 500 megawatts. Greenlink will provide a new interconnector between EirGrid's Great Island substation in County Wexford (Ireland) and the National Grid's Pembroke substation in Pembrokeshire (Wales). The power will be able to flow in either direction at different times, depending on supply and demand in each country.

Greenlink has been awarded Project of Common Interest (PCI) status by the European Commission, making 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 strong policy support demonstrated by:

- the Commission for Regulation of Utilities Water and Energy (CRU) (Ireland) and Ofgem (GB) and via the completion of a Cost Benefit Analysis which demonstrates that Greenlink offers economic benefit to consumers in both jurisdictions;
- the inclusion of the Greenlink in the draft National Energy and Climate Plan 2021 – 2030; and
- the key assumption presented in the Climate Action Plan 2019 that additional interconnection will be added in 2025 and 2026 by the two planned interconnectors i.e. Celtic Interconnector and Greenlink.

The EIAR presents a comprehensive assessment of the potential effects of the installation, operation (including maintenance and repair) and decommissioning of the Proposed Development and sets out Embedded Mitigation and proposes Project Specific Mitigation to avoid or reduce significant effects to an acceptable level.

The Embedded Mitigation and Project Specific Mitigation will form the basis of an Environment Management Plan to be implemented during the installation and operation of the submarine cables.

Following the environmental impact assessment of the residual effects on the physical, biological and human environments, the following can be concluded:

- Baginbun Beach is a popular public beach, fringed by important reef habitat in the intertidal zone; a Qualifying Interest of the Hook Head Special Area of Conservation. Intrusive works on the beach have the potential to cause significant effects to both the public and the sensitive habitat. GIL is proposing to employ a trenchless technique (horizontal directional drilling) whereby the sensitive habitat and beach is avoided. This will ensure there is **no effect on Baginbun Beach and intertidal habitats.** To further minimise public disturbance GIL has committed to avoiding works during the peak tourist season (July and August).

- The main effects associated with the Proposed Development are predicted to be localised, temporary disturbance to the seabed during installation. For the majority of subtidal habitats (benthic communities) and fish species this will result in effects which are not significant. Trenching across areas of Reef habitat and herring spawning grounds could cause significant effects. Project Specific Mitigation in the form of exclusion zones and seasonal restrictions have been proposed that either remove the pathway for effects or reduce the significance of the residual effects to not significant.
- Installation, maintenance and decommissioning activities will generate underwater noise which has the potential to cause slight disturbance effects to fish and marine mammals. For all the activities proposed, with the exception of UXO detonation, the assessment concluded that the effects will be not significant.
- If required, UXO detonation has the potential to have a significant effect on marine mammals including grey seal, a Qualifying Interest of the Saltee Island SAC, and harbour seal, a Qualifying Interest of the Slaney River Valley SAC. The most effective mitigation is to avoid the need for detonation completely, but if this is not feasible, Project Specific Mitigation, following Industry Best Practice has been proposed. Implementation of measures such as using passive acoustic monitoring to support marine mammal observer watches, the use of acoustic deterrent devices and soft start charges to encourage animals to flee will reduce the significance of the residual effect to not significant.
- The preferred protection method is to bury the cables in the seabed. However, external cable protection will be required at third-party asset crossings and may be required at the HDD exit points. A cable burial plan will be produced by the Installation Contractor outlining proposed method statements and cable protection requirements for approval by the Foreshore Unit and discussion with fisheries stakeholders to reduce/avoid disruption to fisheries interests as much as possible. Effective channels of communication will be established and maintained between the appointed Installation Contractor and commercial fishing interests. This will include the appointment of a Fisheries Liaison Officer (FLO). Guard vessels may be used if sections of the cable are exposed between lay and burial.
- The Proposed Development crosses the Hook Head SAC for 8km from the Baginbun Beach landfall. In relation to the site and the Qualifying Interests the EIA concluded:
  - Areas of outcropping Bedrock Reef have been avoided through routeing along a sediment channel. Bedrock Reef has also been identified in the nearshore area, extending out from the intertidal zone. GIL is committed to avoiding effects on this habitat by using a trenchless technique; horizontal directional drilling. Exclusion zones have been established around the Qualifying Interest to avoid effects.

- If the cables cannot be fully buried into the sediment unit at the HDD exit points, it is possible that external cable protection may be placed within the Qualifying Interest habitat 'Shallow Inlets and Bays'. Project Specific Mitigation will be implemented to reduce the likelihood of the contingency being required, and if necessary to reduce the footprint of the deposit. The external cable protection will cover a very small area of the habitat (equivalent to less than 0.0004% of the Qualifying Interest) and will provide a suitable hard substrate for colonisation. Colonisation of the external cable protection by reef species is expected in the medium-term and the overall significance of the effect has been assessed as **not significant**.

- The EIA concluded that the significance of effects on all seabirds (including Qualifying Interests of Special Protection Areas) is **not significant**. This took into consideration the presence of the vessels associated with installation, operation or decommissioning activities.
- During operation, the cables will generate low electromagnetic fields that will diminish to natural background levels within 2m from the bundled cables and 12m from the unbundled cables at the HDD exit points. There will be **no significant effects** on biological receptors (e.g. fish, marine mammals) and the fields will not interfere with navigation systems for commercial shipping or recreational boating.
- The presence of the cable installation vessels will cause temporary disturbance to fishing and shipping activity in the vicinity of the Proposed Development. Disruption will be limited to discrete sections of the Proposed Development, confined to the location of the maintenance or repair activity, or progressing along the Proposed Development during installation and decommissioning. Procedures to minimise disruption near high density shipping areas will be developed and implemented. The residual effect has been assessed as **not significant**.
- The EIA concluded the effects on marine archaeology will be **not significant**. This conclusion took into consideration embedded mitigation which includes preparing a scheme-specific Underwater Archaeology Impact Assessment and establishing a protocol for reporting archaeological discoveries. Archaeological exclusion zones will be implemented around the geophysical anomalies identified during cable route survey.
- There will be **no significant cumulative effects** with other existing and proposed projects and plans during the installation and operation of the Proposed Development. The potential for cumulative effects has been identified but all effects are not significant.
- Any effects from decommissioning activities (cable removal) will be broadly similar to those during installation. The appropriate method of cable decommissioning will be considered towards the end of the interconnectors life. This will consider hazards presented by leaving the cables in situ and potential

disturbances if removed entirely. The effects of removal are predicted to be slight and temporary in nature, and will be considered thoroughly at the time of removal.