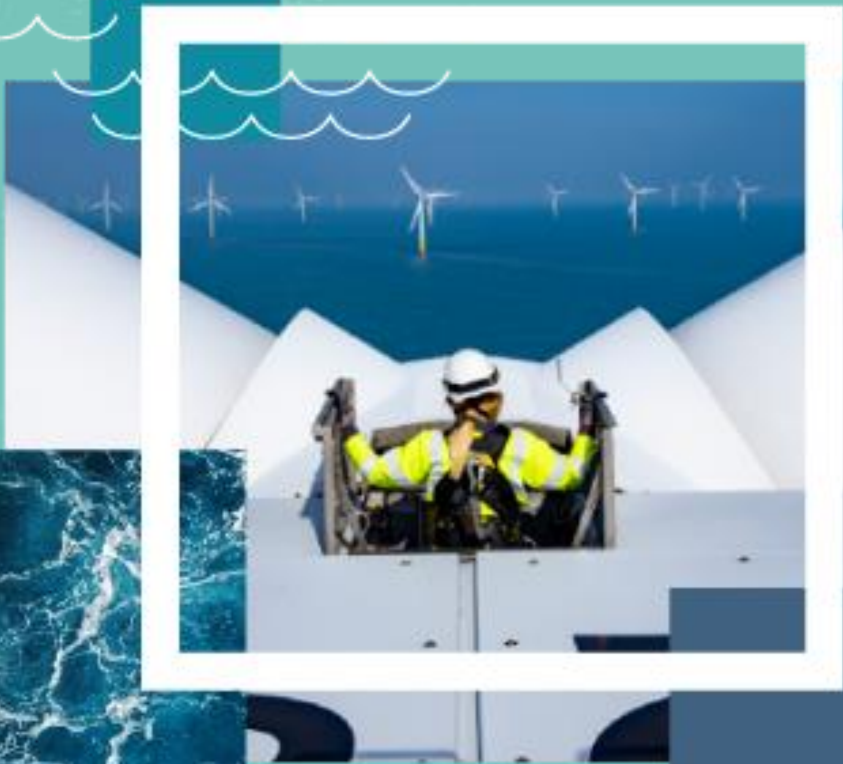

Arklow Bank Wind Park 2

Natura Impact Statement: Stage 2 Appraisal To Inform An Appropriate Assessment Of Implications On European Sites

sse Renewables

Version	Date	Status	Author	Reviewed by	Approved by
1.0	29.05.24	Final (External)	GoBe Consultants	GoBe Consultants	Sure Partners Limited

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Glossary

Term	Meaning
ABWP2 (the Project)	Arklow Bank Wind Park 2 (ABWP2) (The Project) is the onshore and offshore infrastructure. This NIS is being prepared for the Offshore Infrastructure. Consents for the Onshore Grid Infrastructure (Planning Reference 310090) and Operations Maintenance Facility (Planning Reference 211316) has been granted on 26th May 2022 and 20th July 2022, respectively. • Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements to be consented in accordance with the Maritime Area Consent. This is the subject of this NIS and will be referred to as 'the Proposed Development' in the NIS. • Arklow Bank Wind Park 2 Onshore Grid Infrastructure (OGI): This relates to the onshore grid infrastructure for which planning approval has been granted. • Arklow Bank Wind Park 2 Operations and Maintenance Facility (OMF): This includes the onshore and nearshore infrastructure at the OMF, for which planning permission has been granted. • Arklow Bank Wind Park 2 EirGrid Upgrade Works: any non-contestable grid upgrade works, consent to be sought and works to be completed by EirGrid.
Arklow Bank Wind Park 1 (ABWP1)	Arklow Bank Wind Park 1 consists of seven wind turbines, offshore export cable and inter-array cables. Arklow Bank Wind Park 1 has a capacity of 25.2 MW. Arklow Bank Wind Park 1 was constructed in 2003/04 and is owned and operated by Arklow Energy Limited. It remains the first and only operational offshore windfarm in Ireland.
Arklow Bank Wind Park 2 (ABWP2)– Offshore Infrastructure	"The Proposed Development", Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements under the existing Maritime Area Consent.
Array Area	The Array Area is the area within which the Wind Turbine Generators (WTGs), the Offshore Substation Platforms (OSPs), and associated cables (export, inter- array and interconnector cabling) and foundations will be installed.
Bathymetry	The measurement of water depth in oceans, seas and lakes.
Benthic ecology	Benthic ecology encompasses the study of the organisms living in and on the sea floor, the interactions between them and impacts on the surrounding environment.
Biotope	The combination of physical environment (habitat) and its distinctive assemblage of conspicuous species.
Cable Corridor and Working Area	The Cable Corridor and Working Area is the area within which export, inter-array and interconnector cabling will be installed. This area will also facilitate vessel jacking operations associated with installation of WTG structures and associated foundations within the Array Area.
Cable protection	External armouring applied to exposed cables or used at cable crossings, typically comprised of rock (berms or bags), ducting (polyurethane, steel, High Density Polyethylene (HDPE), cast iron or plastic) or concrete mattresses.
Competent Authority (CA)	The authority designated as responsible for performing the duties arising from the EIA Directive as amended. For this application, the Competent Authority is An Bord Pleanála (ABP).
Concrete mattressing	A solution for providing protection to cables from dropped objects, fishing trawl boards and scour (Subsea Protection Systems, 2020). Typically, several metres wide and long, cast of articulated concrete blocks which are linked by a polypropylene rope lattice which are placed on and/or around structures to stabilise the seabed and inhibit erosion.

Term	Meaning
Construction phase	The period during which project infrastructure is being installed.
Decommissioning phase	The period during which Proposed Development infrastructure is being removed at the end of the operational lifetime of Proposed Development.
EirGrid	State-owned electric power transmission system operator (TSO) in Ireland and Transmission Asset Owner (TAO) for the Project’s transmission assets.
Environmental Impact Assessment (EIA)	An Environmental Impact Assessment (EIA) is a statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment as amended by Directive 2014/52/EU of the European Parliament and of the Council (EIA Directive).
Foreshore	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 including the subsoil below, and the water column above the bed and shore and extending to the 12 nautical mile limit.
Foundation	The load carrying support structure for the wind turbine generator tower or offshore substation platform topside. The foundation is the part of the structure from the interfacing flange with the turbine tower or topside-foundation interface, down to below seabed. This includes any secondary steel items associated with the structure. For the purposes of the NIS the term ‘foundation’ includes the structure from the WTG tower or topside interface down to the lower end of the monopile commonly known as the ‘substructure’ and encompasses monopiles and transition pieces.
Habitats Directive	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive).
Indirect Impact	‘Impacts on the environment, which are not a direct result of the Project, often produced away from (the site) or as a result of a complex pathway’ (EPA, 2022).
Infauna	The animals living in the sediments of the seabed.
Intertidal area	The area between the high water mark (HWM) and the low water mark (LWM).
Landfall	The area in which the offshore export cables make landfall and is the transitional area between the offshore cabling and the onshore cabling.
Magnitude	Size, extent and duration of an impact.
Management Unit (MU)	A defined geographical area where a particular species can be found, and the management of human activities is applied.
Maritime Area Consent (MAC)	A consent to occupy a specific part of the maritime area on a non-exclusive basis for the purpose of carrying out a Permitted Maritime Usage strictly in accordance with the conditions attached to the MAC granted on 22nd December 2022 with reference number 2022-MAC-002.
Mitigation Measure	Measure which would avoid, reduce, or offset an impact.
Natura Impact Statement (NIS)	A statement, for the purpose of Article 6 of the Habitats Directive, of the implications of a Proposed Development, on its own or in combination with other plans or projects, for one or more than one European site, in view of the conservation objectives of the site or sites.

Term	Meaning
Permitted Maritime Usage	The construction and operation of an offshore windfarm and associated infrastructure (including decommissioning and other works required on foot of any permission for such offshore windfarm).
Polychaete	A class of segmented worms often known as bristle worms.
Scour protection	A solution for preventing scour around subsea structures, typically comprised of rock or concrete mattresses.
Sensitive Receptor	Physical or natural resource, special interest or viewer group that may experience an impact.
Sensitivity	Vulnerability of a sensitive receptor to change.
Sound Exposure Level (SEL)	A measure of the total sound energy of an event normalised to one second. This allows the total acoustic energy contained in events lasting a different amount of time to be compared on a like-for-like basis.
Sound Pressure Level (SPL)	The measurement of sound pressure in decibels (dB).
Study Area (upper case)	The area which is characterised dependant on the survey and receptor type of the focus of the study.
Subtidal area	The area below Mean Low Water Springs (MLWS).
The Application	The full set of documents that will be submitted to An Bord Pleanála in support of the consent application.
The Developer	Sure Partners Ltd.
Trenchless techniques	Trenchless techniques include steerable direct pipe thrusting ("Direct Pipe") and Horizontal Directional Drilling (HDD) which allow cable ducts to be installed underground without the need to excavate trenches.
Transition Piece (TP)	Structural interface between monopile foundation and WTG tower that contains ancillary infrastructure such as boat landings, working platform and j tubes.
Water Body	A surface water body as defined under Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, as amended, the Water Framework Directive i.e., a river/stream, lake, transitional, coastal or groundwater body.
Zone of Influence	Areas within which environmental impact may occur – to be defined for each receptor by technical specialists

Acronyms

Term	Meaning
AA	Appropriate Assessment
ABP	An Bord Pleanála
ABWP1	Arklow Bank Wind Park 1
ABWP2	Arklow Bank Wind Park 2
AC	Alternating Current
ADCP	Acoustic Doppler Current Profiler
AEoI	Adverse Effects on Integrity
AOB	Apparently occupied burrow
AON	Apparently occupied nests
ASL	Above sea level
ASU	Aquatic Services Unit
BDMPS	Biologically defined minimum population scale
BEIS	Department of Business, Energy, and Industrial Strategy
CAP	Climate Action Plan
CL	Conservation Limit
CO	Conservation Objectives
CJEU	Court of Justice of the European Union
CPGR	Counterfactual of population growth rate
CPS	Counterfactual of population size
CPT	Cone penetration test
CRM	Collision risk model
CSA	Continental Shelf Associates
cSACs	Candidate Special Areas of Conservation
CSIP	Cetacean Stranding Investigation Programme
cSPAs	Candidate Special Protected Areas
DAS	Digital Arial Survey
DCCAE	Department of Communications, Climate Action and Environment

Term	Meaning
DEHLG	Department of the Environment, Heritage and Local Government
DMAP	Designated Maritime Area Plan
DP	Decommissioning Plan
EC	European Commission
EDR	Effective deterrence range
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electro Magnetic Field
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EPS	European Protected Species
EU	European Union
EUNIS	The European Nature Information System
EVMP	Environmental Vehicle Management Plan
FCS	Favourable Conservation Status
GCA	Grid connection assessment
GPS	Global positioning system
GSD	Ground sample distance
HDD	Horizontal Directional Drilling
HF	High frequency
HRA	Habitat Regulations Assessment
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
HWM	High Water Mark
IRCG	Irish Coast Guard
IMO	International Maritime Organisation
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LSE	Likely Significant Effects

Term	Meaning
MAC	Maritime Area Consent
MBES	MultiBeam Echosounder
MMMP	Marine Mammal Mitigation Plan
MMO	Marine Mammal Observer
MPCP	Marine Pollution Contingency Plan
MPDM	Marine Planning and Development Management
MU	Management Unit
NDP	Network Delivery Portfolio
NIS	Natura Impact Statement
NPWS	National Parks and Wildlife Service
OGI	Onshore Grid Infrastructure
OHL	Overhead line
O&M	Operational and Maintenance
OMF	Operations and Maintenance Facility
OPR	Office of the Planning Regulator
OPW	Office of Public Works
ORE	Offshore Renewable Energy
OSP	Offshore Substation Platforms
OWF	Offshore Windfarm
PDA	Planning and Development Act
PTS	Permanent threshold shift
PVA	Population viability assessment
QI	Qualifying Interests
RMS	Root mean square
RPM	Revolutions per minute
RSPB	Royal Society for the Protection of Birds
SAC	Special Areas of Conservation
SBP	Sub-bottom profiler
SCI	Sites of Community Importance

Term	Meaning
SEL	Sound Exposure Level
SID	Strategic Infrastructure Development
SISAA	Supporting Information for Screening for AA
SNCBs	Statutory Nature Conservation Bodies
SOEF	Shaping Our Electricity Future
SPA	Special Protected Areas
SPL	Sound Pressure level
SSC	Suspended sediment concentrations
SSCO	Site specific conservation objectives
SSD	Suspended sediment deposition
SSS	Side scan sonar
SW	South-west
TAO	Transmission Asset Owner
TTS	Temporary threshold shift
UK	United Kingdom
USA	United States of America
UWN	Underwater Noise
UXO	Un-exploded ordinance
VHF	Very High Frequency
VP	Vantage point
WTG	Wind Turbine Generator

Units

Unit	Description
%	Percent
<	Less than
>	More than
°	degrees
A	Amperes
CO_{2eq}	Carbon dioxide equivalent
dB	Decibel (unit used to measure the intensity of sound)
hrs	Hours
Hz	Hertz
kHz	kiloHertz
kJ	Kilojoules
km	Kilometre
km^2	Kilometres square
kn	Knots
kV	Kilovolt (electrical potential)
m	Metre
m/s	Metres per second
mG	milligauss
mg/l	Milligrams per litre
mV/m	millivolts per metrer
MW	Megawatt (power; equal to one million watts)
nm	Nautical Mile (distance; equal to 1.852 km)
Pa	Pascal
V/m	Volts per metre
µT	Microtesla
µPa	Micropascal
µV/m	Microvolts per metre

1 Executive Summary

1.1.1.1 Sure Partners Limited hereafter referred to as “the Developer” intends to build a new offshore windfarm, Arklow Bank Wind Park 2 (ABWP2) (the Project), situated on and around Arklow Bank in the Irish Sea, approximately 6 to 15 km to the east of Arklow in County Wicklow.

1.1.1.2 ABWP2 is made up of both onshore and offshore components. The subject of this Natura Impact Statement (NIS) is the offshore infrastructure only (the Proposed Development).

1.1.1.3 Article 6(3) of the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (as amended) (the Habitats Directive) requires that the relevant competent authority (in this case An Bord Pleanála (ABP)) must undertake an Appropriate Assessment (AA) of the implications of a proposed plan or project, on its own or in combination with other plans or projects, on one or more than one European Site, in view of the Conservation Objectives of the site or sites. There are three stages to the Habitats Directive Assessment process. This report provides information to support the Stage Two AA.

1.1.1.4 A Stage One Supporting Information for Screening for AA (SISAA) report was completed for the Proposed Development to determine whether the Proposed Development alone or in-combination with other plans and project would result in Likely Significant Effects (LSEs) on European sites in view of the sites’ Conservation Objectives. This NIS builds upon the conclusions of the SISAA, with further information presented to better understand the risks presented by LSEs identified at Screening. It constitutes a Stage Two Appropriate Assessment by presenting a study of the potential implications of the Proposed Development alone or in-combination with other plans and projects to adversely affect the integrity of 56 European sites in view of the Conservation Objectives of these sites. These sites are designated to protect qualifying features from four receptor groupings relevant for this Proposed Development: coastal and marine habitats, marine mammals, migratory fish species and intertidal and offshore ornithology.

1.1.1.5 An analysis of LSEs identified at Stage One was undertaken for the 56 sites advanced to Stage Two (AA). This includes ‘transboundary’ sites in the UK and France. Consideration was given to the potential for the Proposed Development alone and in-combination with other plans and projects to result in an adverse effect on the integrity of the sites against the respective sites’ conservation objectives.

1.1.1.6 After detailed consideration of the potential for Adverse Effects on Integrity (AEoI) and in light of commitments (avoidance of effects by design measures) which are included as part of the Proposed Development, a conclusion was determined that no AEoI will result from the Proposed Development alone or in-combination with other plans and projects for all sites.

2 Introduction

2.1 Overview

2.1.1.1 Having regard to Part XAB of the Planning and Development Act 2000 (as amended), this report presents information to support the competent authority ABP, to undertake an AA. The report aims to inform and assist the competent authority in carrying out the AA for European sites. This NIS has been prepared, taking into account the Conservation Objectives (COs) of the European sites (Special Areas of Conservation (SACs), Special Protected Areas (SPAs), Candidate SACs (cSACs) and SPAs (cSPAs) and their qualifying interests (QI)s that were identified within the Supporting Information for Screening for AA Report (SISAA). It should be noted that although cSACs and cSPAs were considered, none were identified for the inclusion within this assessment.

2.1.1.2 This Stage 2 NIS is to assist the competent authority in undertaking its AA for the Proposed Development. There are two Project Design Options this NIS considers through the process.

2.1.2 Statement of Authority

Table 2.1: List of authors and relevant experience

Author	Qualification and experience of authors
Jennifer Gibson	Jennifer Gibson is a Senior HRA Consultant at GoBe Consultants with 5 years' environmental consultancy experience. She gained a Masters in Ecological Management and Conservation Biology from Queens University Belfast. Jennifer had been lead author on a large number of Irish NISs for OWF construction and associated surveys.
Charles Stamp	Charles Stamp is a Senior HRA Consultant at GoBe Consultants with six years of ecological consultancy experience. Charles worked at Natural England for three years where he worked on and managed interaction with a variety of projects including NSIPs, residential housing developments, scientific research and the use of strategic approaches to carrying out Habitat Regulation Assessments. He has a BSc in Zoology from Bangor University, Wales.
Glen Gillespie	Glen is an Associate Director and Head of HRA at GoBe Consultants. Glen was at Natural England for a total of thirteen years where he worked across a range of projects which included windfarms, residential housing developments, nuclear new builds, grid infrastructure and tidal lagoons. Following his departure from Natural England in 2016, Glen has worked in environmental consultancy at Senior, Principal and Associate Director levels, across a range of terrestrial and marine projects - including more than ten offshore windfarm projects across the UK and Ireland.

2.2 Legislative and the AA procedure

2.2.1 The Habitats Directive

2.2.1.1 Article 6(3) of the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (as amended) (the Habitats Directive) requires that–

"Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon either individually or in combination with other plans or projects, shall be subject to AA of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications

for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and if appropriate, after having obtained the opinion of the general public."

2.2.1.2 Thus, Article 6(3) provides a two-stage process:

- The first stage involves a screening for AA; and
- The second stage therefore only arises where the conclusion of the screening is that an AA is required. Where it is concluded that an AA is not required, Stage 2 is not applicable.

2.2.1.3 Article 6(4) introduces a third stage should the conclusion of Stage 2 be negative but the need of the project warrants further consideration and derogation which would allow the project to be approved in limited circumstances where the Stage 2 AA has concluded that it would or may have AEoI on European sites, with Article 6(4) allowing for derogations from Article 6(3).

2.2.1.4 This report is concerned with the second stage of the AA procedure.

2.2.2 Irish Legislation

2.2.2.1 For the purposes of applications for planning permission, Part XAB of the Planning and Development Act 2000, as amended ("the PDA") transposes the obligations under Article 6(3) into Irish law and sets out the duties of the relevant Competent Authority. In relation to other consent regimes, the provisions of the European Communities (Birds and Natural Habitats) Regulations 2011, as amended ("the 2011 Regulations"), transpose those obligations.

2.3 Appropriate Assessment

2.3.1.1 Section 177V of the PDA determines than an AA shall include a determination by the competent authority under Article 6.3 of the Habitats Directive as to whether or not a draft land use plan or proposed development would adversely affect the integrity of a European site. Section 177V (2) states:

"In carrying out an appropriate assessment under subsection (1) the competent authority shall take into account each of the following matters:

(a) the Natura impact report or Natura impact statement, as appropriate;

(b) any supplemental information furnished in relation to any such report or statement;

(c) if appropriate, any additional information sought by the authority and furnished by the applicant in relation to a Natura impact statement;

(d) any additional information furnished to the competent authority at its request in relation to a Natura impact report;

(e) any information or advice obtained by the competent authority;

(f) if appropriate, any written submissions or observations made to the competent authority in relation to the application for consent for proposed development;

(g) any other relevant information."

2.3.1.2 Section 177V (4) states:

"Subject to the other provisions of this Act, consent for proposed development may be given in relation to a proposed development where a competent authority has made modifications or attached conditions to the consent where the authority is satisfied to do so having determined that the proposed development would not adversely affect the integrity of the European site if it is carried out in accordance with the consent and the modifications or conditions attaching thereto."

2.4 Procedure

2.4.1.1 According to European Commission (EC) guidance documents 'Assessment of plans and projects significantly affecting Natura 2000 sites' (EC, 2001); 'Managing Natura 2000 sites: The Provisions of Article 6 of the 'Habitats' Directive 92/43/EEC' (EC, 2019); and the EC 'Guidance document on wind energy developments and EU nature legislation' (EC, 2020), the obligations arising under Article 6 establish a step-wise procedure for AA as follows, and as illustrated in Figure 2.1.

2.4.1.2 The first part of this procedure consists of a pre-assessment (or screening) stage to determine whether, firstly, a project is directly connected with or necessary to the management of the site, and secondly, whether it is likely to have a significant effect on the site. This part is governed by the first sentence of Article 6(3).

2.4.1.3 The second part of the procedure, governed by the second sentence of Article 6(3), relates to the AA and the decision of the competent authority as to whether the plan or project, alone or in combination with other projects or plans, will have Adverse Effects on Integrity (AEoI) of a European site.

2.4.1.4 A third part of the procedure (governed by Article 6(4)) comes into play if, despite a negative assessment it is proposed not to reject a project but to give it further consideration. In this case Article 6(4) allows for derogations from Article 6(3) under certain conditions.

2.4.1.5 The extent to which the sequential steps of Article 6(3) apply to a project depends on several factors, and in the sequence of steps, each step is influenced by the previous step. The order in which the steps are followed is therefore essential for the correct application of Article 6(3).

2.4.1.6 Each step determines whether a further step in the process is required. If, for example, the conclusion at the end of a Stage 1 screening appraisal is that significant effects on European sites can be excluded in the absence of any mitigation measures intended to avoid or reduce the harmful effects of the project on European sites (i.e. factored-in measures and further mitigation), there is no requirement to proceed to the next step.

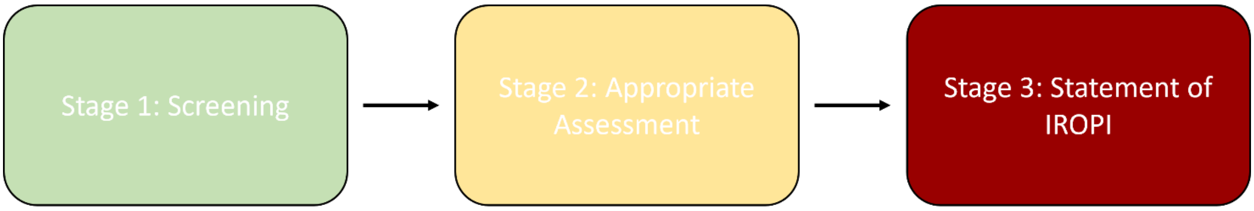

Figure 2.1 Stages of the AA process (Source: DEHLG, 2009)

2.5 Document Structure

2.5.1.1 This report is structured as follows:

- Section 0: Executive Summary;
- Section 2: Introduction – This section sets out the background of the Proposed Development along with the relevant legislation, guidance and approach that has been followed within this document;

- Section 3: Methodology – This section sets out the methodology followed, and guidance documents adhered to in conducting a Stage 2 Appraisal of the implications of the Proposed Development, alone or in-combination with any other plans or projects on European sites;
- Section 4: The Proposed Development – This section describes the Proposed Development, and is the basis of the Stage 2 Appraisal at Section 6 and 7;
- Section 5: Conclusion of Stage 1 SISAA – This section sets out the findings of the Stage 1 SISAA;
- Section 6 and 7: Stage 2 Appraisal for the Proposed Development Alone and In-combination with other Plans/Projects – These sections contain a more detailed examination and analysis of the implications of the Proposed Development on the COs of the European Sites identified in the SISAA and taken forward for a Stage 2 Appraisal. The Stage 2 appraisal has been undertaken in view of best scientific knowledge, in light of the COs of the sites concerned and considers the Proposed Development individually and in combination with other plans and projects;
- Section 8: Conclusion of Stage 2 Appraisal – This section sets out the findings of the Stage 2 AA.

3 Methodology

3.1 Guidance

3.1.1.1 AA Guidelines for Competent Authorities have been published by the Department of the Environment, Heritage and Local Government (DEHLG) (DEHLG, 2010a). In addition to the advice available from the DEHLG, the European Commission has published a number of documents which provide a significant body of guidance on the requirements of AA, most notably including '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, 2001), which sets out the principles of how to approach decision making during the process.

3.1.1.2 The principal national and European guidelines have been followed in the preparation of this report. The following list identifies these and other pertinent guidance that has been adhered to:

- Office of the Planning Regulator (OPR) Practice Note: Appropriate Assessment Screening for Development Management (OPR, 2021);
- Communication from the Commission on the Precautionary Principle, Office for Official Publications of the European Communities, Luxembourg (EC, 2000);
- Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Articles 6(3) and (4) of the Habitats Directive 92/43/EEC. Office for Official Publications of the European Communities, Brussels (EC, 2021);
- Estuaries and Coastal Zones within the Context of the Birds and Habitats Directives - Technical Supporting Document on their Dual Roles as Natura 2000 Sites and as Waterways and Locations for Ports. European Commission (EC, 2009);
- Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government, Dublin (DEHLG, 2010a);
- Department of Environment Heritage and Local Government Circular NPW 1/10 and PSSP 2/10 on Appropriate Assessment under Article 6 of the Habitats Directive - Guidance for Planning Authorities (DEHLG, 2010b);
- Guidance document on the implementation of the birds and habitats directive in estuaries and coastal zones with particular attention to port development and dredging. European Commission (EC, 2012);
- Guidance document: Wind Energy Developments and Natura 2000. European Commission (EC, 2010);
- Marine Natura Impact Statements in Irish Special Areas of Conservation: A working document, National Parks and Wildlife Service, Dublin (NPWS, 2012);
- Interpretation Manual of European Union Habitats. Version EUR 28. European Commission (EC, 2013a);
- Guidelines on Climate Change and Natura 2000. European Commission (EC, 2013b);
- Guidance on EIS and NIS Preparation for Offshore Renewable Energy Projects. Department of Communications, Climate Action and Environment (DCCAE, 2017);
- European Commission Notice C (2018) 7621 'Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC', Office for Official Publications of the European Communities, Luxembourg (EC, 2019);
- Institute of Air Quality Management 'A guide to the assessment of air quality impacts on designated nature conservation sites (Version 1.1)' (IAQM, 2020); and
- European Commission Notice C (2020) 7730 'Guidance document on wind energy developments and EU nature legislation', Office for Official Publications of the European Communities, Luxembourg (EC, 2020).

3.2 Adverse Effects on Integrity of European Sites (AEoI)

3.2.1.1 The European Commission's 2018 Notice (EC, 2019) advises that the purpose of the AA is to assess the implications of the plan or project in respect of the European site's COs, either individually or in combination with other plans or projects. The conclusions should enable the competent authorities to ascertain whether the plan or project will adversely affect the integrity of the site concerned. The focus of the AA is therefore specifically on the species and/or the habitats for which the European site is designated.

3.2.1.2 EC (2019) also emphasises the importance of using the best scientific knowledge when carrying out the AA in order to enable the competent authorities to conclude with certainty that there will be no AEoI of the site. This guidance notes that it is at the time of adoption of the decision authorising implementation of the project that there must be no reasonable scientific doubt remaining as to the absence of AEoI of the site in question.

3.2.1.3 The judgement of the Court of Justice of the European Union (CJEU) confirmed in its ruling in Case C-258/11 that 'Article 6(3) of the Habitats Directive must be interpreted as meaning that a plan or project not directly connected with or necessary to the management of a site will adversely affect the integrity of that site if it is liable to prevent the lasting preservation of the constitutive characteristics of the site that are connected to the presence of a priority natural habitat whose conservation was the objective justifying the designation of the site in the list of Sites of Community Importance (SCIs), in accordance with the directive. The precautionary principle should be applied for the purposes of that appraisal'. EC (2019) advises that the logic of such an interpretation would also be relevant to non-priority habitat types and to habitats of species.

3.2.1.4 ‘As regards the meaning of 'integrity', this clearly relates to ecological integrity. This can be considered as a quality or condition of being whole or complete. In a dynamic ecological context, it can also be considered as having the sense of resilience and ability to evolve in ways that are favourable to conservation’.

3.2.1.5 ‘The 'integrity of the site' can be usefully defined as the coherent sum of the site's ecological structure, function and ecological processes, across its whole area, which enables it to sustain the habitats, complex of habitats and/or populations of species for which the site is designated’ (EC, 2019).

3.2.1.6 EC (2019) notes that ‘if the competent authority considers the mitigation measures are sufficient to avoid the AEoI identified in the AA, they will become an integral part of the specification of the final plan or project or may be listed as a condition for project approval’.

3.2.1.7 EC (2020) advises that ‘it is for the competent authorities, in the light of the conclusions made in the AA on the implications of a plan or project for the European site concerned, to approve the plan or project. This decision can only be taken after they have made certain that the plan or project will not adversely affect the integrity of the site. That is the case where no reasonable scientific doubt remains as to the absence of such effects’.

3.2.1.8 EC (2020) also reaffirms that ‘the authorisation criterion laid down in the second sentence of Article 6(3) of the Habitats Directive integrates the precautionary principle and makes it possible effectively to prevent the protected sites from suffering AEoI as the result of the plans or projects. A less stringent authorisation criterion could not as effectively ensure the fulfilment of the objective of site protection intended under that provision. The onus is therefore on demonstrating the absence of AEoI rather than their presence, reflecting the precautionary principle. It follows that the AA must be sufficiently detailed and reasoned to demonstrate the absence of AEoI, in light of the best scientific knowledge in the field’.

3.3 Consideration of Ex-situ Effects

3.3.1.1 EC (2019) advises that 'Member States, both in their legislation and in their practice, allow for the Article 6(3) safeguards to be applied to any development pressures, including those which are external to European sites, but which are likely to have significant effects on any of them'.

3.3.1.2 The CJEU developed this point when it issued a ruling in case C-461/17 ("Brian Holohan and Others v An Bord Pleanála") that determined inter alia that Article 6(3) of Directive 92/43/EEC must be interpreted as meaning that an AA must on the one hand, catalogue the entirety of habitat types and species for which a site is protected, and, on the other, identify and examine both the implications of the proposed project for the species present on that site, and for which that site has not been listed, and the implications for habitat types and species to be found outside the boundaries of that site, provided that those implications are liable to affect the COs of the site.

3.3.1.3 In that regard, consideration has been given in this Stage 2 appraisal to inform AA.

3.4 Conservation Objectives (COs)

3.4.1.1 The COs for each European site are to maintain or restore the favourable conservation condition of the habitats and/or species for which the European site has been selected.

3.4.1.2 The favourable conservation status of a habitat is achieved when:

- its natural range, and area it covers within that range, are stable or increasing;
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and
- the conservation status of its typical species is favourable.

3.4.1.3 The favourable conservation status (FCS) (or condition, at a site level) of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats;
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

3.4.1.4 The most up-to-date site-specific COs for the European sites being considered have been used in this appraisal. Details in relation to the QIs of SACs and SPAs is based on publicly available data sourced from the relevant Statutory Nature Conservation Bodies (SNCBs) in Ireland and other relevant states in December 2023.

3.5 In-Combination Effects

3.5.1.1 Article 6(3) of the Habitats Directive requires that in-combination effects with other plans or projects are also considered. As set out in the Commission's 2018 Notice (EC, 2019), significance will vary depending on factors such as magnitude of impact, type, extent, duration, intensity, timing, probability, in-combination effects and the vulnerability of the habitats and species concerned.

3.5.1.0 In that context, all elements of the Proposed Development are considered in combination. This includes the other components of the ABWP2 Project:

- ABWP2 Onshore Grid Infrastructure (OGI);
- ABWP2 Operations and Maintenance Facility (OMF); and
- EirGrid Upgrade Works.

3.5.1.1 In addition, other plans or projects which are completed, approved but uncompleted, or proposed are considered. EC (2019) specifically advises that "as regards other proposed plans or projects (i.e. other projects not proposed by the Applicant), on grounds of legal certainty it would seem appropriate to restrict the in-combination provision to those which have been actually proposed, i.e. for which an application for approval or consent has been introduced". However, on a precautionary basis this has been amended for this NIS to include projects for which reasonable steps have been taken as to not limit the assessment to other projects where an application for approval or consent has been introduced.

3.5.1.2 The Developer submitted a Foreshore Licence Application for Site Surveys (associated with the Proposed Development) to the Minister for Housing, Local Government and Heritage in April 2023 (FS007555) and this application is pending determination. The Developer confirms and commits that they will not conduct any activities the subject of the Foreshore Licence Application for Site Surveys (should a licence be granted) at the same time as any development is being carried out under this permission (if granted). As such, there is no temporal overlap between the activities proposed in the Foreshore Licence Application and the Proposed Development. For this reason, FS007555 is not considered within the in-combination assessment of this NIS.

3.5.1.3 All of the projects to be considered in combination with the Proposed Development are described more comprehensively in Section 7 of the NIS.

3.5.1.4 The ability for impacts arising from the Proposed Development to overlap with those from other projects, plans and activities to result in AEoI has been assessed on a receptor basis for each group of QIs. This means that, in most examples, with the impacts arising from the two (or more) projects, both (or multiple) projects must have some form of impact arising from project related activities on the same QI and CO at the same time for an in-combination effect to arise. For example, for an in-combination sedimentation effect to be established between the Proposed Development and another project, it must be established that the extent of sediment release from both projects has the potential to overlap and may affect a receptor at the same protected site. This also applies to mobile species and as an example there are certain mobile receptors that may move between, and be subject to, two or more separate physical extents of impact from two or more projects. Marine mammals and Birds are the primary species this applies to. With Marine Mammals they may be affected by noise impacts from the Proposed Development, as well as those from other projects where the extent of another defined works area does not directly overlap with that of the Proposed Development but that is within that species range. Furthermore, individual receptors from the same population may be exposed to separate impacts from different projects occurring at the same time while the population is separated, leading to an effect upon the population as a whole. Where relevant, these potential eventualities have been taken into consideration in the in-combination assessment and mitigation proposed as necessary to prevent adverse in-combination effects occurring.

3.6 Assessment Approach

3.6.1.1 Two Project Design Options are being considered for the Proposed Development. It is therefore necessary that the NIS assesses both Project Design Options.

3.6.1.2 To assess both Project Design Options along with all permutations of the Proposed Development, the NIS assessment makes clear where parameters between the two Project Design Options are the same (and therefore the effect on COs for each European Site which has been scoped in, is the same). The NIS also makes clear where parameters between the two Project Design Options differ (and therefore where the effect on the COs for each European Site which has been scoped in may differ).

4 The Proposed Development

4.1 Location

4.1.1.1 The Proposed Development is a proposed offshore windfarm situated on and around Arklow Bank in the Irish Sea, approximately 6 km to 15 km to the east of Arklow in County Wicklow. Arklow Bank is a shallow offshore sandbank, measuring approximately 27 km by 2.5 km. On the bank, water depths vary between 0.6 m and 25 m relative to Lowest Astronomical Tide (LAT), with shallower areas particularly occurring in the vicinity of the existing seven wind turbines of Arklow Bank Wind Park 1 (ABWP1). The general morphology of this feature is oriented roughly in a north-south direction. There is a large variation in depth within the area, with water depths in excess of 50 m LAT beyond the bank towards the east. Arklow Bank is subject to very strong tidal currents with the general direction of flow in the offshore regions of the bank towards the north-north-east during flood and towards south-south-west during ebb. The Arklow Bank is sand and gravel dominated with mobile surface sediments. Medium sand is mainly located at upper levels. ABWP1 which is adjacent has a capacity of 25.2 MW and was constructed on Arklow Bank in 2003/04. It is owned and operated by Arklow Energy Limited (ABWP1) and remains the first and only operational offshore windfarm in Ireland.

4.1.1.2 The area in which the Wind Turbine Generators (WTGs), Offshore Substation Platforms (OSP(s)) and associated cables (export, inter- array and interconnector cabling) and foundations will be located is referred to as the Array Area. The Array Area covers an area of seabed 63.4 km^2. The area in which the export, inter-array and interconnector cabling will be located will be referred to as the Cable Corridor and Working Area, and will extend from the Array Area to a landfall approximately 4.5 km to the north of Arklow at Johnstown North. This area will also facilitate vessel jacking operations associated with installation of WTG structures and associated foundations within the Array Area.

4.1.1.3 Figures showing the site location and proposed site layouts can be found in Figure 4.1 and Figure 4.2.

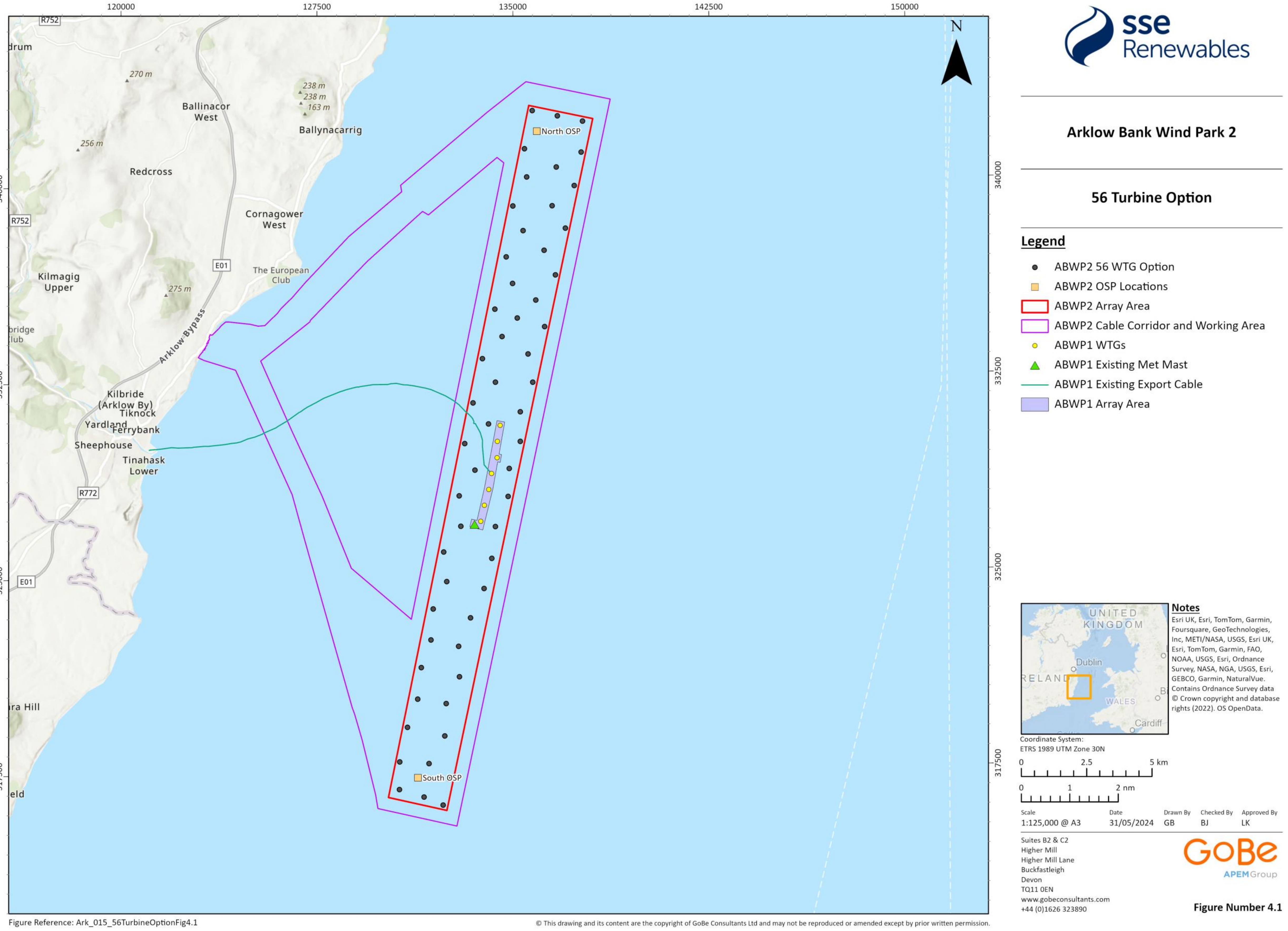

Figure 4.1: The Proposed Development Array Area and Export Cable Corridor for Project Design Option 1

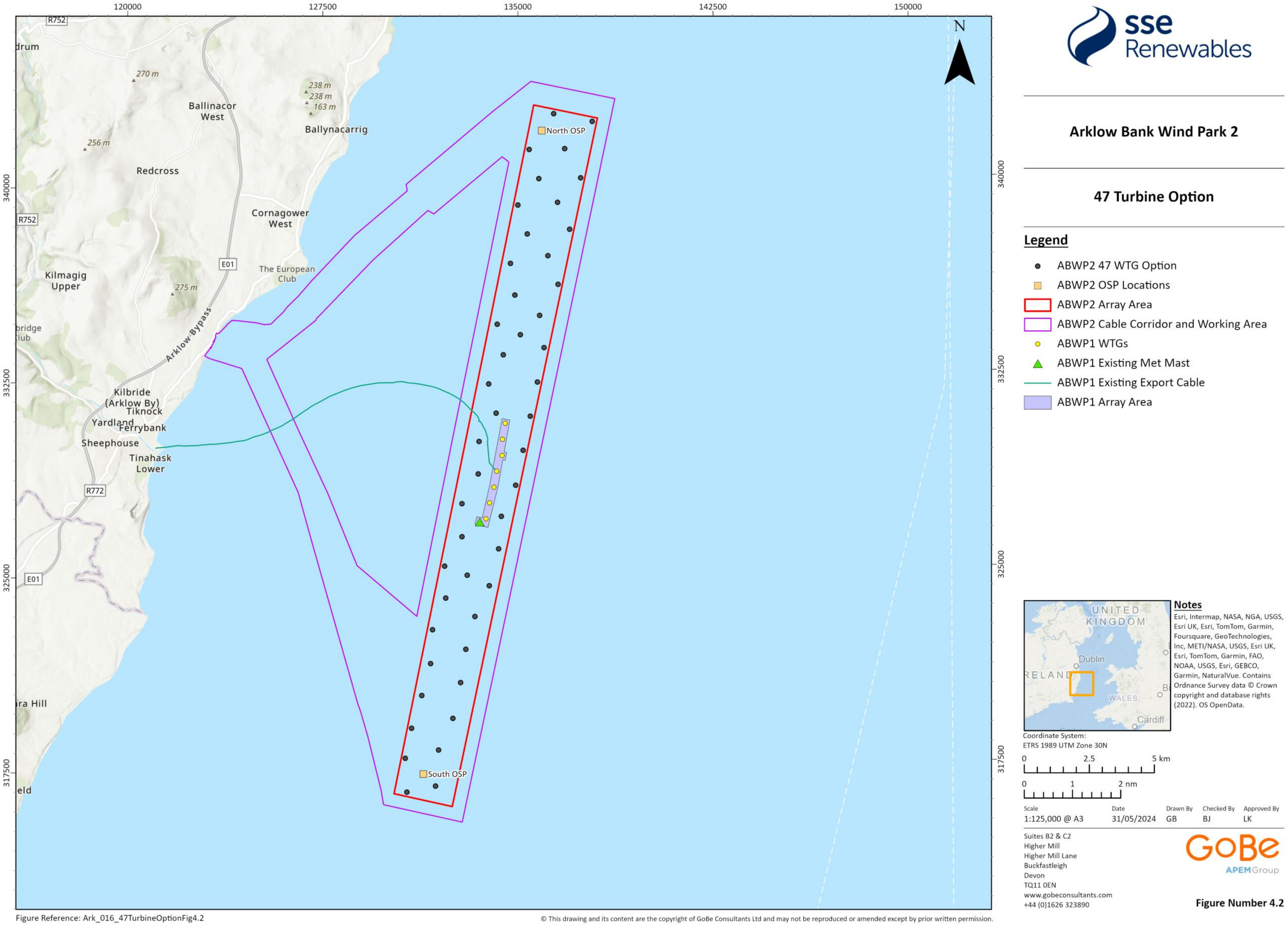

Figure 4.2: The Proposed Development Array Area and Export Cable Corridor for Project Design Option 2

4.2 Overview of the Proposed Development

4.2.1.1 The full description of the Proposed Development, including both design options, and associated cabling is contained within Section 4 of the Screening Report.

5 Conclusion of the Stage 1 Screening Assessment

5.1 Summary of Stage 1 Screening Assessment for SACs

5.1.1.1 From the findings of the screening stage appraisal presented (Volume I, Supporting Information for Screening for Appropriate Assessment Report), the possibility of Likely Significant Effects could not be excluded for the following SACs and QIs at the screening stage (Table 5.1), in the absence of further evaluation and analysis and/or mitigation measures. The result of the screening applies to both Project Design Options and all other permutations described in Section 4.

Table 5.1: SACs and their Qualifying Interest considered in this NIS where Likely Significant Effect could not be excluded at the screening stage

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
Wicklow Reef SAC	3.61	To maintain the favourable conservation condition of reefs in Wicklow Reef SAC, which defined by the following list of attributes and targets: • **Habitat area** – permanent habitat area in stable or increasing, subject to natural processes; • **Distribution** – the distribution of reefs in stable or increasing, subject to natural processes; and • **Community structure** – conserve the following community type in a natural condition: Current-swept subtidal reef community complex.	(NPWS, 2013a)	Reefs [1170]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution
Magherabeg Dunes SAC	3.66	To maintain the favourable conservation condition of Annual vegetation of drift lines in Magherabeg Dunes SAC, which is defined by the following list of attributes and targets: • **Habitat area** - Area stable or increasing, subject to natural processes, including erosion and succession; • **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; • **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; • **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; • **Vegetation composition: typical species and sub-communities -** Maintain the presence of	(NPWS, 2017a)	Annual vegetation of drift lines [1210]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		species-poor communities with typical species: sea rocket (*Cakile maritima*), sea sandwort (*Honckenya peploides*), prickly saltwort (*Salsola kali*) and oraches (*Atriplex* spp.); and • **Vegetation composition: negative indicator species -** Negative indicator species (including non-native species) to represent less than 5% cover.			
		To maintain the favourable conservation condition of Embryonic shifting dunes in Magherabeg Dunes SAC, which is defined by the following list of attributes and targets: • **Habitat Area** - Area stable or increasing, subject to natural processes, including erosion and succession; • **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; • **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; • **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; • **Vegetation composition: plant health of foredune grasses** - More than 95% of sand couch grass (*Elytrigia juncea*) and/or lyme-grass (*Leymus arenarius*) should be healthy (i.e., green plant parts above ground and flowering heads present);		Embryonic shifting dunes [2110]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		• **Vegetation composition: typical species and sub-communities -** Maintain the presence of species-poor communities with typical species: sand couch grass (*Elytrigia juncea*) and/or lyme-grass (*Leymus arenarius*); and • **Vegetation composition: negative indicator species -** Negative indicator species (including non-native species) to represent less than 5% cover.			
		To maintain the favourable conservation condition of Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) in Magherabeg Dunes SAC, which is defined by the following list of attributes and targets: • **Habitat Area** - Area stable or increasing, subject to natural processes, including erosion and succession; • **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; • **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; • **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; • **Vegetation composition: plant health of foredune grasses** - More than 95% of marram grass (*Ammophila arenaria*) and/or lyme-grass (*Leymus arenarius*) should be healthy (i.e., green		Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		plant parts above ground and flowering heads present); • **Vegetation composition: typical species and sub-communities -** Maintain the presence of species-poor communities dominated by marram grass (*Ammophila arenaria*) and/or lyme-grass (*Leymus arenarius*); and • **Vegetation composition: negative indicator species -** Negative indicator species (including non-native species) to represent less than 5% cover.			
		To restore the favourable conservation condition of Fixed coastal dunes with herbaceous vegetation (grey dunes) in Magherabeg Dunes SAC, which is defined by the following list of attributes and targets: • **Habitat Area** - Area stable or increasing, subject to natural processes, including erosion and succession; • **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; • **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; • **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; • **Vegetation structure: Sward height** – maintain structural variation within sward;		Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		• **Vegetation composition: typical species and sub-communities** - Maintain the presence of typical species; • **Vegetation composition: negative indicator species -** Negative indicator species (including non-native species) to represent less than 5% cover; and • **Vegetation composition: scrub/ trees** – No more than 5% cover of under control.			
		To maintain the favourable conservation condition of Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) in Magherabeg Dunes SAC, which is defined by the following list of attributes and targets: • **Habitat Area** - Area stable or increasing, subject to natural processes, including erosion and succession; • **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; • **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; • **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; • **Vegetation structure**: bare ground – maintain structural variation within swards; • **Vegetation structure: Sward height** – maintain structural variation within sward;		Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) [2150]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		• **Vegetation composition: typical species and sub-communities** - Maintain the presence of typical species; • **Vegetation composition: negative indicator species -** Negative indicator species (including non-native species) to represent less than 5% cover; and • **Vegetation composition: scrub/ trees** – No more than 5% cover of under control.			
Buckroney-Brittas Dunes and Fen SAC	0.31	To maintain the favourable conservation condition of Annual vegetation of drift lines in Buckroney-Brittas Dunes and Fen SAC, which is defined by the following list of attributes and targets: • **Habitat area** - Area stable or increasing, subject to natural processes, including erosion and succession; • **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; • **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; • **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; • **Vegetation composition: typical species and sub-communities** - Maintain the presence of species-poor communities with typical species: sea rocket (*Cakile maritima*), sea sandwort	(NPWS, 2017b)	Annual vegetation of drift lines [1210]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		(*Honckenya peploides*), prickly saltwort (*Salsola kali*) and oraches (*Atriplex* spp.); and • **Vegetation composition: negative indicator species** - Negative indicator species (including non-native species) to represent less than 5% cover.			
		To restore the favourable conservation condition of Perennial vegetation of stony banks in Buckroney-Brittas Dunes and Fen SAC, which is defined by the following list of attributes and targets: **Habitat Area** - Area stable or increasing, subject to natural processes, including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation composition: typical species and sub-communities** - Maintain the presence of species-poor communities with typical vegetated shingle flora including the range of subcommunities within the different zones; and **Vegetation composition: negative indicator species** - Negative indicator species (including non-native species) to represent less than 5% cover.		Perennial vegetation of stony banks [1220]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		To maintain the favourable conservation condition of Mediterranean salt meadows (*Juncetalia maritimi*) in Buckroney-Brittas Dunes and Fen SAC, which is defined by the following list of attributes and targets: **Habitat Area** - Area stable or increasing, subject to natural processes, including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Physical structure**: creeks and pans - Maintain creek and pan structure, subject to natural processes including erosion and succession; **Physical structure**: **flooding regime** – maintain natural tidal regime; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation structure: vegetation height** – maintain structural variation in the sward; **Vegetation structure: vegetation cover** - Maintain range of subcommunities with typical species; and **Vegetation composition: negative indicator species – *Spartina anglica*** - There is no record of common cordgrass (*Spartina anglica*) in the SAC and its establishment should be prevented.		Mediterranean salt meadows (*Juncetalia maritimi*) [1410]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		To restore the favourable conservation condition of Embryonic shifting dunes in Buckroney-Brittas Dunes and Fen SAC, which is defined by the following list of attributes and targets: **Habitat area** – Area stable or increasing, subject to natural processes including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation composition: plant health of foredune grasses** – More than 95% of sand couch grass (*Elytrigia juncea*) and/or lyme-grass (*Leymus arenarius*) should be healthy (i.e., green plant parts above ground and flowering heads present); **Vegetation composition: typical species and subcommunities** - Maintain the presence of species-poor communities with typical species: sand couch grass (*Elytrigia juncea*) and/or lyme-grass (*Leymus arenarius*); and **Vegetation composition: negative indicator species** - Negative indicator species (including non-native species) to represent less than 5% cover.		Embryonic shifting dunes [2110]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		To restore the favourable conservation condition of Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) in Buckroney-Brittas Dunes and Fen SAC, which is defined by the following list of attributes and targets: **Habitat area** – Area stable or increasing, subject to natural processes including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation composition: plant health of foredune grasses** – More than 95% of marram grass (*Ammophila arenaria*) and/or lyme-grass (Leymus arenarius) should be healthy (i.e., green plant parts above ground and flowering heads present); **Vegetation composition: typical species and subcommunities** - Maintain the presence of species-poor communities dominated by marram grass (*Ammophila arenaria*) and/or lyme-grass (Leymus arenarius); and **Vegetation composition: negative indicator species -** Negative indicator species (including non-native species) to represent less than 5% cover.		Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		To maintain the favourable conservation condition of Fixed coastal dunes with herbaceous vegetation (grey dunes)* in Buckroney-Brittas Dunes and Fen SAC, which is defined by the following list of attributes and targets: **Habitat area** – Area stable or increasing, subject to natural processes including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation structure: bare ground** - Bare ground should not exceed 10% of fixed dune habitat, subject to natural processes; **Vegetation structure: sward heigh** - Maintain structural variation within sward; **Vegetation composition: typical species and subcommunities** - Maintain range of subcommunities with typical species; **Vegetation composition: negative indicator species (including *Hippophae rhamnoides*)** - Negative indicator species (including non-native species) to represent less than 5% cover; and **Vegetation composition: scrub/trees** – No more than 5% cover under control.		Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		To restore the favourable conservation condition of Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) in Buckroney-Brittas Dunes and Fen SAC, which is defined by the following list of attributes and targets: **Habitat area** – Area stable or increasing, subject to natural processes including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; • **Physical structure: functionality and sediment supply** - Maintain the natural circulation **of** sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation structure: bare ground** - Bare ground should not exceed 10% of dune habitat, subject to natural processes; **Vegetation structure: sward heigh** - Maintain structural variation within sward; **Vegetation composition: typical species and subcommunities** - Maintain range of subcommunities with typical species; **Vegetation composition: negative indicator species** - Negative indicator species (including non-native species) to represent less than 5% cover; and **Vegetation composition: scrub/trees** – No more than 5% cover under control.		Atlantic decalcified fixed dunes *(Calluno-Ulicetea*) [2150]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		To maintain the favourable conservation condition of Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*) in Buckroney-Brittas Dunes and Fen SAC, which is defined by the following list of attributes and targets: **Habitat area** – Area stable or increasing, subject to natural processes including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation structure: bare ground** - Bare ground should not exceed 10% cover, subject to natural processes; **Vegetation structure: sward heigh** - Maintain structural variation within sward; **Vegetation composition: typical species and subcommunities** - Maintain range of subcommunities with typical species; **Vegetation composition**: **cover and height of *Salix repens*** - Maintain more than 10% cover of creeping willow (*Salix repens*); vegetation height should be in the average range of 5-20 cm; **Vegetation composition: negative indicator species (including *Hippophae rhamnoides*)** -		Dunes with Salix repens ssp. argentea (*Salicion arenariae*) [2170]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Negative indicator species (including non-native species) to represent less than 5% cover; and **Vegetation composition: scrub/trees** - For trees and scrub other than creeping willow (*Salix repens*), there should be no more than 5% cover or their presence should be under control.			
		To restore the favourable conservation condition of Humid dune slacks in Buckroney-Brittas Dunes and Fen SAC, which is defined by the following list of attributes and targets: **Habitat area** – Area stable or increasing, subject to natural processes including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Physical structure: hydrological and flooding regime** - Maintain natural hydrological regime; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession. **Vegetation structure: bare ground** - Bare ground should not exceed 5% of dune slack habitat, with the exception of pioneer slacks which can have up to 20% bare ground; **Vegetation structure: sward height** - Maintain structural variation within sward;		Humid dune slacks [2190]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Vegetation composition: typical species and subcommunities - Maintain range of subcommunities with typical species; **Vegetation composition: cover of *Salix repens*** – Maintain less than 40% cover of creeping willow (*Salix repens*); **Vegetation composition: negative indicator species** - Negative indicator species (including non-native species) to represent less than 5% cover; and **Vegetation composition: scrub/trees** – No more than 5% cover under control.			
Kilpatrick Sandhills SAC	6.8	To maintain the favourable conservation condition of Annual vegetation of drift lines in Kilpatrick Sandhills SAC, which is defined by the following list of attributes and targets: **Habitat area -** Area stable or increasing, subject to natural processes, including erosion and succession; **Habitat distribution -** No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply -** Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation composition: typical species and subcommunities -** Maintain the presence of species-poor communities with typical species: sea rocket (*Cakile maritima*), sea sandwort (*Honckenya*	(NPWS, 2017c)	Annual vegetation of drift lines [1210]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		peploides), prickly saltwort (*Salsola kali*) and oraches (*Atriplex* spp.); and **Vegetation composition: negative indicator species -** Negative indicator species (including non-native species) to represent less than 5% cover.			
		To maintain the favourable conservation condition of Embryonic shifting dunes in Kilpatrick Sandhills SAC, which is defined by the following list of attributes and targets: **Habitat area -** Area stable or increasing, subject to natural processes, including erosion and succession; **Habitat distribution -** No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply -** Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation composition: plant health of foredune grasses** - More than 95% of sand couch grass (*Elytrigia juncea*) and/or lyme-grass (*Leymus arenarius*) should be healthy (i.e., green plant parts above ground and flowering heads present); **Vegetation composition: typical species and subcommunities -** Maintain the presence of species-poor communities with typical species: sand couch grass (Elytrigia juncea) and/or lyme-grass (Leymus arenarius); and		Embryonic shifting dunes [2110]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Vegetation composition: negative indicator species - Negative indicator species (including non-native species) to represent less than 5% cover.			
		To restore the favourable conservation condition of Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) in Kilpatrick Sandhills SAC, which is defined by the following list of attributes and targets: **Habitat area -** Area stable or increasing, subject to natural processes, including erosion and succession; **Habitat distribution -** No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply -** Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation composition: plant health of dune grasses -** More than 95% of marram grass (*Ammophila arenaria*) and/or lyme-grass (*Leymus arenarius*) should be healthy (i.e., green plant parts above ground and flowering heads present); **Vegetation composition: typical species and subcommunities -** Maintain the presence of species-poor communities dominated by marram grass (*Ammophila arenaria*) and/or lyme-grass (*Leymus arenarius*); and		Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Vegetation composition: negative indicator species - Negative indicator species (including non-native species) to represent less than 5% cover.			
		To restore the favourable conservation condition of Fixed coastal dunes with herbaceous vegetation (grey dunes)* in Kilpatrick Sandhills SAC, which is defined by the following list of attributes and targets: **Habitat area** – Area stable or increasing, subject to natural processes including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Physical structure: hydrological and flooding regime** - Maintain natural hydrological regime; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation structure: bare ground** - Bare ground should not exceed 5% of dune slack habitat, with the exception of pioneer slacks which can have up to 20% bare ground; **Vegetation structure: sward height** - Maintain structural variation within sward; **Vegetation composition: typical species and subcommunities** - Maintain range of subcommunities with typical species;		Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Vegetation composition: negative indicator species - Negative indicator species (including non-native species) to represent less than 5% cover; and **Vegetation composition: scrub/trees** - No more than 5% cover or under control.			
		To restore the favourable conservation condition of Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)* in Kilpatrick Sandhills SAC, which is defined by the following list of attributes and targets: **Habitat area -** Area stable or increasing, subject to natural processes, including erosion and succession; **Habitat distribution -** No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply -** Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation composition: plant health of dune grasses** - More than 95% of marram grass (*Ammophila arenaria*) and/or lyme-grass (*Leymus arenarius*) should be healthy (i.e., green plant parts above ground and flowering heads present); **Vegetation composition: typical species and subcommunities -** Maintain the presence of species-poor communities dominated by marram grass (*Ammophila arenaria*) and/or lyme-grass (*Leymus arenarius*);		Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) [2150	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Vegetation composition: negative indicator species - Negative indicator species (including non-native species) to represent less than 5% cover; and **Vegetation composition: scrub/trees** - No more than 5% cover or under control.			
The Murrough Wetlands SAC	11.15	To restore the favourable conservation condition of Annual vegetation of drift lines in The Murrough Wetlands SAC, which is defined by the following list of attributes and targets: **Habitat area** - Area stable or increasing, subject to natural processes, including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation composition: typical species and sub-communities -** Maintain the presence of species-poor communities with typical species: sea rocket (*Cakile maritima*), sea sandwort (*Honckenya peploides*), prickly saltwort (*Salsola kali*) and oraches (*Atriplex* spp.); **Vegetation composition: native negative indicator species -** Native negative indicator species cover in any individual monitoring stop should not be more than 25%; no negative indicator species should be	(NPWS, 2021a)	Annual vegetation of drift lines [1210]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		present in more than 60% of monitoring stops; cover of negative indicator species across the whole site should not be more than 5%; and **Vegetation composition: nonnative species -** Non-native species should not be present in more than 20% of monitoring stops.			
		To restore the favourable conservation condition of Perennial vegetation of stony banks in The Murrough Wetlands SAC, which is defined by the following list of attributes and targets: **Habitat area** - Area stable or increasing, subject to natural processes, including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation composition: communities and typical species -** Maintain the typical species within the range of vegetated shingle communities; **Vegetation composition: native negative indicator species -** Native negative indicator species cover in any individual monitoring stop should not be more than 25%; no negative indicator species should be present in more than 60% of monitoring stops; and		Perennial vegetation of stony banks [1220]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Vegetation composition: nonnative species - Non-native species cover in any individual monitoring stop should not be more than 1%; non-native species should not be present in more than 20% of monitoring stops; cover of non-native species across the whole site should not be more than 1%.			
		To restore the favourable conservation condition of Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) in The Murrough Wetlands SAC, which is defined by the following list of attributes and targets: **Habitat area** - Area stable or increasing, subject to natural processes, including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; Physical structure: hydrology - No human disturbance; **Vegetation structure: plant height -** Standard deviation of median plant height more than 5; **Vegetation structure: disturbed ground -** Percentage cover at a representative number of 2 m x 2 m monitoring stops; **Vegetation structure: zonation -** Adequate number of zones present, depending on geographical type of saltmarsh; **Vegetation structure**: transitions - No loss of natural transitions; **Vegetation composition**: typical species - Minimum of twelve typical species recorded across all plots;		Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Vegetation composition: negative species - Spartina spp. have not been recorded in the habitat in this SAC and establishment should be prevented; **Other negative indicators -** No signs of infilling, reclamation, turf-cutting or pollution or other negative indicators; and **Indicators of local distinctiveness -** No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat.			
		To restore the favourable conservation condition of Mediterranean salt meadows (*Juncetalia maritimi*) in The Murrough Wetlands SAC, which is defined by the following list of attributes and targets: **Habitat area** - Area stable or increasing, subject to natural processes, including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure**: hydrology - No human disturbance; **Vegetation structure: disturbed ground** - Cover of disturbed ground less than 5%; **Vegetation structure: transitions** - No loss of natural transitions; **Vegetation composition: typical species -** Minimum of six typical species recorded across all plots; minimum two typical species in more than 25% of plots (excluding *Juncus maritimus*); **Vegetation composition: negative species -** Spartina spp. have not been recorded in the habitat in this SAC and establishment should be prevented;		Mediterranean salt meadows (*Juncetalia maritimi*) [1410]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Other negative indicators - No signs of infilling, reclamation, turf-cutting or pollution or other negative indicators; and **Indicators of local distinctiveness -** No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat.			
Slaney River Valley SAC	44.54	The status of the freshwater pearl mussel (*Margaritifera margaritifera*) as a qualifying Annex II species for the Slaney River Valley SAC is currently under review. The outcome of this review will determine whether a site-specific conservation objective is set for this species	(NPWS, 2011a)	Freshwater peal mussel *Margaritifera margaritifera* [1029]	Risk of disturbance or displacement to host species (Atlantic salmon)
		To restore the favourable conservation condition of Sea lamprey in the Slaney River Valley SAC, which is defined by the following list of attributes and targets: **Distribution: extent of anadromy** - Greater than 75% of main stem length of rivers accessible from estuary; **Population structure of juveniles** - At least three age/size groups present; **Juvenile density in fine sediment** - Juvenile density at least 1/m²; **Extent and distribution of spawning habitat** - No decline in extent and distribution of spawning beds; and **Availability of juvenile habitat** - More than 50% of sample sites positive.		Sea lamprey *Petromyzon marinus* [1095]	Underwater noise and EMF

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		To restore the favourable conservation condition of River lamprey in the Slaney River Valley SAC, which is defined by the following list of attributes and targets: **Distribution -** Access to all water courses down to first order streams; **Population structure of juveniles -** At least three age/size groups of river/brook lamprey present; **Juvenile density in fine sediment** - Mean catchment juvenile density of brook/river lamprey at least 2/m²; **Extent and distribution of spawning habitat** - No decline in extent and distribution of spawning beds; and **Availability of juvenile habitat** - More than 50% of sample sites positive		River lamprey *Lampetra fluviatilis* [1099]	Underwater noise and EMF
		To restore the favourable conservation condition of Twaite shad in the Slaney River Valley SAC, which is defined by the following list of attributes and targets: **Distribution: extent of anadromy** - Greater than 75% of main stem length of rivers accessible from estuary; **Population structure: age classes** - More than one age class present; **Extent and distribution of spawning habitat** - No decline in extent and distribution of spawning habitats; **Water quality: oxygen levels** - No lower than 5 mg/l; and **Spawning habitat quality: Filamentous algae; macrophytes; sediment** - Maintain stable gravel		Twaite shad *Alosa fallax* [1103]	Underwater noise and EMF

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		substrate with very little fine material, free of filamentous algal (macroalgae) growth and macrophyte (rooted higher plants) growth.			
		To restore the favourable conservation condition of Salmon in the Slaney River Valley SAC, which is defined by the following list of attributes and targets: **Distribution: extent of anadromy -** 100% of river channels down to second order accessible from estuary; **Adult spawning fish -** Conservation limit (CL) for each system consistently exceeded; **Salmon fry abundance -** Maintain or exceed 0+ fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry/5 minutes sampling; **Out-migrating smolt abundance** - No significant decline; **Number and distribution of redds -** No decline in number and distribution of spawning redds due to anthropogenic causes; and **Water quality -** At least Q4 at all sites sampled by EPA.		Salmon *Salmo salar* [1106]	Underwater noise and EMF
		To restore the favourable conservation condition of harbour seal in the Slaney River Valley SAC, which is defined by the following list of attributes and targets: **Access to suitable habitat -** Species range within the site should not be restricted by artificial barriers to site use; **Breeding behaviour -** The breeding sites should be maintained in a natural condition;		Harbour seal *Phoca vitulina* [1365]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Moulting behaviour - The moult haul-out sites should be maintained in a natural condition; **Resting behaviour -** The resting haul-out sites should be maintained in a natural condition; and **Disturbance -** Human activities should occur at levels that do not adversely affect the harbour seal population at the site.			Collision Risk, Accidental pollution Changes in prey
Cahore Polders and Dunes SAC	18.19	To restore the favourable conservation condition of Embryonic shifting dunes in Cahore Polders and Dunes SAC, which is defined by the following list of attributes and targets: **Habitat area -** Area stable or increasing, subject to natural processes, including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply -** Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation composition: plant health of foredune grasses -** More than 95% of sand couch grass (*Elytrigia juncea*) and/or lyme-grass (*Leymus arenarius*) should be healthy (i.e., green plant parts above ground and flowering heads present); **Vegetation composition: typical species and subcommunities** - Maintain the presence of species-poor communities with typical species: sand	(NPWS, 2016)	Embryonic shifting dunes [2110]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		couch grass (Elytrigia juncea) and/or lyme-grass (Leymus arenarius); and **Vegetation composition: negative indicator species -** Negative indicator species (including non-native species) to represent less than 5% cover.			
		To restore the favourable conservation condition of Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) in Cahore Polders and Dunes SAC, which is defined by the following list of attributes and targets: **Habitat area -** Area stable or increasing, subject to natural processes, including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply** - Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation composition: plant health of foredune grasses** - More than 95% of sand couch grass (*Elytrigia juncea*) and/or lyme-grass (*Leymus arenarius*) should be healthy (i.e., green plant parts above ground and flowering heads present); **Vegetation composition: typical species and subcommunities -** Maintain the presence of species-poor communities with typical species: sand		Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		couch grass (*Elytrigia juncea*) and/or lyme-grass (*Leymus arenarius*); and **Vegetation composition: negative indicator species -** Negative indicator species (including non-native species) to represent less than 5% cover.			
		To restore the favourable conservation condition of Fixed coastal dunes with herbaceous vegetation (grey dunes)* in Cahore Polders and Dunes SAC, which is defined by the following list of attributes and targets: **Habitat area -** Area stable or increasing, subject to natural processes, including erosion and succession; **Habitat distribution** - No decline or change in habitat distribution, subject to natural processes; **Physical structure: functionality and sediment supply -** Maintain the natural circulation of sediment and organic matter, without any physical obstructions; **Vegetation structure: zonation** - Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession; **Vegetation structure: bare ground -** Bare ground should not exceed 10% of fixed dune habitat, subject to natural processes; **Vegetation structure: sward height -** Maintain structural variation within sward; **Vegetation composition**: typical species and subcommunities - Maintain range of subcommunities with typical Species; and		Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Vegetation composition: negative indicator species – Negative indicator species (including non-native species) to represent less than 5% cover.			
		No conservation objectives available.		Humid dune slacks [2190]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution
Blackwater Bank SAC	19.76	To maintain the favourable conservation condition of Sandbanks which are slightly covered by sea water all the time in Blackwater Bank SAC, which is defined by the following list of attributes and targets: **Habitat area –** The permanent habitat area is stable or increasing, subject to natural processes; **Habitat distribution –** The distribution of sandbanks is stable or increasing, subject to natural processes; and **Community distribution –** Conserve the following community type in a natural condition: Sand with *Nephtys* and *Bathyporeia elegans* community complex.	(NPWS, 2023)	Sandbanks which are slightly covered by sea water all the time [1110]	Elevated levels of suspended sediment concentrations and associated sediment deposition, Accidental pollution
		No conservation objectives available for this feature at this time. Assessment will be based upon the COs of the closest designated site with the same qualifying feature that has COs, within the same population community (MU).		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
					Collision Risk, Accidental pollution, EMF, Changes in prey
Rockabill to Dalkey Island SAC	70.39	To maintain the favourable conservation condition of harbour porpoise in Rockabill to Dalkey Island SAC, which is defined by the following list of attributes and targets: **Access to suitable habitat -** Species range within the site should not be restricted by artificial barriers to site use; and **Disturbance -** Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.	(NPWS, 2013c)	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Codling Fault Zone SAC	63.31	No conservation objectives available for this feature at this time. Assessment will be based upon the COs of the closest designated site with the same qualifying feature that has COs, within the same population community (MU).	N/A	Harbour porpoise *Phocoena phocoena* [1351	Underwater noise, Underwater noise from UXO clearance,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
					Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
West Wales Marine / Gorllewin Cymru Forol SAC (UK)	93.50	To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour Porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that: **harbour porpoise is a viable component of the site** - The intent of this objective is to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site; **There is no significant disturbance of the species** - operations within or affecting the site should be managed to ensure that the animals' potential usage of the site is maintained; and **The condition of supporting habitats and processes, and the availability of prey is maintained** - The maintenance of supporting habitats	(NRW, 2016)	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site.			
River Barrow and River Nore SAC	109.60	The status of the freshwater pearl mussel (*Margaritifera margaritifera*) as a qualifying Annex II species for the River Barrow and River Nore SAC is currently under review. The outcome of this review will determine whether a site-specific conservation objective is set for this species. Please note that the Nore freshwater pearl mussel (*Margaritifera durrovensis*) remains a qualifying species for this SAC. This document contains a conservation objective for the latter species.	(NPWS, 2011b)	Freshwater peal mussel *Margaritifera margaritifera* [1029]	Risk of disturbance or displacement to host species (Atlantic salmon)
		To restore the favourable conservation condition of Sea lamprey in the River Barrow and River Nore SAC, which is defined by the following list of attributes and targets: **Distribution: extent of anadromy** - Greater than 75% of main stem length of rivers accessible from estuary; **Population structure of juveniles** - At least three age/size groups present; **Juvenile density in fine sediment** - Juvenile density at least 1/m²; **Extent and distribution of spawning habitat** - No decline in extent and distribution of spawning beds; and **Availability of juvenile habitat** - More than 50% of sample sites positive.		Sea lamprey *Petromyzon marinus* [1095]	Underwater noise and EMF

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		To restore the favourable conservation condition of River lamprey in the River Barrow and River Nore SAC, which is defined by the following list of attributes and targets: **Distribution -** Access to all water courses down to first order streams; **Population structure of juveniles -** At least three age/size groups of river/brook lamprey present; **Juvenile density in fine sediment** - Mean catchment juvenile density of brook/river lamprey at least 2/m²; **Extent and distribution of spawning habitat** - No decline in extent and distribution of spawning beds; and **Availability of juvenile habitat** - More than 50% of sample sites positive.		River lamprey *Lampetra fluviatilis* [1099]	Underwater noise and EMF
		To restore the favourable conservation condition of Twaite shad in the River Barrow and River Nore SAC, which is defined by the following list of attributes and targets: **Distribution: extent of anadromy** - Greater than 75% of main stem length of rivers accessible from estuary; **Population structure: age classes** - More than one age class present; **Extent and distribution of spawning habitat** - No decline in extent and distribution of spawning habitats; **Water quality: oxygen levels** - No lower than 5 mg/l; and		Twaite shad *Alosa fallax* [1103]	Underwater noise and EMF

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Spawning habitat quality: Filamentous algae; macrophytes; sediment - Maintain stable gravel substrate with very little fine material, free of filamentous algal (macroalgae) growth and macrophyte (rooted higher plants) growth.			
		To restore the favourable conservation condition of Salmon in the River Barrow and River Nore SAC, which is defined by the following list of attributes and targets: **Distribution: extent of anadromy -** 100% of river channels down to second order accessible from estuary; **Adult spawning fish -** Conservation limit (CL) for each system consistently exceeded; **Salmon fry abundance -** Maintain or exceed 0+ fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry/5 minutes sampling; **Out-migrating smolt abundance** - No significant decline; **Number and distribution of redds -** No decline in number and distribution of spawning redds due to anthropogenic causes; and **Water quality -** At least Q4 at all sites sampled by EPA.		Salmon *Salmo salar* [1106]	Underwater noise and EMF
North Anglesey Marine / Gogledd Môn Forol SAC (UK)	114.17	To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour Porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that:	(NRW, 2019)	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		harbour porpoise is a viable component of the site - The intent of this objective is to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site; **There is no significant disturbance of the species** - operations within or affecting the site should be managed to ensure that the animals' potential usage of the site is maintained; and **The condition of supporting habitats and processes, and the availability of prey is maintained** - The maintenance of supporting habitats and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site.			Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Lambay Island SAC	62.87	To maintain the favourable conservation condition of grey seal in Lambay Island SAC, which is defined by the following list of attributes and targets: **Access to suitable habitat** - Species range within the site should not be restricted by artificial barriers to site use; **Breeding behaviour** - The breeding sites should be maintained in a natural condition; **Moulting behaviour** - The moult haul-out sites should be maintained in natural condition; **Resting behaviour** - The resting haul-out sites should be maintained in a natural condition; **Population composition** - The grey seal population occurring within this site should contain adult, juvenile and pup cohorts annually; and	(NPWS, 2013b)	Grey seal *Halichoerus grypus* [1364]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, Changes in prey

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Disturbance - Human activities should occur at levels that do not adversely affect the grey seal population.			
		No conservation objectives available for this feature at this time. Assessment will be based upon the COs of the closest designated site with the same qualifying feature that has COs, within the same population community (MU).		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Saltee Islands SAC	90.70	To maintain the favourable conservation condition of grey seal in the Saltee Islands SAC, which is defined by the following list of attributes and targets: **Access to suitable habitat** - Species range within the site should not be restricted by artificial barriers to site use; **Breeding behaviour** - The breeding sites should be maintained in a natural condition; **Moulting behaviour** - The moult haul-out sites should be maintained in natural condition;	(NPWS, 2011c)	Grey seal *Halichoerus grypus* [1364]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Resting behaviour - The resting haul-out sites should be maintained in a natural condition; **Population composition** - The grey seal population occurring within this site should contain adult, juvenile and pup cohorts annually; and **Disturbance** - Human activities should occur at levels that do not adversely affect the grey seal population.			Accidental pollution, Changes in prey
Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC (UK)	73.32	To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status. **Populations –** The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements include: • population size; • structure, production; and • condition of the species within the site. **Range** – The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; **Supporting habitats and species** – The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include; • distribution;	(NRW, 2018a)	Grey seal *Halichoerus grypus* [1364]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, Changes in prey
				Bottlenose dolphin *Tursiops truncatus* [1349]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		• extent; • structure; • function and quality of habitat; and • prey availability and quality. **Restoration and recovery** – As part of this objective it should be noted that for the bottlenose dolphin and otter, populations should be increasing.			Collision Risk, Accidental pollution, EMF, Changes in prey
Carnsore Point SAC	73.83	No conservation objectives available for this feature at this time. Assessment will be based upon the COs of the closest designated site with the same qualifying feature that has COs, within the same population community (MU).	N/A	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Lower River Suir SAC	126.51	To restore the favourable conservation condition of Freshwater Pearl Mussel in Lower River Suir SAC, which is defined by the following list of attributes and targets:	(NPWS, 2017d)	Freshwater peal mussel *Margaritifera margaritifera* [1029]	Risk of disturbance or displacement to host species (Atlantic salmon)

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Distribution - Restore distribution to 10.4 km; **Population size** - Restore population to at least 10,000 adult mussels; **Population structure: recruitment** - Restore to at least 20% of each population no more than 65 mm in length; and at least 5% of each population no more than 30 mm in length; **Population structure: adult mortality** - No more than 5% decline from previous number of live adults counted; dead shells less than 1% of the adult population and scattered in distribution; **Suitable habitat: extent** - Restore suitable habitat in more than 8.8 km in the Clodiagh system and any additional stretches necessary for salmonid spawning; **Suitable habitat: condition** - Restore condition of suitable habitat; **Water quality: macroinvertebrate and phytobenthos (diatoms)** - Restore water quality - macroinvertebrates: EQR greater than 0.90 (Q4-5 or Q5); phytobenthos: EQR greater than 0.93; **Substratum quality: filamentous algae (macroalgae); macrophytes (rooted higher plants)** - Restore substratum quality - filamentous algae: absent or trace (less than 5%); macrophytes: absent or trace (less than 5%); **Substratum quality: sediment** - Restore substratum quality - stable cobble and gravel substrate with very little fine material; no artificially elevated levels of fine sediment;			

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Substratum quality: oxygen availability - Restore to no more than 20% decline from water column to 5 cm depth in substrate; **Hydrological regime: flow variability** - Maintain appropriate hydrological regime; **Host fish** - Maintain sufficient juvenile salmonids to host glochidial larvae; and **Fringing habitat: area and condition** - Restore the area and condition of fringing habitats necessary to support the population.			
		To restore the favourable conservation condition of Sea Lamprey in Lower River Suir SAC, which is defined by the following list of attributes and targets: **Distribution: extent of anadromy** - Greater than 75% of main stem length of rivers accessible from estuary; **Population structure of juveniles** - At least three age/size groups present; **Juvenile density in fine sediment** - Juvenile density at least 1/m²; **Extent and distribution of spawning habitat** - No decline in extent and distribution of spawning beds; and **Availability of juvenile habitat** - More than 50% of sample sites positive.		Sea lamprey *Petromyzon marinus* [1095]	Underwater noise and EMF
		To restore the favourable conservation condition of River Lamprey in Lower River Suir SAC, which is defined by the following list of attributes and targets: **Distribution -** Access to all water courses down to first order streams;		River lamprey *Lampetra fluviatilis* [1099]	Underwater noise and EMF

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Population structure of juveniles - At least three age/size groups of river/brook lamprey present; **Juvenile density in fine sediment** - Mean catchment juvenile density of brook/river lamprey at least 2/m²; **Extent and distribution of spawning habitat** - No decline in extent and distribution of spawning beds; and **Availability of juvenile habitat** - More than 50% of sample sites positive.			
		To restore the favourable conservation condition of Twaite Shad in Lower River Suir SAC, which is defined by the following list of attributes and targets: **Distribution: extent of anadromy** - Greater than 75% of main stem length of rivers accessible from estuary; **Population structure: age classes** - More than one age class present; **Extent and distribution of spawning habitat** - No decline in extent and distribution of spawning habitats; **Water quality: oxygen levels** - No lower than 5 mg/l; and **Spawning habitat quality: Filamentous algae; macrophytes; sediment** - Maintain stable gravel substrate with very little fine material, free of filamentous algal (macroalgae) growth and macrophyte (rooted higher plants) growth.		Twaite shad *Alosa fallax* [1103]	Underwater noise and EMF

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		To restore the favourable conservation condition of Atlantic Salmon in Lower River Suir SAC, which is defined by the following list of attributes and targets: **Distribution: extent of anadromy** - 100% of river channels down to second order accessible from estuary; **Adult spawning fish -** Conservation limit (CL) for each system consistently exceeded; **Salmon fry abundance -** Maintain or exceed 0+ fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry/5 minutes sampling; **Out-migrating smolt abundance** - No significant decline; **Number and distribution of redds -** No decline in number and distribution of spawning redds due to anthropogenic causes; and **Water quality -** At least Q4 at all sites sampled by EPA.		Salmon *Salmo salar* [1106]	Underwater noise and EMF

Cardigan Bay / Bae Ceredigion SAC (UK)	82.73	To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status. **Populations -** The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements include: • population size; • structure, production; and • condition of the species within the site. **Range** - The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; **Supporting habitats and species** - The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include; • distribution; • extent; • structure; • function and quality of habitat; and • prey availability and quality. **Restoration and recovery** - As part of this objective it should be noted that for the bottlenose dolphin and otter, populations should be increasing.	(NRW, 2018b)	Bottlenose dolphin *Tursiops truncatus* [1349] Grey seal *Halichoerus grypus* [1364]	Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF (only bottlenose dolphin), Changes in prey
River Boyne and River Blackwater SAC	99.86	To restore the favourable conservation condition of River Lamprey (*Lampetra fluviatilis*) in River Boyne and River Blackwater SAC, which is defined by the following list of attributes and targets: **Distribution -** Restore access to all water courses down to first order streams;	NPWS (2021b)	River Lamprey *Lampetra fluviatilis* [1099]	Risk of disturbance or displacement

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Distribution of larvae - Not less than 50% of sample sites with suitable habitat positive for larval brook/river lamprey; **Population structure of larvae -** At least three age/size classes of larval brook/river lamprey present; **Larval lamprey density in fine sediment -** Mean density of brook/river larval lamprey in sites with suitable habitat more than 5/m²; and **Extent and distribution of spawning nursery habitat -** No decline in extent and distribution of spawning and nursery beds.			
		To restore the favourable conservation condition of Atlantic Salmon (*Salmo salar*) in River Boyne and River Blackwater SAC, which is defined by the following list of attributes and targets: **Distribution: extent of anadromy -** 100% of river channels down to second order accessible from estuary; **Adult spawning fish -** Conservation limit (CL) for each system consistently exceeded; **Salmon fry abundance -** Maintain or exceed 0+ fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry/5 minutes sampling; **Out-migrating smolt abundance** - No significant decline; **Number and distribution of redds -** No decline in number and distribution of spawning redds due to anthropogenic causes; and **Water quality -** At least Q4 at all sites sampled by Environmental Protection Agency (EPA).		Salmon *Salmo salar* [1106]	Risk of disturbance or displacement

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
Hook Head SAC	109.9	No conservation objectives available for this feature at this time. Assessment will be based upon the COs of the closest designated site with the same qualifying feature that has COs, within the same population community (MU).	N/A	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
		No conservation objectives available for this feature at this time. Assessment will be based upon the COs of the closest designated site with the same qualifying feature that has COs, within the same population community (MU).		Bottlenose dolphin *Tursiops truncatus* [1349]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
					Changes in prey
Bristol Channel Approaches / Dynesfeydd Môr Hafren SAC (UK)	214.68	To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in UK waters: **harbour porpoise is a viable component of the site -** The intent of this objective is to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site; **There is no significant disturbance of the species -** Operations within or affecting the site should be managed to ensure that the animals' potential usage of the site is maintained; and **The condition of supporting habitats and processes, and the availability of prey is maintained -** The maintenance of supporting habitats and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site.	(JNCC, 2019a)	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
North Channel SAC (UK)	194.53	To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in UK waters: **harbour porpoise is a viable component of the site -** The intent of this objective is to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site;	(JNCC, 2019b)	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		There is no significant disturbance of the species - Operations within or affecting the site should be managed to ensure that the animals' potential usage of the site is maintained; and **The condition of supporting habitats and processes, and the availability of prey is maintained** - The maintenance of supporting habitats and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site.			Collision Risk, Accidental pollution, EMF, Changes in prey
Roaringwater Bay and Islands SAC	310.71	To maintain the favourable conservation condition of harbour Porpoise in Roaringwater Bay and Islands SAC, which is defined by the following list of attributes and targets: **Access to suitable habitat** - Species range within the site should not be restricted by artificial barriers to site use; and **Disturbance** - Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.	(NPWS, 2011d)	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Blasket Islands SAC	425.35	To maintain the favourable conservation condition of harbour porpoise in Blasket Islands SAC, which is defined by the following list of attributes and targets:	(NPWS, 2014a)	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Access to suitable habitat – Species range within the site should not be restricted by artificial barriers to site use; and **Disturbance** – Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.			Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Kenmare River SAC	371.44	No conservation objectives available for this feature at this time. Assessment will be based upon the COs of the closest designated site with the same qualifying feature that has COs, within the same population community (MU).	N/A	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
Nord Bretagne DH SAC (FR)	487.83	As the site specific conservation objectives (SSCOs) for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Récifs et landes de la Hague (FR) SAC	591.00	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
					Changes in prey
Cote de Granit Rose-Sept Iles SAC (FR)	509.47	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Anse de Vauville (FR) SAC	591.23	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
					Accidental pollution, EMF, Changes in prey
Mers Celtiques - Talus du golfe de Gascogne (FR) SAC	610.35	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Tregor Goëlo (FR) SAC	541.79	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Conservation Status (FCS) for harbour porpoise in EU waters.			Collision Risk, Accidental pollution, EMF, Changes in prey
Banc et récifs de Surtainville (FR) SAC	597.06	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Baie de Morlaix (FR) SAC	505.31	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**			Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Ouessant-Molène (FR) SAC	502.42	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
Belgica Mound Province SAC	465.83	No conservation objectives available for this feature at this time. Assessment will be based upon the COs of the closest designated site with the same qualifying feature that has COs, within the same population community (MU).	N/A	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Cap d'Erquy-Cap Fréhel (FR) SAC	594.22	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
					Changes in prey
Chausey (FR) SAC	622.23	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Abers - Côtes des legends (FR) SAC	486.66	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
					Accidental pollution, EMF, Changes in prey
Côtes de Crozon (FR) SAC	531.45	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Baie de Saint-Brieuc – Est (FR) SAC	588.78	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
		Conservation Status (FCS) for harbour porpoise in EU waters.			Collision Risk, Accidental pollution, EMF, Changes in prey
Chaussée de Sein (FR) SAC	543.15	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Baie de Lancieux, Baie de l'Arguenon, Archipel de	612.40	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
Saint Malo et Dinard (FR) SAC		follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**			Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Baie du Mont Saint-Michel (FR) SAC	641.16	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same QIs, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
Estuaire de la Rance (FR) SAC	629.00	As SSCOs for this site are unavailable, it is assumed that the COs are similar to other UK sites with the same Qis, for example, North Anglesey Marine / Gogledd Môn Forol SAC and West Wales Marine/ Gorllewin Cymru Forol. The overall SSCO is as follows: **To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in EU waters.**		Harbour porpoise Phocoena phocoena [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Bunduff Lough and Machair / Trawalua / Mullaghmore SAC	536.88	No conservation objectives available for this feature at this time. Assessment will be based upon the COs of the closest designated site with the same qualifying feature that has COs, within the same population community (MU).	N/A	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
					Changes in prey
Inishmore Island SAC	549.28	No conservation objectives available for this feature at this time. Assessment will be based upon the COs of the closest designated site with the same qualifying feature that has COs, within the same population community (MU).	N/A	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey
Kilkieran Bay and Islands SAC	562.75	No conservation objectives available for this feature at this time. Assessment will be based upon the COs of the closest designated site with the same qualifying feature that has COs, within the same population community (MU).	N/A	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk,

Site Name	Distance of European site from closest point of the Proposed Development (km)	Conservation Objectives	Reference	Qualifying Interests (QI)s	Potential Impacts Screened In
					Accidental pollution, EMF, Changes in prey
West Connacht Coast SAC	605.46	No conservation objectives available for this feature at this time. Assessment will be based upon the COs of the closest designated site with the same qualifying feature that has COs, within the same population community (MU).	N/A	Harbour porpoise *Phocoena phocoena* [1351]	Underwater noise, Underwater noise from UXO clearance, Underwater noise from other activities, Collision Risk, Accidental pollution, EMF, Changes in prey

5.2 Summary of Stage 1 Screening Assessment for SPAs

5.2.1.1 From the findings of the screening stage appraisal presented (Volume I, Supporting Information for Screening for Appropriate Assessment Report), the possibility of Likely Significant Effects could not be excluded for the following SPAs and their QIs at the screening stage (Table 5.2), in the absence of further evaluation and analysis and/or mitigation measures.

Table 5.2: SPAs and their Special Conservation Interest considered in this NIS where Likely Significant Effect could not be excluded at the screening stage

Site Name	Distance of European site from the Proposed Development (km)	Conservation Objectives	Qualifying Interest (QI)	Why?	Reference
Wicklow Head SPA	5.3	**To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:** **The favourable conservation status of a species is achieved when:** • Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats; • The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and • There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.	Kittiwake	Risk of collision	NPWS. 2022a 12/10/2022
Howth Head Coast SPA	48.6	**To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:** **The favourable conservation status of a species is achieved when:** • Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats; • The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and • There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.	Kittiwake	Risk of collision	NPWS, 2022b 12/10/2022
Ireland's Eye SPA	52.8	**To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:**	Guillemot	Risk of displacement	NPWS, 2022c 12/10/2022
			Herring gull	Risk of collision	

Site Name	Distance of European site from the Proposed Development (km)	Conservation Objectives	Qualifying Interest (QI)	Why?	Reference
		The favourable conservation status of a species is achieved when: • Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats; • The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and • There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.	Kittiwake	Risk of collision	
			Razorbill	Risk of displacement	
Lambay Island SPA	61.6	**To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:** **The favourable conservation status of a species is achieved when:** • Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats; • The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and • There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.	Guillemot	Risk of displacement	NPWS, 2022d 12/10/2022
			Herring gull	Risk of collision	
			Kittiwake	Risk of collision	
			Lesser black-backed gull	Risk of collision	
			Puffin	Risk of displacement	
			Razorbill	Risk of displacement	
Saltee Island SPA	70.4	To maintain the favourable conservation condition of Gannet in the Saltee Islands SPA, which is defined by the following list of attributes and targets: **No significant decline:** • Breeding population abundance: apparently occupied nests (AONs);	Gannet	Risk of collision	NPWS, 2011c 21/10/2011

Site Name	Distance of European site from the Proposed Development (km)	Conservation Objectives	Qualifying Interest (QI)	Why?	Reference
		• Productivity rate; • Distribution: breeding colonies; • Prey biomass available; **No significant increase:** • Barriers to connectivity; • Disturbance at the breeding site; and • Disturbance at marine areas immediately adjacent to the colony.			
		To maintain the favourable conservation condition of Guillemot in the Saltee Islands SPA, which is defined by the following list of attributes and targets: **No significant decline:** • Breeding population abundance: individual adult; • Productivity rate; • Distribution: breeding colonies; • Prey biomass available; **No significant increase:** • Barriers to connectivity; • Disturbance at the breeding site; and • Disturbance at marine areas immediately adjacent to the colony.”	Guillemot	Risk of displacement	
		To maintain the favourable conservation condition of Herring Gull in the Saltee Islands SPA, which is defined by the following list of attributes and targets: **No significant decline:** • Productivity rate; • Distribution: breeding colonies; • Prey biomass available; **No significant increase:** • Productivity rate; and	Herring gull	Risk of collision	

Site Name	Distance of European site from the Proposed Development (km)	Conservation Objectives	Qualifying Interest (QI)	Why?	Reference
		• Distribution: breeding colonies.			
		To maintain the favourable conservation condition of Kittiwake in the Saltee Islands SPA, which is defined by the following list of attributes and targets: **No significant decline:** • Breeding population abundance: apparently occupied nests (AONs); • Productivity rate; • Distribution: breeding colonies; and • Prey biomass available. **No significant increase:** • Barriers to connectivity; and • Disturbance at the breeding site.	Kittiwake	Risk of collision	
		To maintain the favourable conservation condition of Lesser Black-backed Gull in the Saltee Islands SPA, which is defined by the following list of attributes and targets: **No significant decline:** • Breeding population abundance: apparently occupied nests (AONs); • Productivity rate; • Distribution: breeding colonies; and • Prey biomass available. **No significant increase:** • Barriers to connectivity; and • Disturbance at the breeding site.	Lesser black-backed gull	Risk of collision	
		To maintain the favourable conservation condition of Puffin in the Saltee Islands SPA, which is defined by the following list of attributes and targets:	Puffin	Risk of displacement	

Site Name	Distance of European site from the Proposed Development (km)	Conservation Objectives	Qualifying Interest (QI)	Why?	Reference
		No significant decline: • Breeding population abundance: apparently occupied burrow (AOB); Productivity rate; • Distribution: breeding colonies; and • Prey biomass available. **No significant increase:** • Barriers to connectivity; • Disturbance at the breeding site; and • Disturbance at marine areas immediately adjacent to the colony. **Absent or under control:** • Occurrence of mammalian predators.			
		To maintain the favourable conservation condition of Puffin in the Saltee Islands SPA, which is defined by the following list of attributes and targets: **No Significant decline:** • Breeding population abundance: individual adult; • Productivity rate; and • Distribution: breeding colonies. **No significant increase:** • Barriers to connectivity; • Disturbance at the breeding site; and • Disturbance at marine areas immediately adjacent to the colony.	Razorbill	Risk of displacement	
Skerries Island SPA	72	**To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:** **The favourable conservation status of a species is achieved when:**	Herring gull	Risk of collision	NPWS, 2022e 12/10/2022

Site Name	Distance of European site from the Proposed Development (km)	Conservation Objectives	Qualifying Interest (QI)	Why?	Reference
		• Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats; • The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and • There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.			

6 Stage 2 Information to Inform the Assessment Alone

6.1 Baseline information to inform Stage 2 AA for Annex I Coastal and Marine Habitat QIs

6.1.1.1 As outlined in Section 5.1, the following designated sites in Ireland have continued through the Stage 1 Screening Assessment to be assessed in Stage 2, as a likely significant effect could not be ruled out. These are presented in Figure 6.1.

- Wicklow Reef SAC – Reef;
- Magherabeg Dunes SAC – Sand dune habitats;
- Buckroney-Brittas Dunes and Fen SAC – Sand dune habitats;
- Kilpatrick Sandhills SAC – Sand dune habitats;
- The Murrough Wetlands SAC – Mediterranean salt meadows, Atlantic salt meadows;
- Cahore Polders and Dunes SAC – Sand dune habitats; and
- Blackwater Bank SAC – Sandbanks which are slightly covered by sea water all the time.

6.1.1.2 The Array Area and Cable Corridor and Working Area do not overlap with any of these designated sites, with the closest site being Wicklow Reef SAC at 3.61 km from the Proposed Development. The Stage 1 SISAA concluded that there was potential for LSE via habitat deterioration for sand dune habitats, Mediterranean salt meadows, Atlantic salt meadows, reefs and sandbanks which are slightly covered by sea water all the time.

6.1.1.3 Habitat deterioration can result from elevated concentrations of suspended sediment and elevated concentrations of contaminants both arising as a result of construction and maintenance activities.

6.1.1.4 Overall, the following impacts are therefore considered, with consideration of the COs of the qualifying interests of these SACs:

- Elevated concentration of suspended sediment from construction and maintenance activities; and
- Accidental pollution from construction and maintenance activities.

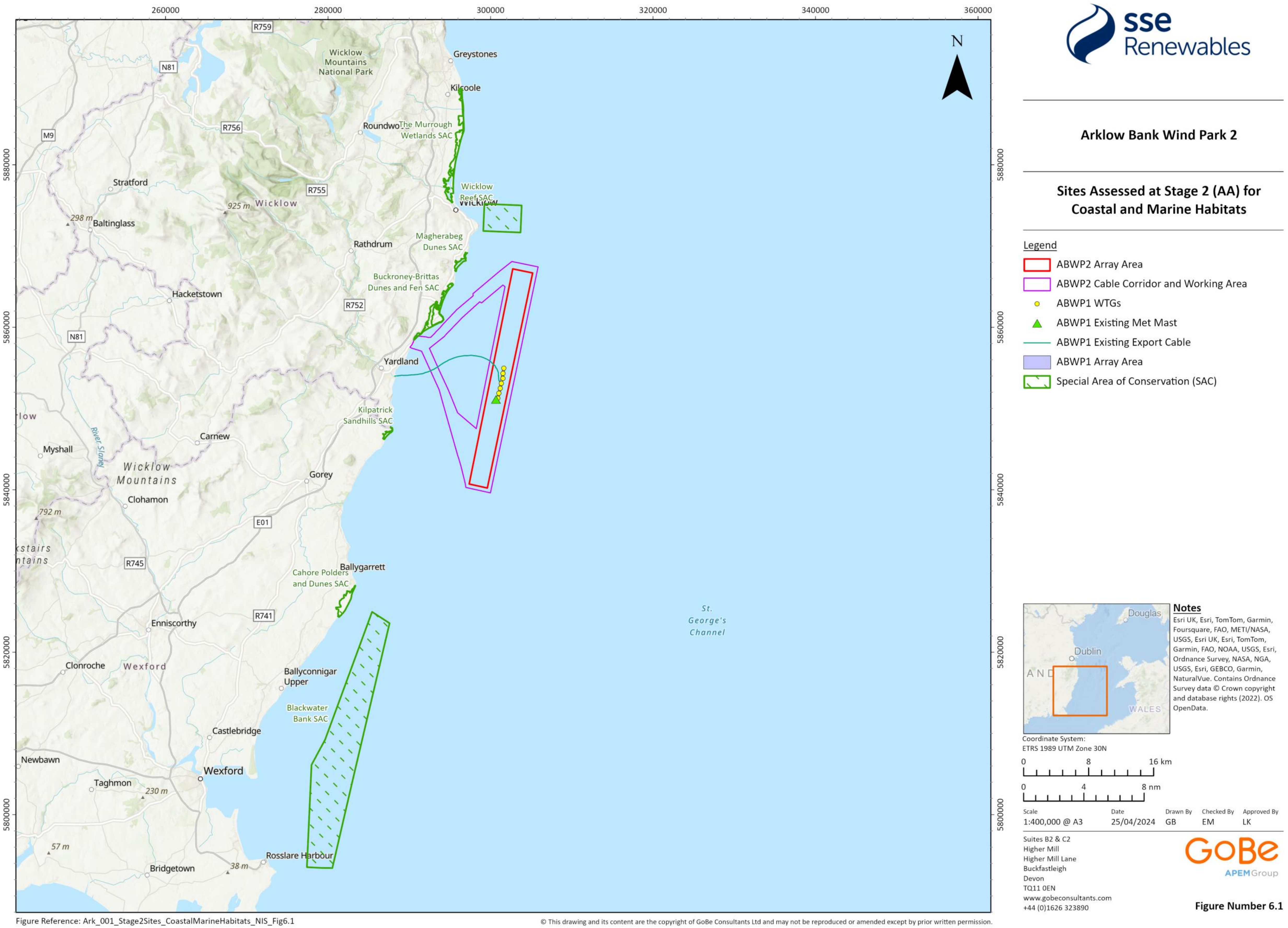

Figure 6.1: Sites assessed at Stage 2 AA for Coastal and Marine Habitats

6.1.2 Baseline Environment

Site-specific survey summary

6.1.2.1 Several benthic subtidal surveys have been conducted across the Benthic Subtidal and Intertidal Ecology Study Area between 2000 and 2021. These included pre-construction baseline surveys (prior to construction for the ABWP1 WTGs) undertaken in 2000 and 2001, a series of post-construction monitoring surveys undertaken over a period of eight years (2004 to 2011, inclusive) and a subtidal benthic ecology survey, conducted as part of the post-construction monitoring programme for ABWP1 in 2021. These site-specific monitoring surveys were focussed primarily on Arklow Bank and the area inshore, although some sampling was also undertaken to the east of Arklow Bank. In addition, site-specific geophysical surveys for ABWP2 were also undertaken across the Array Area and offshore export cable routes in 2019 and 2022. These data provide further characterisation information, including seabed feature and sediment types, which were considered alongside the ecological datasets.

6.1.2.2 An intertidal Phase I walkover survey and on-site dig-over sediment sampling of the landfall site, located to the south of Ennereilly Beach, was conducted in June 2019. The survey was conducted following guidance outlined in Davies *et al.* (2001) and Wyn *et al.* (2006), while habitats/biotopes were classified in accordance with Connor *et al.* (2004). For the purposes of this report, EUNIS codes have also been provided (EEA, 2019). The results of this survey have provided a robust and up-to date baseline characterisation of the benthic intertidal ecology study area to inform this assessment.

6.1.2.3 A summary of site-specific surveys undertaken to inform the Stage 2 appraisal on coastal and marine habitats is provided in Table 6.1.

Table 6.1: Summary of site-specific surveys undertaken for coastal and marine habitats

Data Source	Date(s) of survey	Survey Methodology
EcoServe (2001b) ABWP1 baseline survey	June 2000	Anchor dredge with large net mesh (infauna and PSA) – 21 stations.
	September 2000	Anchor dredge with large net mesh (infauna and PSA) – 19 stations; and Otter trawl (fish and epifauna) – 6 stations.
	April 2001	Anchor dredge with large net mesh (infauna and PSA) – 15 stations; and Agassiz trawl (fish and epifauna) – 3 stations.
HydroServ Projects Ltd. (2004). ABWP1 post-construction survey.	June/July 2004	Day grabs (infauna and PSA); and Beam trawls (epifauna).
HydroServ Projects Ltd (2005). ABWP1 post-construction survey.	October 2004	Anchor dredge with closed metal base (infauna and PSA); and Beam trawl (epifauna).
HydroServ Projects Ltd (2006a). ABWP1 post-construction survey.	June 2005	
HydroServ Projects Ltd (2006b). ABWP1 post-construction survey.	November 2005	
HydroServ Projects Ltd (2007a). ABWP1 post-construction survey.	June 2006	

Data Source	Date(s) of survey	Survey Methodology
HydroServ Projects Ltd (2007b). ABWP1 post-construction survey.	May 2007	
HydroServ Projects Ltd (2009). ABWP1 post-construction survey.	May 2008	
HydroServ Projects Ltd (2010). ABWP1 post-construction survey.	June 2009	
GE Wind Energy (2011). ABWP1 post-construction survey.	June 2010	
GE Wind Energy (2012). ABWP1 post-construction survey.	June 2011	
GE Wind Energy (2021). ABWP1 post-construction survey.	September 2021	
Aquafact International Services Ltd (2008) Proposed Dredge Disposal Sites for Arklow Harbour Commissioner.	June 2007	Divers using corers for benthic infauna, particle size analysis and organic carbon
Atalah *et al.* 2013. Diversity of demersal and megafaunal assemblages inhabiting sandbanks of the Irish Sea.	August 2007	Beam trawls (demersal fish and megafaunal invertebrates).
Aquatic Services Unit (2016). Sediment chemistry sampling to support dredge dumping as sea permit application for ABWP1	May 2016	Van Veen grabs for sediment chemistry.
RPS (2019). ABWP2 Intertidal Phase I walkover survey and on-site dig-over sediment sampling of the Landfall site.	June 2019	Phase I walkover survey and on-site digging
Ultrabeam Ltd. (2019) Site-specific geophysical surveys of the ABWP2 Array Area and offshore export cable routes.	July/August 2019	Multibeam echo sounder, sidescan sonar, sub-bottom profiler and magnetometre sampling
Green Rebel (2022) Site-specific geophysical and hydrographic surveys of the ABWP2 Array Area and offshore export cable routes.	August to November 2022	Sub-bottom profiler, Ultra High Resolution Survey (UHRS), sidescan sonar and magnetometre, multi-beam bathymetry and backscatter

Seabed Sediment

6.1.2.4 The results of the latest site-specific survey conducted in 2021 were in line with the findings from previous surveys, indicating that the seabed is predominately sedimentary with little or no fixed hard substrata (GW Wind Energy, 2021). Minor variations were observed in terms of sediment particle size at select locations between the current survey and previous surveys, which is related to the heterogenous nature of sediments across the site. The seabed on Arklow Bank consisted of slightly gravelly sand, with coarser gravelly sands characterising the eastern and western parts of the bank. To the north of Arklow Bank, the seabed varied, ranging from sand, gravelly sand and gravel. Seabed to the south of Arklow bank was predominately sandy with areas of gravel and mud.

6.1.2.5 Site-specific geophysical surveys of the Array Area conducted in 2019 indicate a boulder field near the northeast tip of Arklow Bank, sandwaves to the south, and sand habitat across the bank itself. Very small patches of course sediments were recorded near the central section along the western flank. Water depths across Arklow Bank were typically less than 20 m, with the deepest areas in the northeast (up to 43 m) and southeast of the Array Area (up to 35 m).

6.1.2.6 The 2022 site-specific geophysical survey of the Cable Corridor and Working Area found that the distribution of sediment across the cable routes show predominant facies of medium to coarse sands which coincide with the large presence of sandwaves, megaripples and sediment waves on the approach to Arklow Bank. Conversely, finer grained facies types such as sandy mud to clay are visible in troughs between sand wave crests. The water depths gradually increased offshore to a maximum depth of 35 m below Lowest Astronomical Tide (LAT) before decreasing at Arklow Bank.

Subtidal Benthic Ecology

6.1.2.7 The subtidal benthic ecology surveys indicated the presence of low diversity communities with little temporal variation. Results of the most recent site-specific survey conducted in 2021 recorded a total of 185 taxa (2,440 individuals) and 238 taxa (6,355 individuals) within beam trawls and anchor dredge samples, respectively. Overall, the number of taxa recorded within beam trawls and anchor dredge samples were in keeping with previous surveys and similar to those identified in surveys between 2007 and 2011.

6.1.2.8 Species diversity was highest within areas of sandy shell, gravel and cobbles in the northwest, southwest and southeast of Arklow Bank and inshore along the proposed offshore export cable route. The communities associated with sandy sediments were extremely species poor in comparison, as would be expected for the more mobile sandy sediments characterising a shallow sandbank. The most abundant species recorded during the 2021 survey were found to be broadly similar to the most abundant species in previous surveys. The species typically recorded were the reef-building worms *Sabellaria alveolata* and *Sabellaria spinulosa*; the polychaetes *Spirobranchus lamarcki, Dipolydora coeca, Serpulidae* spp. and *Scoloplos armiger*; the molluscs shiny button clam *Nucula nucleus*, wrinkled rock borer *Hiatella arctica* and white furrow shell *Abra alba;* the crustaceans wart barnacle *Verruca stroemia* and long clawed porcelain crab *Pisidia longicornis*; and the tunicates baked bean ascidian *Dendrodoa grossularia* and *Polycarpa fibrosa*. The assemblages and patterns recorded in the site-specific surveys reflect the desktop data, including observations made by Keegan *et al.* (1987) and more recent mapping by the EUSeaMap and Robinson *et al.* (2012).

Subtidal Sediment Contaminants

6.1.2.9 In May 2016, the Aquatic Services Unit (ASU) was commissioned to undertake sediment sampling and chemical analysis of sediments from three locations on Arklow Bank to support a permit application to undertake seabed levelling works along Arklow Bank. The seabed levelling was required to facilitate access for maintenance vessels for the existing ABWP1 WTGs, and the associated disposal of material. Levels of contaminants which included a suite of metals, organochlorines, polychlorinated biphenyls (PCBs), tributylin (TBT), dibutylin (DBT) and polycyclic aromatic hydrocarbons (PAHs) were typically low and below the respective lower Irish Action Levels (Cronin *et al.*, 2006). The exception being arsenic which was marginally elevated and exceeded the lower Irish Action Level at a single station, although consultation with the Marine Institute confirmed that this was acceptable for the material to be disposed of at sea (Ramboll Environ, 2016).

6.1.3 Avoidance through Design and Standard Project Environmental Protection Measures of the Proposed Development

6.1.3.1 The design of the Proposed Development is such that some potential impact can be avoided as seen by applying the design features and management measures relevant to Annex I coastal and marine habitats which are presented in Table 6.2.

Table 6.2: Project design and environmental protection measures relevant to Annex I coastal and marine habitats

Measure	Justification
Scour protection	In the absence of scour protection, there is potential for scour pits to develop around foundations. This may result in the release of sediment into the water column and a change to seabed habitat in the vicinity of the foundation.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339)	The Developer was granted a Foreshore Licence (FS007339) for Site Investigations (associated with the Proposed Development) from the Minister for Housing, Local Government and Heritage in May 2022. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339) being carried out. As such there is no temporal overlap between the activities consented in this Foreshore Licence and the Proposed Development and there will be no potential for cumulative effects.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried	The Developer submitted a Foreshore Licence Application for Site Surveys to the Minister for Housing, Local Government and Heritage in April 2023 (FS007555) and this application is pending determination. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried out. As such there is no temporal overlap between the activities proposed in the Foreshore Licence Application and the Proposed Development.
Impact avoidance/ reduction through design and engineering for Construction and Operational and Maintenance activities as detailed in Supporting Information for Screening for Appropriate Assessment Report	The construction activities including cable plans, techniques and burial depths are detailed in Volume II, Chapter 4. Operational and maintenance activities are also set out in Volume II, Chapter 4.
Impact avoidance/ reduction through Development of and adherence to a Rehabilitation Schedule (Volume III, Appendix 4.1).	The Rehabilitation Schedule outlines the measures associated with the decommissioning of the Proposed Development and Rehabilitation of the area which

Measure	Justification
	includes measures to reduce the risk of impact on coastal and marine habitats.
Impact avoidance/ reduction through Development of and implementation of an Environmental Management Plan (EMP) (Volume III, Appendix 25.1, Annex 2) and Marine Pollution Contingency Plan (MPCP) (Volume III, Appendix 25.1, Annex 2).	Ensures plans are in place to manage any marine pollution spills and including key emergency contact details.
Impact avoidance/ reduction through a Confirmatory Survey to be undertaken within the Array Area, Cable Corridor and Working Area to verify the presence/ absence of any areas of reef habitat and seed mussel beds.	Confirmatory surveys will include a geophysical survey carried out prior to construction which will confirm the location and extent of any potential areas of Annex I *Sabellaria* reef habitat which will then be ground truthed via underwater video (i.e. ROV). Any areas of Annex I *Sabellaria* reef habitat identified will be avoided via micro-routing and micro-siting of infrastructure. In addition, the presence of Annex I bedrock or stony reef and blue mussel beds will be identified and avoided via micro-routing and micro-siting.
Impact avoidance/ reduction through an Invasive Non-Indigenous Species Management Plan being implemented. (Volume III, Appendix 25.4).	The plan outlines measures to ensure vessels comply with the International Maritime Organisation (IMO) ballast water management guidelines, it will consider the origin of vessels and contain standard housekeeping measures for such vessels as well as measures to be adopted in the event that a high alert species is recorded.
Impact avoidance/ reduction through Environmental Monitoring Measures which are set out in SISAA, Section:4 Tables 4.27 to 4.33.	Volume II, Chapter 25: Summary of Factored in Measures, Mitigation and Monitoring sets out commitments to environmental monitoring in pre-, during and post-construction phases.
Impact avoidance/ reduction through post-installation cable burial surveys and periodic monitoring of cables.	Post-construction surveys to monitor the impacts of cable burial and cable protection on benthic ecology receptors to ensure that the cables do not move or require maintenance. If surveys determine that there is a fault or issue with the cables, maintenance will be carried out to ensure that the cables do not have an adverse impact on benthic ecology.

6.1.4 Impacts and Parameters Assessed

6.1.4.1 The Proposed Development has the potential to result in AEoI on Annex I coastal and marine habitats that are QIs for screened in European Sites and seen in Table 6.3.

Table 6.3: Project Design Options 1 and 2 considered for the assessment of potential impacts on Annex I coastal and marine habitats

Potential impact	Phase C	Phase O	Phase D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
Elevated levels suspended sediment concentrations and associated sediment deposition	✓	✓	✓	Project Design Option 1 **Construction phase:** Confirmatory surveys: • A suite of site (Array Area, Cable Corridor and Working Area) investigations will be undertaken to confirm on the seabed and geological conditions prior to the installation of the infrastructure. Complete details of the full suite of surveys proposed are provided in Section 4 of Volume I, Supporting Information for Screening for Appropriate Assessment Report. Those which are relevant to Increased suspended sediment concentrations and associated deposition are: Geotechnical survey: • Boreholes (131 samples); • CPT (431 samples); • Vibrocore/ gravity core (300 samples); and • grab samples (240 samples). Metocean survey: • Floating LiDAR (includes seabed anchor points); • Acoustic Doppler Current Profiler (ADCP) (deployed on a seabed frame and includes mooring structure); and • Wave buoy (includes seabed mooring). Sediment dynamics survey: • Benthic flume; • Benthic lander (ballasted structure which requires no mooring/ anchor). Site preparation:	Sediment disturbance arising from construction activities (e.g. site preparation, foundation installation (WTG and OSP) and cable installation (including trenchless techniques such as HDD)) may result in indirect impacts on benthic subtidal and intertidal communities as a result of temporary increases in suspended sediment concentrations (SSCs) and associated sediment deposition (i.e. smothering effects). Despite a larger number of WTGs required for Project Design Option 1 there is only anticipated to be a minimal difference in SSCs, therefore Project Design Option 1 and Option 2 are anticipated to have the same potential for elevated levels of suspended sediment concentrations and associated sediment deposition. Within the Operational and Management Phase, both Project Design Option 1 and 2 have the same level of potential impact. Sediment disturbance arising from decommissioning activities (e.g., removal of structures above the seabed) may result in indirect impacts on benthic subtidal and intertidal communities as a result of temporary increases in SSCs and associated sediment deposition (i.e. smothering effects). However, decommissioning would have a lesser degree of sediment disturbance in comparison to construction, and operational and maintenance phases as scour protection, cables and cable protection will be left

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		Site preparation activities prior to inter-array, interconnector, and offshore export cable installation to include sandwave clearance: • For inter-array cables, sandwaves will be cleared along a width of 70 m, to a depth of 10 m, along 30% of the inter-array cables length, a total volume of 1,000,000 m^3. • For export cables, sandwaves will be cleared along a width of 70 m, to a depth of 10 m, along 30% of the export cables length, a total volume of 500,000 m^3. • For OSP interconnector, sandwaves will be cleared along a width of 70 m, to a depth of 10 m, along 30% of the OSP interconnector length, a total volume of 500,000 m^3. • For scour protection, sandwaves will be cleared along a diametre of 99 m, to a depth of 10 m, along 50%, a total volume of 1,000,000 m^3. • For OSP/WTG installation, sandwaves will be cleared along a diametre of 100 m, to a depth of 5 m, at 20% of locations, a total volume of 139,200 m^3. Sandwave clearance has been modelled at representative locations across the Array Area and Cable Corridor and Working Area. Site preparation activities also include boulder clearance ploughing and picking of 100% of inter-array, export and interconnector cables at a width of 15 m and depth of 500 mm with a total seabed area of 2,850,000 m^2. Foundation installation: WTGs and OSPs installed on monopile foundations: • Drilled installation of 25 WTG piles 7-11 m in diameter at 0.2 – 1.0 m/h to full depth of 37 m. 1 concurrent drilling event with a drilling duration per pile of 88 hours and a total volume of approximately 132,000 m^3 of drill arisings. • Drilled installation of 2 OSP piles 7-14 m in diameter at 0.2 – 1.0 m/h to full depth of 45 m. 1 concurrent drilling event with a drilling duration per pile of 88 hours and a total volume of approximately 27,720 m^3 of drill arisings.	*in situ*. Project Design Option 1 and 2 will have the same level of potential impact.

Potential impact	Phase C	O	D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
				Modelled at representative locations across the Array Area. Potential refusal of monopiles during construction (where required). Volume of 4.474 m^3 per refusal and a total volume of 22,370 m^3 for a maximum of five refusals. <u>Cable installation:</u> • For inter-array cables, total length of 110 – 122 km with a seabed disturbance width of 15 m, with a total of 1,830,000 m^2 of seabed disturbance. • For export cable, total length of 35 - 40 km with a seabed disturbance width of 15 m with a total of 600,000 m^2 of seabed disturbance. • For interconnector, total length of 25-28 km with a seabed disturbance width of 15 m with a total of 420,000 m^2 of seabed disturbance. Modelled at representative locations across Array Area and Cable Corridor and Working Area. <u>Landfall works:</u> HDD drilling fluid release. Rate of release: 20 tonnes (per 24 hours)); and Period of release: 4.5 days (initial punch out followed by reaming phase). **Operational and maintenance phase** Cable repair and maintenance: Operational dredging of inter-array, export and interconnector cables: • For inter-array cables, operational dredging of 300,000 m^3 every five years; • For export cable and interconnector cables, operational dredging of 100,000 m^3 every five years; Inter-array, export and interconnector cable repair/reburial activities:	

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		• For inter-array cables, repair and reburial of cables between 110 km and 122 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 1.5 m deep trench (cable repair once every three years and cable re-burial once every three years). • For export cables, repair and reburial of cables between 30 km and 40 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 2.5 m deep trench (cable repair once every five years and cable re-burial once every five years). • Interconnector cables: repair and reburial of cables of between 25 km and 28 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 10 m deep trench (cable repair once every three years and cable re-burial once every three years). Jack-up Vessels: Presence of jack-up vessels during operational and maintenance activities: • Disturbance of 613,200 m^2 of seabed from jack-up barge across construction period. **Decommissioning phase** Piles will be cut 2 m below the seabed and lifted. Scour protection, cables and cable protection would be left *in situ*.	
		Project Design Option 2 **Construction Phase:** Confirmatory surveys: • A suite of site (Array Area, Cable Corridor and Working Area) investigations will be undertaken to confirm on the seabed and geological conditions prior to the installation of the infrastructure. Complete details of the full suite of surveys proposed are provided in Volume II, Chapter 4: Description of Development. Those which are relevant to Increased suspended sediment concentrations and associated deposition are: Geotechnical survey: • Boreholes (131 samples);	

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		• CPT (431 samples); • Vibrocore/ gravity core (300 samples); and • grab samples (240 samples). Metocean survey: • Floating LiDAR (includes seabed anchor points); • Acoustic Doppler Current Profiler (ADCP) (deployed on a seabed frame and includes mooring structure); and • Wave buoy (includes seabed mooring). Sediment dynamics survey: • Benthic flume; • Benthic lander (ballasted structure which requires no mooring/ anchor). Site preparation: Site preparation activities prior to inter-array, interconnector, and offshore export cable installation to include sandwave clearance: • For inter-array cables, sandwaves will be cleared along a width of 70 m, to a depth of 10 m, along 30% of the inter-array cables length, a total volume of 1,000,000 m^3. • For export cables, sandwaves will be cleared along a width of 70 m, to a depth of 10 m, along 30% of the export cables length, a total volume of 500,000 m^3. • For OSP interconnector, sandwaves will be cleared along a width of 70 m, to a depth of 10 m, along 30% of the OSP interconnector length, a total volume of 500,000 m^3. • For scour protection, sandwaves will be cleared along a diametre of 99 m, to a depth of 10 m, along 50%, a total volume of 1,000,000 m^3. • For OSP/WTG installation, sandwaves will be cleared along a diametre of 100 m, to a depth of 5 m, at 20% of locations, a total volume of 117,600 m^3. Sandwave clearance has been modelled at representative locations across the Array Area and Cable Corridor and Working Area.	

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		Site preparation activities also include boulder clearance ploughing and picking of 100% of inter-array, export and interconnector cables at a width of 15 m and depth of 500 Muir Mhòr, with a total seabed area of 2,850,000 m^2. Foundation installation: WTGs and OSPs installed on monopile foundations: • Drilled installation of 25 WTG piles 7-11 m in diametre at 0.2 – 1.0 m/h to full depth of 37 m. 1 concurrent drilling event with a drilling duration per pile of 88 hours and a total of approximately 176,000 m^3 of drill arisings. • Drilled installation of 2 OSP piles 7-14 m in diametre at 0.2 – 1.0 m/h to full depth of 45 m. 1 concurrent drilling event with a drilling duration per pile of 88 hours and total volume of approximately 27,720 m3 of drill arisings. Modelled at representative locations across the Array Area. Potential refusal of monopiles during construction (where required). Volume of 4,474 m^3 per refusal and a total volume of 22,370 m^3 for a maximum of 5 refusals. Cable installation: Installation of inter-array, export and interconnector cables: • For inter-array cables, total length of 110 – 122 km with a seabed disturbance width of 15 m with a total area of 1,830,000 m^2 of seabed disturbance. • For export cable, total length of 35 - 40 km with a seabed disturbance width of 15 m with a total areas of 600,000 m^2 of seabed disturbance. • For interconnector, total length of 25-28 km with a seabed disturbance width of 15 m with a total area of 420,000 m^2 of seabed disturbance. Modelled at representative locations across Array Area and Cable Corridor and Working Area	

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		Operational and maintenance phase Cable repair and maintenance: Operational dredging of inter-array, export and interconnector cables: • For inter-array cables, operational dredging of 300,000 m^3 every five years • For export cable and interconnector cables, operational dredging of 100,00 m^3 every five years Inter-array, export and interconnector cable repair/reburial activities. • For inter-array cables, repair and reburial of cables between 110 km and 122 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 1.5 m deep trench (cable repair and re-burial once every three years). • For export cables, repair and reburial of cables between 30 km and 40 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 2.5 m deep trench (cable repair once every five years and cable re-burial once every five years). • Interconnector cables: repair and reburial of cables of between 25 km and 28 km in length over the lifetime of the Proposed Development with disturbance of seabed material from 15 m wide and 10 m deep trench (cable repair and re-burial once every three years). Jack-up Vessels: Presence of jack-up vessels during operational and maintenance activities: • Disturbance of 613,200 m^2 of seabed from jack-up barge across construction period. **Decommissioning phase** Piles will be cut 2 m below the seabed and lifted. Scour protection, cables and cable protection would be left *in situ*.	

Potential impact	Phase C	O	D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
Accidental release of pollutants	✓	✓	✓	Project Design Option 1 **Construction Phase:** Foundation installation: • Installation of 56 WTGs and two OSPs within the Array Area. Cable installation: • Installation of inter-array cables between 110 – 122 km in length, OSP interconnector cables between 25 – 28 km in length, and offshore export cables between 35 – 40 km in length. Landfall: • Potential contamination of nearshore/intertidal habitats; Drilling mud (bentonite) used to facilitate the installation of offshore export cables via trenchless techniques i.e. HDD and Direct Pipe. Vessels: • 66 vessels on site at one time comprised of jack up barges, cargo, support, tug/anchor, cable installation, guard, survey, crew transfer, sandwave clearance and UXO clearance vessels. • 4,150 return trips across construction period and 1,797 return trips per year. • Construction schedule of 24 hours a day, 7 days a week for a period of 5 years. • 294 helicopter return trips over the construction phase and 118 helicopter return trips per year. **Operational and maintenance phase** Foundations: • Presence of 56 WTGs and two OSPs. • Maintenance activities of 56 WTGs and two OSPs.	Within the construction phase Project Design Option 1 consists of a larger number of foundations to be installed – 58 monopile foundations in total (56 for WTGs and 2 for OSPs), whilst Project Design Option 2 comprises of 49 foundations in total (47 for WTGs and 2 for OSPs). Other potential causes for the accidental release of pollutants are present however are the same within both Project Design Options. Therefore, Project Design Option 1 and Option 2 will have the same potential for accidental release of pollutants for construction. Within the Operational and Management Phase, both Project Design Option 1 and 2 have the same level of potential impact. Within the Decommissioning Phase Project Design Option 1 will result in the deconstruction and removal of all 56 WTGs and two OSPs whilst Project Design Option 2 consists of the deconstruction and complete removal of all 47 WTGs and two OSPs. Other potential causes for the accidental release of pollutants are present however are the same within both Project Design Options. Therefore, Project Design Option 1 and Option 2 will have the same potential for accidental release of pollutants for decommissioning.

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		Vessels: • 30 vessels on site at one time comprised of crew transfer, jack-up, cable repair, service operations, cable survey and excavator vessels. • 1,359 return trips per year. • 485 helicopter return trips per year. **Decommissioning phase** Foundations: • Decommissioning of 56 WTGs and two OSPs Vessels: • Presen and movement of vessels during the decommissioning phase (Volume III, Appendix 4.1: Rehabilitation Schedule).	
		Project Design Option 2 **Construction phase** Foundation installation: • Installation of 47 WTGs and two OSPs within the Array Area. Cable installation: • Installation of inter-array cables between 110 – 122 km in length, OSP interconnector cables between 25 – 28 km in length, and offshore export cables between 35 – 40 km in length. Vessels:	

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		• 66 vessels on site at one time comprised of jack up barges, cargo, support, tug/anchor, cable installation, guard, survey, crew transfer, sandwave clearance and UXO clearance vessels. • 4,150 return trips across construction period and 1,797 return trips per year. • Construction schedule of 24 hours a day, 7 days a week for a period of five years. • 294 helicopter return trips over the construction phase and 118 helicopter return trips per year. **Operational and maintenance phase** Foundations: • Presence of 47 WTGs and two OSPs. • Maintenance activities of 47 WTGs and two OSPs. Vessels: • 30 vessels on site at one time comprised of crew transfer, jack-up, cable repair, service operations, cable survey and excavator vessels. • 1,359 return trips per year. • 485 helicopter return trips per year. **Decommissioning phase** Foundations: • Decommissioning of 47 WTGs and two OSPs. Vessels: • Presence and movement of vessels during the decommission phase (Volume III, Appendix 4.1: Rehabilitation Schedule).	

6.2 Assessment of Proposed Development Alone for Coastal and Marine Habitat QIs

6.2.1 Overview

6.2.1.1 Increases of suspended sediments and associated sediment deposition are predicted to occur during the construction and decommissioning phases as a result of confirmatory surveys (Table 6.3), installation/removal of the foundations, sand wave clearance activities and installation of inter-array, interconnector and offshore export cables. Increases of suspended sediments and associated sediment deposition are also predicted to occur during the operational and maintenance phase due to inter-array, interconnector and offshore export cable repair and reburial events.

6.2.1.2 The Stage 1 SISAA (Volume I) concluded that in the absence of computational modelling and further specialist evaluation and analysis demonstrating the predicted extent of sediment plumes arising from construction stage activities then the risk of habitat deterioration as a result of interference with the sediment supply could not be excluded for Wicklow Reef SAC, Magherabeg Dunes SAC, Buckroney-Brittas Dunes and Fen SAC, Kilpatrick Sandhills SAC, The Murrough Wetlands SAC, Cahore Polder and Dunes SAC or Blackwater Bank SAC during the construction and decommissioning phases.

COASTAL PROCESSES MODELLING

6.2.1.3 Project Design Options 1 and 2 were applied to the assessment of effect to Annex I habitats, which considered those activities associated with cable and foundation installation which would result the greatest changes in suspended sediment concentrations (SSC) and associated sediment deposition. These activities included sand wave clearance prior to cable and foundation installation, trenching of inter-array, interconnector and offshore export cables and drilling of foundations. Any other installation methods would lead to lower increases in suspended sediments or sediment deposition. A summary of the scenarios which were subject to computational modelling for each of the installation activities are presented in Volume III, Appendix 6.1: Marine Physical Processes Numerical Modelling of the NIS.

6.2.1.4 Modelling of suspended sediment associated with sandwave clearance in the Array Area show SSC at a maximum of 2,000 mg/l within the first hour. However, after five hours the SSC is less than 2.5 mg/l. Disposal south of the Array Area initially results in a plume with SSC at a maximum of 2,000 mg/l, which after five hours is reduced down to less than 2.5 mg/l. Suspended sediments will largely be limited to the Array Area and to the area to the north and south of this (i.e. along the dominant tidal axis), with the resultant plume not extending beyond 8 km from the Array Area and Cable Corridor and Working Area under all tidal flow simulations (speeds and direction). For sediment deposition thicknesses between 100 mm and 500 mm are predicted to occur within 1 km of the disturbance event. At 10 km from the disturbance event sediment deposition is predicted to be 2.5 mm and beyond this sediment deposition becomes immeasurable.

6.2.1.5 Modelling of suspended sediment associated with sandwave clearance along the export cables show SSC at a maximum of 2,000 mg/l within the first hour. However, after four hours the SSC are less than 2.5 mg/l. Disposal south of the Array Area initially results in a plume with SSC at a maximum of 2,000 mg/l, which after five hours is reduced down to less than 5 mg/l. Suspended sediments will largely be limited to the Array Area and to the area to the north and south of this (i.e. along the dominant tidal axis), with the resultant plume not extending beyond 8 km from the Array Area and Cable Corridor and Working Area under all tidal flow simulations (speeds and direction). For sediment deposition, thicknesses up to 250 mm are predicted to occur within 1 km of the disturbance event. At 10 km from the disturbance event sediment deposition is predicted to be 2.5 mm and beyond this sediment deposition becomes immeasurable.

6.2.1.6 The design scenario for foundation installation assumes the drilled installation of 25 WTG piles 11 m in diametre and 2 OSP piles 14 m in diametre. Numerical modelling has simulated drilling at WTG for 88 hours, followed by a 12 hour pause and then another 88 hour drilling event at the Southern OSP. Suspended sediments concentrations and sediment plume extent progressively increase across the drilling event. After completion of WTG drilling the greatest SSC is within the centre of the plume (approximately 25 mg/l). During OSP drilling SSC of over 100 mg/l are expected at the point of activity, reducing to <25 mg/l after 12 hours, 18 km to the north of the drilling activity. Two days following cessation of drilling activities SSCs are undiscernible from background levels. Sediment deposition is expected to be approximately 15 mm immediately adjacent, following completion of drilling.

6.2.1.7 At the landfall the use of techniques such as HDD could also result in an increase in suspended sediments and sediment deposition at the exit point(s), including release of bentonite (drilling mud). Modelling of SSC at the HDD shows maximum concentrations of 50 mg/l with concentrations no greater than 2.5 mg/l outside the Proposed Development. For sediment deposition, 6.5 days after cessation of works a maximum deposition of 7.5 mm is predicted within 0.3 km.

6.2.1.8 Confirmatory Surveys activities include a range of methods which will disturb the seabed, on a short-term and localised basis, due to the placement of an instrument and its' mooring system on the seabed to sediment removal (as boreholes/ grabs). No modelling has been undertaken for confirmatory surveys. However, sediment disturbance resulting from confirmatory surveys activities will typically be of shorter duration (hours to days), lesser magnitude and localised when compared to those resulting from site preparation, foundation and cable installation works.

6.2.1.9 The design scenario assumes the installation of 110-122 km of inter array cables, 25-40 km of export cables and 25-28 km of interconnector cables. Computational modelling has been undertaken for installation of the cables. Numerical modelling show that the greatest increase in SSC is observed immediately adjacent to the works (approx. 500 mg/l), with levels above background (2.5 mg/l) being observed 8 km away from the disturbance event. Sediment deposition of 25 mm occur within 1 km and <2.5 mm at 10 km.

6.2.1.10 The outputs of the coastal processed modelling were used to determine whether or not increases in suspended sediments and associated sediment deposition would lead to an adverse effect on Annex I QIs of the identified SACs, when considering the COs of the relevant QIs of the SACs.

6.2.1.11 The results of the sediment modelling can be seen in Figure 6.2 and Figure 6.3.

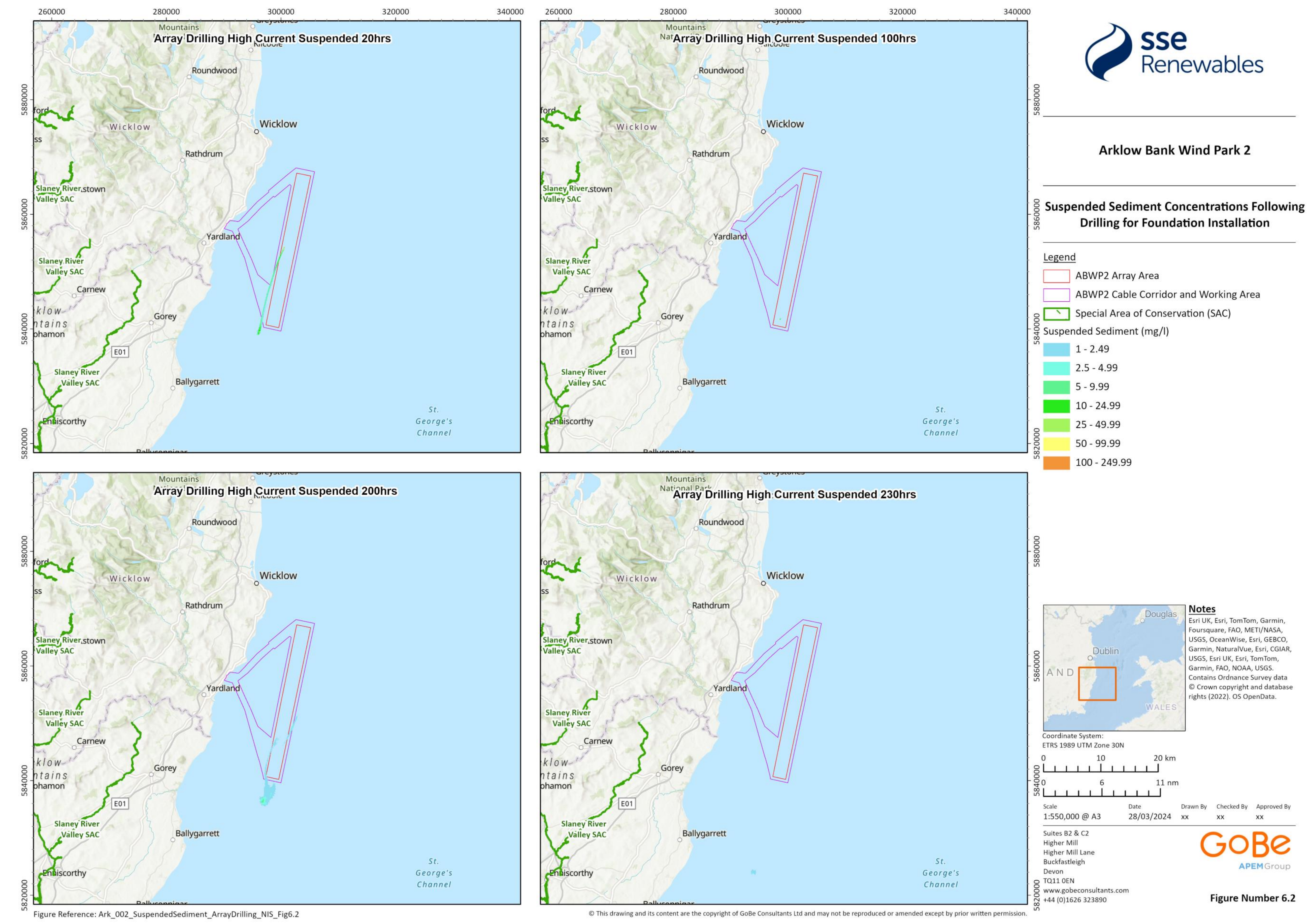

Figure 6.2: Suspended Sediment Concentrations following drilling for foundation installation

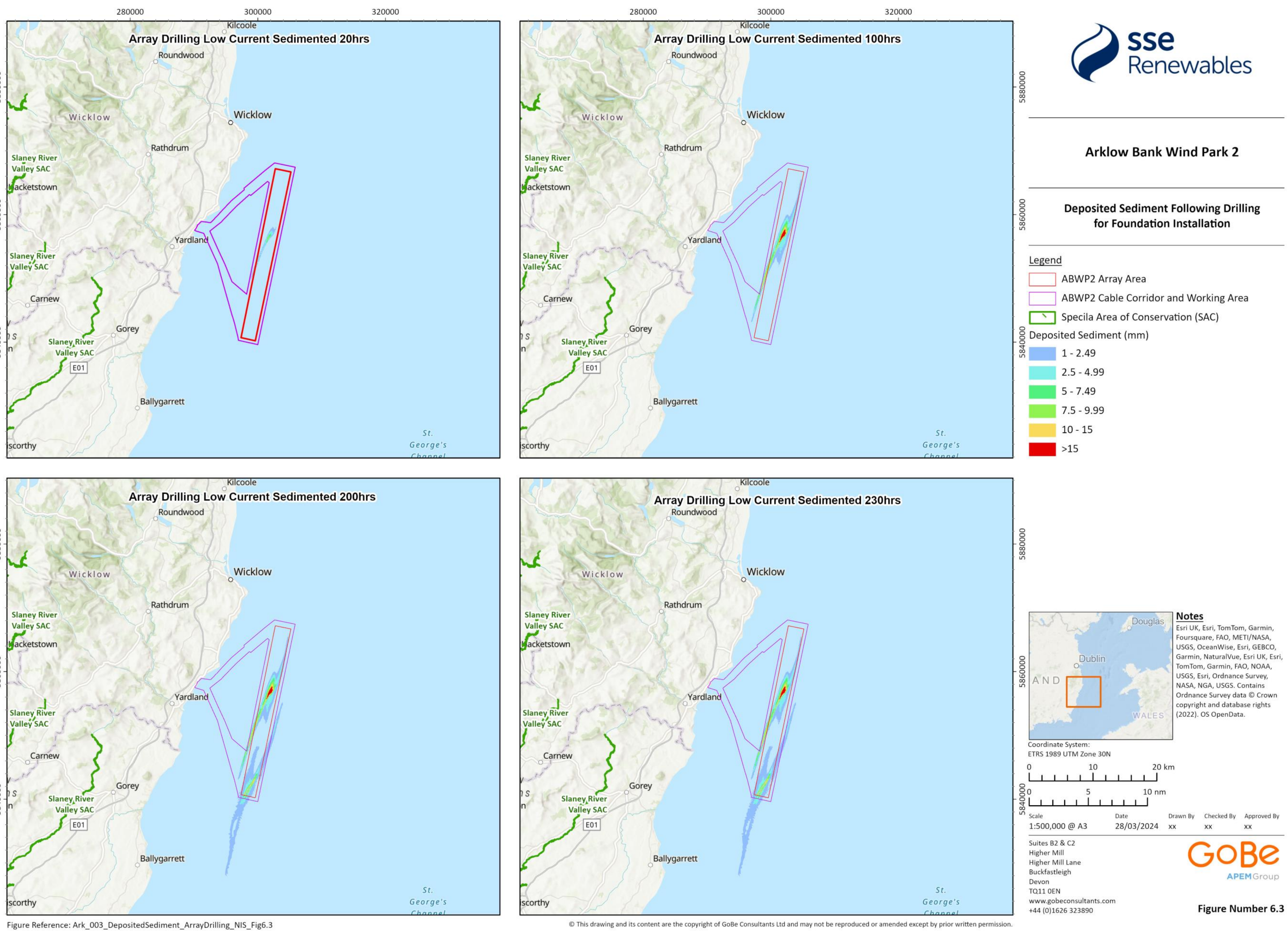

Figure 6.3: Deposited Sediment following drilling for foundation installation

6.2.2 Wicklow Reef SAC

6.2.2.1 The conservation objective for reefs within Wicklow Reef SAC is to maintain the favourable conservation condition of reefs in Wicklow Reef SAC, which is defined in Table 5.1.

6.2.2.2 There are two potential impacts on reefs associated with the construction, operational and maintenance and decommissioning of the Proposed Development, which are presented in Table 6.3 and are assessed below for each phase of the Proposed Development.

ELEVATED LEVELS OF SUSPENDED SEDIMENT CONCENTRATIONS AND ASSOCIATED SEDIMENT DEPOSITION

CONSTRUCTION, OPERATIONAL AND DECOMMISSIONING

6.2.2.3 As determined in Table 6.3, Project Design Option 1 and Project Design Option 2 will have the same potential for adverse effects from elevated levels of suspended sediment and associated sediment deposition on coastal and intertidal benthic habitats.

6.2.2.4 It was identified at the Stage 1 Screening Appraisal that the Proposed Development did not present any risk to maintaining the favourable conservation condition of Annex I reef habitat with reference to conservation targets for 'Habitat area' or 'Distribution', as the Proposed Development would have no bearing whatsoever on whether or not the permanent area (or distribution as the case may be) of reef habitat is stable or increasing, subject to natural processes.

6.2.2.5 The SAC supporting document (NPWS, 2013a) notes that these targets refer to activities or operations that propose to permanently remove reef habitat, thus reducing the permanent amount of reef habitat (or range over which this habitat occurs as the case may be). Importantly, the targets do not refer to temporary or short-term disturbance of the biology of reef habitats. On this basis, these conservation targets will not be undermined by the predicted increases in suspended sediment concentrations during the construction phase of the Proposed Development.

6.2.2.6 The 'Community structure' target to conserve the reef community complex in a natural condition was identified as having the potential to be undermined by sediment plumes and associated sediment deposition. The results of the modelling discussed above and in Volume III, Appendix 6.1: Marine Physical Processes Numerical Modelling of the NIS, confirm that there is no potential for construction phase sediment plumes or associated sediment deposition to smother the reef habitats in Wicklow Reef SAC or have any effects on the community composition characterising the Annex I reef habitats. The Proposed Development will have no bearing whatsoever on whether the reef community complex in Wicklow Reef SAC is conserved in a natural condition.

6.2.2.7 **There will be no AEoI upon the integrity of Wicklow Reef SAC, as defined by the COs of the site, as a result of suspended sediments and sedimentation effects from Project Design Option 1.**

6.2.2.8 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

ACCIDENTAL POLLUTION

CONSTRUCTION AND DECOMMISSIONING

6.2.2.9 As determined in Table 6.3, Project Design Option 1 and Project Design Option 2 will have the same potential for adverse effects from accidental pollution on coastal and intertidal benthic habitats.

6.2.2.10 Construction of the Proposed Development and confirmatory surveys may lead to the accidental release of pollutants through spills and leaks from vessels and equipment. The magnitude of the impact is dependent on the quantities of potential pollutants carried by vessels, helicopters, and equipment. Although many of the large vessels (e.g. installation vessels) may contain large quantities of diesel oil, any accidental spill from vessels, vehicles, machinery from construction activities would be subject to immediate dilution and rapid dispersal.

6.2.2.11 The avoidance of effect through design and management measures of the Proposed Development includes an EMP and Marine Pollution Contingency Plan. Adherence to the avoidance by design and standard project environmental protection measures outlined in Table 6.2 and good working practices will significantly reduce the likelihood of an accidental pollution incident occurring and the magnitude of its impact. Given the factored-in measures, the likelihood of accidental release of pollutants is considered to be extremely low.

6.2.2.12 There is also a risk to reef habitats from water based drilling mud, including bentonite, which is used as a lubricant during the cable installation via trenchless techniques. Trenchless techniques such as HDD and Direct Pipe will be undertaken to install the offshore export cables at the landfall and potentially across the sandbank for inter-array cable installation. Drilling muds are used in a closed system to minimise loss to the environment; however, it is possible that muds (including bentonite) can break out during drilling operations, which may occur in intertidal or subtidal areas. Bentonite is low toxicity drilling mud and therefore the risk to reefs is minimal, particularly when considering that any break outs will be quickly diluted (seawater degrades the bentonite fluid, causing it to flocculate and allowing faster dispersal). However, any potential break outs or accidental spills of bentonite will be managed via good working practices (e.g. monitoring of mud volumes and pressure, detection of break outs and pausing drilling, plugging fissures and ongoing monitoring) such that any loss of bentonite to the environment is minimal.

6.2.2.13 **Given the inherent low likelihood of accidental pollution from vessel activity, as well as the proposed avoidance/ impacts reduction measures (as set out in Table 6.2), there is no potential for AEoI from accidental pollution on Wicklow Reef SAC, as defined by the COs of the site, from Project Design Option 1.**

6.2.2.14 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE

6.2.2.15 As determined in Table 6.3, Project Design Option 1 and Option 2 will have the same potential for adverse effects from accidental pollution on coastal and intertidal benthic habitats.

6.2.2.16 Operational and maintenance tasks within the Proposed Development may lead to the accidental release of pollutants through spills and leaks from vessels and equipment. The magnitude of the impact will be dependent on the quantities of potential pollutants carried by vessels, helicopters, and equipment. Although many of the large vessels (e.g. installation vessels) may contain large quantities of diesel oil, any accidental spill from vessels, vehicles, or machinery would be subject to immediate dilution and rapid dispersal.

6.2.2.17 Given the avoidance of effects by design, the likelihood of accidental release is considered to be extremely low. Adherence to the avoidance of effects by design outlined in Table 6.2Table 6.2: and good working practices will significantly reduce the likelihood of an accidental pollution incident occurring and the magnitude of its impact on reefs.

6.2.2.18 **Given the inherent low likelihood of accidental pollution from vessel activity as well as the proposed avoidance/ impacts reduction measures (as set out in** Table 6.2**), and the low risk of pollution from cable installation via trenchless techniques such as HDD and Direct pipe, there is no potential for AEoI from accidental pollution on Wicklow Reef SAC, as defined by the COs of the site, from Project Design Option 1.**

6.2.2.19 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.2.3 Buckroney-Brittas Dunes and Fen SAC

6.2.3.1 The conservation objectives for Buckroney-Brittas Dunes and Fen SAC is to maintain the favourable conservation conditions of annual vegetation of drift lines, Mediterranean salt meadows (*Juncetalia maritimi*), fixed coastal dunes with herbaceous vegetation (grey dunes), dunes with *Salix repens* ssp. *argentea* (*Silicion aremariae*) and Alkaline fens in Buckroney-Brittas Dunes and Fens SAC, and to restore the favourable conservation conditions of perennial vegetation of stony banks, embryonic shifting dunes, shifting dunes alone the shoreline with *Ammophila arenaria* (white dunes), Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) and humid dune slacks in Buckroney-Brittas Dunes and Fen SAC.

6.2.3.2 There are two potential impacts on the intertidal and subtidal benthic habitats associated with the construction, operational and maintenance and decommissioning of the Proposed Development, which are presented in Table 6.3, and are assessed below for each phase of the Proposed Development.

ELEVATED LEVELS OF SUSPENDED SEDIMENT CONCENTRATIONS AND ASSOCIATED SEDIMENT DEPOSITION

CONSTRUCTION, OPERATIONAL AND DECOMMISSIONING

6.2.3.3 As determined in Table 6.3, Project Design Option 1 and Project Design Option 2 will have the same potential for adverse effects from elevated levels of suspended sediment and associated sediment deposition on coastal and intertidal benthic habitats.

6.2.3.4 It was identified at the Stage 1 Screening Appraisal that the Proposed Development did not present any risk to maintaining the favourable conservation condition of the designated dune habitats with reference to conservation targets for ‘Habitat area’ or ‘Distribution’ as the Proposed Development would have no bearing whatsoever on whether or not the permanent area (or distribution as the case may be) of dune habitat is stable or increasing, subject to natural processes.

6.2.3.5 The SAC supporting document (NPWS, 2017a) notes that these targets refer to activities or operations that proposed to permanently remove dune habitats, thus reducing the permanent amount of dune habitat (or range over which this habitat occurs as the case may be). Importantly, the targets do not refer to long- or short-term disturbance of the biology of reef habitats. On this basis, these conservation targets will not be undermined by the predicted increases in suspended sediment concentrations during the construction phase of the Proposed Development.

6.2.3.6 Whilst implementing the Proposed Development at a distance of 0.31 km from this coastal SAC is unlikely to jeopardise the conservation targets for habitat area, habitat distribution, vegetation structure and vegetation composition of its habitats, the targets for its sand dune habitats listed under ‘Physical structure: functionality and sediment supply’ are to maintain, or where necessary restore, the natural circulation of sediment and organic matter, without any physical obstructions.

6.2.3.7 Results of modelling discussed above and in Volume III, Appendix 6.1: Marine Physical Processes Numerical Modelling of the NIS confirm that there is no potential for sediment plumes or associated sediment deposition to interrupt or physically obstruct the natural circulation of sediment and organic matter. The Proposed Development will have no bearing whatsoever on natural circulation of sediment and organic matter for sand dune habitats in Buckroney-Brittas Dunes and Fen SAC.

6.2.3.8 **Therefore, it is concluded that there will be no AEoI on Buckroney-Brittas Dunes and Fen SAC, as defined by the COs of the site, as a result of suspended sediments and deposition effects for Project Design Option 1.**

6.2.3.9 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

ACCIDENTAL POLLUTION

CONSTRUCTION AND DECOMMISSIONING PHASE

6.2.3.10 As determined in Table 6.3, Project Design Option 1 has a greater potential for adverse effects from accidental pollution on coastal and intertidal benthic habitats than Project Design Option 2.

6.2.3.11 The installation of the Proposed Development and confirmatory surveys may lead to the accidental release of pollutants through spills and leaks from vessels and equipment. The magnitude of the impact is dependent on the quantities of potential pollutants carried by vessels, helicopters, and equipment. Although many of the large vessels (e.g. installation vessels) may contain large quantities of diesel oil, any accidental spill from vessels, vehicles, machinery from construction activities would be subject to immediate dilution and rapid dispersal.

6.2.3.12 The avoidance of effect through design of the Proposed Development includes an Environmental Management Plan (EMP) and Marine Pollution Contingency Plan. Adherence to the avoidance by design measures outlined in Table 6.2 and good working practices will significantly reduce the likelihood of an accidental pollution incident occurring and the magnitude of its impact. Given the factored-in measures, the likelihood of accidental release is considered to be extremely low.

6.2.3.13 There is also a risk to reef habitats from water based drilling mud, including bentonite, which is used as a lubricant during the cable installation via trenchless techniques such as HDD and Direct pipe process. Trenchless techniques such as HDD and Direct pipe will be undertaken to install the offshore export cables at the landfall and potentially across the sandbank for inter-array cable installation. Drilling muds are used in a closed system to minimise loss to the environment; however, it is possible that muds (including bentonite) can break out during drilling operations, which may occur in intertidal or subtidal areas. Bentonite is low toxicity drilling mud and therefore the risk to reefs is minimal, particularly when considering that any break outs will be quickly diluted (seawater degrades the bentonite fluid, causing it to flocculate and allowing faster dispersal). However, any potential break outs or accidental spills of bentonite will be managed via good working practices (e.g. monitoring of mud volumes and pressure, detection of break outs and pausing drilling, plugging fissures and ongoing monitoring) such that any loss of bentonite to the environment is minimal.

6.2.3.14 **Given the inherent low likelihood of accidental pollution from vessel activity, as well as the proposed avoidance/ impacts reduction measures (as set out in Table 6.2), and the low risk of pollution from cable installation via trenchless techniques such as HDD and Direct pipe, there is no potential for AEoI from accidental pollution on Buckroney-Brittas Dunes and Fen SAC, as defined by the COs of the site, from Project Design Option 1.**

6.2.3.15 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE

6.2.3.16 As determined in Table 6.3, Project Design Option 1 and Option 2 have the same potential for adverse effects from accidental pollution on coastal and intertidal benthic habitats.

6.2.3.17 Operational and maintenance tasks within the Proposed Development may lead to the accidental release of pollutants through spills and leaks from vessels and equipment. The magnitude of the impact will be dependent on the quantities of potential pollutants carried by vessels, helicopters, and equipment. Although many of the large vessels (e.g. installation vessels) may contain large quantities of diesel oil, any accidental spill from vessels, vehicles, machinery or from construction, operational and maintenance and decommissioning activities would be subject to immediate dilution and rapid dispersal.

6.2.3.18 Given the avoidance of effects by design, the likelihood of accidental release is considered to be extremely low. Adherence to the avoidance of effects by design outlined in Table 6.2 and good working practices will significantly reduce the likelihood of an accidental pollution incident occurring and the magnitude of its impact on reefs.

6.2.3.19 **Given the inherent low likelihood of accidental pollution from vessel activity, as well as the proposed avoidance/ impacts reduction measures (as set out in Table 6.2), and the low risk of pollution from cable installation via trenchless techniques such as HDD and Direct pipe, there is no potential for AEoI from accidental pollution on Buckroney-Brittas Dunes and Fen SAC, as defined by the COs of the site, from Project Design Option 1.**

6.2.3.20 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.2.4 Magherabeg Dunes SAC

6.2.4.1 The conservation objectives for Magherabeg Dunes SAC is to maintain the favourable conservation condition of Annual vegetation of drift lines, Embryonic shifting dines, Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes), Fixed coastal dunes with herbaceous vegetation (grey dunes) and Atlantic decalcified fixed dunes (*Calluno-Ulicetea*), and to restore the favourable conservation condition of Petrifying springs with tufa formation (Cratoneurion) within Magherabeg Dunes SAC. These conservation objectives are defined in Table 5.1.

6.2.4.2 There are two potential impacts on the dune habitats associated with the construction, operational and maintenance and decommissioning of the Proposed Development, which are presented in Table 6.3, and are assessed below for each phase of the Proposed Development.

6.2.4.3 **The QI Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) is primarily a terrestrial habitat which will fall outside the scope of works taking place within the Array Area and Cable Corridor and Working Area. Therefore, it is concluded that increases in suspended sediment and deposition and accidental pollution will have no AEoI on this QI from Project Design Option 1.**

6.2.4.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.2.4.5 With consideration that the impact severity is based on distance from the site of works, Buckroney-Brittas Dunes and Fen SAC is designated for several of the same or similar QIs and is located nearer to the Proposed Development (0.31 km from the Proposed Development) than Magherabeg Dunes SAC (3.66 km from the Proposed Development), it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.2.4 it has been concluded that none of the potential effects on intertidal and subtidal benthic habitats would result in an AEoI of the QIs.

6.2.4.6 **Therefore, there is no AEoI for Magherabeg Dunes SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting intertidal and subtidal benthic habitats from Project Design Option 1.**

6.2.4.7 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.2.5 Kilpatrick Sandhills SAC

6.2.5.1 The conservation objectives for Kilpatrick Sandhills SAC are to maintain the favourable conservation conditions of annual vegetation of drift lines, and to restore the favourable conservation conditions of embryonic shifting dunes, shifting dunes along the shoreline with *Ammophila arenaria* (white dunes), fixed coastal dunes with herbaceous vegetation (grey dunes), and Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) in Kilpatrick Sandhills SAC.

6.2.5.2 There are two potential impacts on the intertidal and subtidal benthic habitats associated with the construction, operational and maintenance and decommissioning of the Proposed Development, which are presented in Table 6.3 and are assessed below for each phase of the Proposed Development.

6.2.5.3 The QI Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) is primarily a terrestrial habitat which will fall outside the scope of works taking place within the Array Area and Cable Corridor and Working Area. Therefore, increases in suspended sediment and deposition and accidental pollution will have no AEoI on this QI.

6.2.5.4 With consideration that the impact severity is based on distance from the site of works, Magherabeg Dunes SAC is designated for several of the same or similar QIs and is located nearer to the Proposed Development (3.66 km from the Proposed Development) than Kilpatrick Sandhills SAC (6.8 km from the Proposed Development), it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.2.4 it has been concluded that none of the potential effects on intertidal and subtidal benthic habitats would result in an AEoI of the QIs.

6.2.5.5 **Therefore, there is no AEoI for Kilpatrick Sandhills SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting intertidal and subtidal benthic habitats from Project Design Option 1.**

6.2.5.6 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.2.6 The Murrough Wetlands SAC

6.2.6.1 The conservation objectives for The Murrough Wetlands SAC are to restore the favourable conservation condition of annual vegetation of drift lines, perennial vegetation of stony banks, Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), Mediterranean salt meadows (*Juncetalia maritimi*), Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* and Alkaline fens in The Murrough Wetlands SAC.

6.2.6.2 There are two potential impacts on the intertidal and subtidal benthic habitats associated with the construction, operational and maintenance and decommissioning of the Proposed Development, which are presented in Table 6.3 and are assessed below for each phase of the Proposed Development.

6.2.6.3 With consideration that the impact severity is based on distance from the site of works, Magherabeg Dunes SAC is designated for several of the same or similar QIs and is located nearer to the Proposed Development (3.66 km from the Proposed Development) than The Murrough Wetlands SAC (11.15 km from the Proposed Development), it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.2.4 it has been concluded that none of the potential effects on intertidal and subtidal benthic habitats would result in an AEoI of the QIs.

6.2.6.4 **Therefore, there is no AEoI for The Murrough Wetlands SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting intertidal and subtidal benthic habitats from Project Design Option 1.**

6.2.6.5 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.2.7 Cahore Polders and Dunes SAC

6.2.7.1 The conservation objectives for Cahore Polders and Dunes SAC are to restore the conservation conditions of annual vegetation of drift lines, Embryonic shifting dunes, shifting dunes along the shoreline with *Ammophila arenaria* (white dunes), fixed coastal dunes with herbaceous vegetation (grey dunes) and humid dune slacks.

6.2.7.2 There are two potential impacts on the intertidal and subtidal benthic habitats associated with the construction, operational and maintenance and decommissioning of the Proposed Development, which are presented in Table 6.3 and are assessed below for each phase of the Proposed Development.

6.2.7.3 With consideration that the impact severity is based on distance from the site of works, Magherabeg Dunes SAC is designated for several of the same or similar QIs and is located nearer to the Proposed Development (3.66 km from the Proposed Development) than Cahore Polders and Dunes SAC (18.19 km from the Proposed Development), it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.2.4 it has been concluded that none of the potential effects on intertidal and subtidal benthic habitats would result in an AEoI of the QIs.

6.2.7.4 **Therefore, there is no AEoI for Cahore Polders and Dunes SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting intertidal and subtidal benthic habitats from Project Design Option 1.**

6.2.7.5 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.2.8 Blackwater Bank SAC

6.2.8.1 The conservation objectives for Blackwater Bank SAC are to maintain the favourable conservation conditions of sandbanks which are slightly covered by sea water all the time in Blackwater Bank SAC.

6.2.8.2 There are two potential impacts on the intertidal and subtidal benthic habitats associated with the construction, operational and maintenance and decommissioning of the Proposed Development, which are presented in Table 6.3 and are assessed below for each phase of the Proposed Development.

6.2.8.3 With consideration that the impact severity is based on distance from the site of works, Magherabeg Dunes SAC is designated for several of the same or similar QIs and is located nearer to the Proposed Development (3.66 km from the Proposed Development) than Blackwater Bank SAC (19.76 km from the Proposed Development), it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.2.4 it has been concluded that none of the potential effects on intertidal and subtidal benthic habitats would result in an AEoI of the QIs.

6.2.8.4 **Therefore, there is no AEoI for Blackwater Bank SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting intertidal and subtidal benthic habitats from Project Design Option 1.**

6.2.8.5 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.2.9 Summary of Stage 2 Appraisal for Sites Screened in for Annex I Coastal Habitat QIs

6.2.9.1 Two potential impacts were assessed for impacts on Coastal Habitats resulting from construction, operational and maintenance and decommissioning of the Proposed Development, the results of this assessment can be seen in Table 6.4.

Table 6.4: Conclusion for the assessment of potential impacts on Sites Screened in for Annex I coastal and marine habitat QIs

Potential impact	Differences between Project Design Option 1 and 2	Conclusion
Elevated levels of suspended sediment concentrations and associated sediment deposition	For Project Design Option 1, there is a higher number of monopile foundations requiring installation however, there is not anticipated to be a higher risk of elevated levels of suspended sediment concentrations and associated sediment deposition for Project Design Option 2.	As both options present suspended sediment plumes that will disperse a significant distance outside all SAC boundaries, a conclusion of no AEoI is applicable to both Project Design Option 1 and 2 for all SACs for increased suspended sediment concentrations and associated sediment deposition.
Accidental release of pollutants	For Project Design Option 1, there is a higher number of monopile foundations requiring installation and maintenance and therefore, there is a higher risk of accidental pollution.	As both Project Design Option 1 and 2 present avoidance by design and management measures which will be implemented to reduce the likelihood of accidental pollution events, a conclusion of no AEoI is applicable for both Project Design Option 1 and 2 for all SACs for accidental pollution.

6.3 Baseline information to inform Stage 2 AA for Annex II Marine Mammal Species QIs

6.3.1.1 As outlined in Section 5.1, the following designated sites have continued through the Stage 1 Screening Assessment to be assessed in Stage 2 as a likely significant effect could not be ruled out. These are presented in Figure 6.4.

- Within Ireland:
  - Blackwater Bank SAC – harbour porpoise;
  - Slaney River Valley SAC – harbour seal;
  - Lambay Island SAC – grey seal and harbour porpoise;
  - Codling Fault Zone SAC – harbour porpoise
  - Rockabill to Dalkey Island SAC – harbour porpoise;
  - Carnsore Point SAC – harbour porpoise;
  - Saltee Islands SAC – grey seal;
  - Hook Head SAC - harbour porpoise;
  - Roaringwater Bay and Islands SAC – harbour porpoise;
  - Kenmare River SAC – harbour porpoise;
  - Blasket Islands SAC – harbour porpoise;
  - Belgica Mound Province SAC – harbour porpoise;
  - Bunduff Lough and Machair / Trawalua / Mullaghmore SAC – harbour porpoise;
  - Inishmore Island SAC – harbour porpoise;
  - Kilkieran Bay and Islands SAC – harbour porpoise;
  - West Connacht Coast SAC – harbour porpoise;
- Transboundary sites within the UK:
  - West Wales Marine/ Gorllewin Cymru Forol SAC – harbour porpoise;
  - North Anglesey Marine/ Gogledd Môn Forol SAC – harbour porpoise;

- Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC – grey seal and bottlenose dolphin;
- Cardigan Bay/ Bae Ceredigion SAC – grey seal and bottlenose dolphin;
- Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC – harbour porpoise;
- North Channel SAC – harbour porpoise;

- Transboundary sites within mainland Europe:
  - Nord Bretagne DH (FR)– harbour porpoise;
  - Récifs et Lands de la Hague (FR) SAC – harbour porpoise;
  - Anse de Vauville (FR) SAC – harbour porpoise;
  - Mers Celtiques – Talus du golfe de Gascogne (FR) SAC – harbour porpoise;
  - Tregor Goëlo (FR) SAC – harbour porpoise;
  - Banc et récifs de Surtainville (FR) SAC – harbour porpoise;
  - Baie de Morlaix (FR) SAC – harbour porpoise;
  - Ouessant-Molène (FR) SAC – harbour porpoise ;
  - Cap d'Erquy-Cap Fréhel (FR) SAC – harbour porpoise;
  - Chausey (FR) SAC – harbour porpoise;
  - Côte de Granit rose-Sept-Iles (FR) SAC – harbour porpoise;
  - Abers – Côtes des legends (FR) SAC – harbour porpoise;
  - Côtes de Crozon (FR) SAC – harbour porpoise;
  - Baie de Saint-Brieuc – Est (FR) SAC – harbour porpoise;
  - Chaussée de Sein (FR) SAC – harbour porpoise;
  - Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard (FR) SAC – harbour porpoise;
  - Baie du Mont Saint-Michel (FR) SAC – harbour porpoise; and
  - Estuaire de le Rance (FR) SAC – harbour porpoise.

6.3.1.2 The boundary for the Proposed Development does not overlap any of these designated sites, with the closest site comprising Blackwater Bank SAC at 19.76 km from the Proposed Development. All marine mammal species are highly mobile and so despite distance the above sites have been screened in due to potential LSE on the qualifying features caused by the Proposed Development. The Stage 1 SISAA concluded that there was potential for LSE via underwater noise, vessel collision and changes in prey for harbour porpoise, bottlenose dolphin, harbour seal and grey seal, and EMF for harbour porpoise and bottlenose dolphin.

6.3.1.3 Underwater noise will be produced by the Proposed Development primarily through piling activities and geophysical surveys, with vessel movements also partly contributing to the LSE potential from underwater noise. Underwater noise from piling and other activities can result in individuals suffering physical injury, hearing damage and disturbance or displacement.

6.3.1.4 The potential for LSE from vessel collision is associated with the movements of vessels for construction, operational and maintenance, and decommissioning activities, where the vessel pose a risk of injury or death to the marine mammals through physical collision, typically with the propeller.

6.3.1.5 There is potential for LSE from an accidental release of pollutants to occur from vessels and equipment associated with the construction, operational and maintenance and decommissioning phases of the Proposed Development, which may result in adverse effects on marine mammals. Pollutants may include diesel fuel, bentonite (from drilling activities), lubricants, grease and oils, anti-fouling biocides, and grout.

6.3.1.6 EMF induced effects (e.g. effects on navigation and other life-history dependant functions) may occur during the operational and maintenance phase of the Proposed Development if individuals are located within close proximity to the cabling.

6.3.1.7 Changes in prey can comprise a change in species distribution and abundance and may be caused by accidental pollution and/ or an ensonified underwater noise environment and/ or as a result of increased collision risk with vessels and/ or prey species may be impacted by EMF induced effects.

6.3.1.8 Overall, the following impacts are therefore considered, with consideration of the COs of the qualifying interests of these SACs:

- Underwater noise from piling activities;
- Underwater noise from other activities;
- Vessel collision;
- EMF (only for sites with harbour porpoise and bottlenose dolphin features);
- Accidental pollution; and
- Changes in prey.

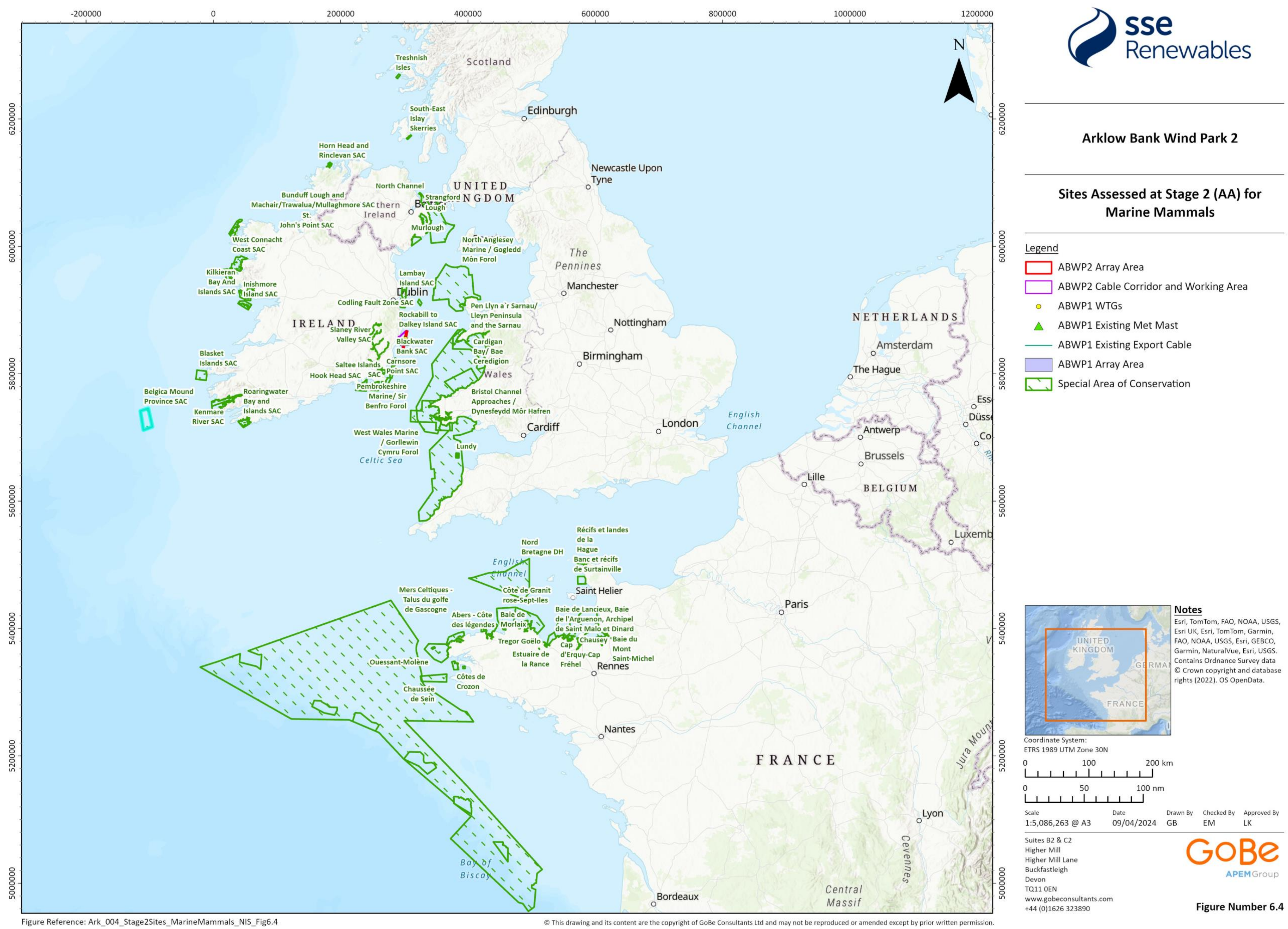

Figure 6.4: Sites assessed at Stage 2 AA for Marine Mammals

6.3.1 Baseline Environment

Site-specific surveys summary

6.3.1.1 A summary of the site-specific surveys undertaken to inform the Stage 2 AA on marine mammals is provided in Table 6.5.

Table 6.5: Summary of site-specific survey data for Marine Mammals

Data source	Overview of survey	Survey contractor	Date	Reference to further information
Acoustic monitoring	Static acoustic data logger	Coveney Wildlife Consulting Ltd (CWC)	August to September 2002	Coveney Wildlife Consulting Ltd (CWC) (2002); Appended to EIAR Volume III, Appendix 11.2: Marine Mammal Technical Report.
Historical boat-based visual survey	Visual boat-based survey	CWC	July 2000 to June 2005	CWC (2003; 2004; 2005); Appended to EIAR Volume III, Appendix 11.2: Marine Mammals Technical Report.
Historical boat-based visual survey	Visual boat-based survey	Fulmar Ecological Services	July 2005 to June 2006	Fulmar Ecological Services (2006); Appended to EIAR Volume III, Appendix 11.2: Marine Mammals Technical Report.
Historical boat-based visual survey	Visual boat-based survey	Cork Ecology	July 2006 to June 2009	Cork Ecology (2007; 2009; 2010); Appended to EIAR Volume III, Appendix 11.2: Marine Mammals Technical Report.
Baseline digital aerial survey (DAS)	DAS	HiDef Aerial Surveying Limited	March 2018 to February 2020 (excluding April 2019 plus April 2020)	HiDef (2020a; b); Appended to EIAR Volume III, Appendix 11.2: Marine Mammals Technical Report.
MMO Daily sightings data	Boat-based sightings during mitigation for geophysical survey campaign	IWDG Consulting	July to August 2019	IWDG Consulting (2019); Appended to EIAR Volume III Appendix 11.2: Marine Mammals Technical Report.
MMO Daily sightings data	Boat-based sightings during mitigation for geophysical survey campaign	Gavin & Doherty Geosolutions Ltd	July to August 2020	Gavin & Doherty Geosolutions Ltd (2020a); Appended to EIAR Volume III, Appendix 11.2: Marine Mammals Technical Report.
MMO Daily sightings data	Boat-based sightings during mitigation for geophysical survey campaign	Gavin & Doherty Geosolutions Ltd	October to November 2020	Gavin & Doherty Geosolutions Ltd (2020b); Appended to EIAR Volume III, Appendix 11.2: Marine Mammals Technical Report.
MMO Daily sightings data	Boat-based sightings	Gavin & Doherty	July to August 2023	Gavin & Doherty Geosolutions Ltd (2023a; b); Appended to EIAR

Data source	Overview of survey	Survey contractor	Date	Reference to further information
	during mitigation for geotechnical nearshore and offshore survey campaigns	Geosolutions Ltd		Volume III, Appendix 11.2: Marine Mammals Technical Report.

Boat-based visual surveys (historical)

6.3.1.2 These surveys were carried out as part of the marine mammal monitoring programme to support Arklow Bank Wind Park (ABWP1). They focused on three survey areas comprising: the Foreshore Lease Area, a 5 km wide survey area surrounding the bank and a survey area encompassing the whole of the ABWP1 cable route leading from the western edge of the bank area to the shore.

6.3.1.3 Monitoring surveys were conducted during the pre-construction phase (Years 1 to 3), construction phase (Year 4) and post-construction phase (Years 5 to 9) of the ABWP1 project. The surveys were conducted following an adaptation of the standard Joint Nature Conservation Committee (JNCC) European Seabirds at Sea (ESaS) methodology using line transects (Webb and Durinck, 1992). Further information with regards to the methodology can be found in the monitoring reports referenced in Table 6.5.

Acoustic Monitoring

6.3.1.4 The acoustic monitoring was designed to monitor harbour porpoise. The surveys used an acoustic data logger deployed to the northwest of the ABWP1 project area. Data was collected for 25 days between 1st August 2002 and 1st September 2002. Further information with regards to the methodology can be found in the monitoring reports referenced in Table 6.5.

Digital Aerial Survey (DAS)

6.3.1.5 These surveys were carried out to inform the baseline for the Proposed Development. Aerial digital methods are widely accepted as an appropriate methodology for collecting baseline data for offshore wind development, both in the UK and Ireland (see for example, DCCAE, 2018). Aerial surveys of seabirds and marine mammals commenced in March 2018 and continued monthly until February 2020 with an additional month (April 2020) added to cover a missed survey in April 2019 (due to adverse weather). The surveys were conducted by HiDef from an aircraft equipped with four HiDef Gen II cameras with sensors to set resolution of 2 cm ground sample distance (GSD). The transects followed the routes at a height of ~550 m above sea level (ASL) and the aircraft operational speed was 220 km per hour. Position data for the aircraft was recorded using a Garmin GPSMap 296 receiver with differential GPS to give 1 m accuracy and allowed recording updates at one second intervals to match to bird and marine mammal observations.

6.3.1.6 A total of 20 transects spaced ~2 km apart, were carried out across the aerial survey area. This encompassed the Array Area, and a minimum 4 km buffer area; matching the survey area covered by the historical boat-based surveys but extending further to the west in order to sample the inshore area up to the Wicklow coastline. Transects were flown to cover a total length of approximately 340 km in each month, and the four cameras captured information across a total width of 500 m. The requirement was to provide 10% coverage of the Aerial Survey Area and therefore data from two partial cameras (100 m strip width) were subsampled giving a total strip width of 200 m to achieve 10% coverage (~68 km² per month).

Annex 2 Marine Mammal Species

6.3.1.7 A technical report has been prepared to provide a detailed characterisation of the receiving baseline (Volume III, Appendix 11.2: Marine Mammals Technical Report). A summary of the key findings is included below, and conclusions are based upon findings within the report and the EIAR, Volume II, Chapter 11: Marine Mammals.

6.3.1.8 A review of the data available has confirmed the likely presence of the following Annex 2 species within the vicinity of the Proposed Development:

- Harbour porpoise;
- Bottlenose dolphin;
- Grey seal; and
- Harbour seal.

6.3.1.9 In Table 6.6, density estimates, and population assessments are provided for each species. It should be noted that the site-specific density estimates are not representative of animal densities across the wider scale for large scale impacts such as from underwater noise caused by piling or UXO.

Table 6.6: Marine mammal density (animals/km) and population estimates

Species	Density (animals/km²)	Density source	Reference population	Reference population estimate	Reference population source
Harbour porpoise	0.38	Site-specific DAS	Celtic and Irish Seas Management Unit (MU)	62,517	IAMMWG (2023)
	0.2803	Gilles *et al.* (2023)			
	Grid-cell specific	Derived from SCANS-III density surfaces (Lacey *et al.*, 2022)			
Bottlenose dolphin	0.0201	Rogan *et al.* (2018a)	Irish Sea MU	293	IAMMWG (2023)
	0.2352	Gilles *et al.* (2023)			
	Grid-cell specific	Derived from SCANS-III density surfaces (Lacey *et al.*, 2022)			
Grey seal	0.08	Grid cell-specific average across the Array Area and Cable Corridor and Working Area extracted from Carter *et al.* (2020)	East region of Republic of Ireland	1,662	Scaled from count data (Morris and Duck, 2019)
Harbour seal	0.0003	Grid cell-specific average	East region of Republic of Ireland	182	Scaled from count data

Species	Density (animals/km²)	Density source	Reference population	Reference population estimate	Reference population source
		across the Array Area and Cable Corridor and Working Area extracted from Carter *et al.* (2020)			(Morris and Duck, 2019)

Harbour porpoise

6.3.1.10 Harbour porpoises are listed under Annex II of the Habitats Directive as a species of Community Interest. There are several SACs screened in for stage 2 AA where harbour porpoises are listed as a qualifying feature. Within Ireland this comprises Blackwater Bank SAC, Lambay Island SAC, Codling Fault Zone SAC, Rockabill to Dalkey Island SAC, Carnsore Point SAC, Hook Head SAC, Roaringwater Bay and Islands SAC, Kenmare River SAC, Blasket Islands SAC, Belgica Mound Province SAC, Bunduff Lough and Machair / Trawalua / Mullaghmore SAC, Inishmore Island SAC, Kilkieran Bay and Islands SAC and West Connacht Coast SAC where the species has a 'favourable' conservation status and a 'stable' population trend (NPWS, 2019). There are a number of sites which have only recently been designated for harbour porpoise (Blackwater Bay SAC, Lambay Island SAC, Codling Fault Zone SAC, Carnsore Point SAC, Hook Head SAC, Kenmare River SAC, Belgica Mound Province SAC, Bunduff Lough and Machair / Trawalua / Mullaghmore SAC, Inishmore Island SAC, Kilkieran Bay and Islands SAC and West Connacht Coast SAC) and do not have conservation status or trends established. On a precautionary basis the assessment is based upon the trends and status of the nearest designated site within the same population community (MU) as the new designation.

6.3.1.11 Based on the data within the sources (Volume III, Appendix 11.2 – Marine Mammals Technical Report) stated within Table 6.6, harbour porpoise are the most frequently recorded marine mammal species within the survey area, and they are present all year round, with the highest densities present in the summer months.

Bottlenose dolphin

6.3.1.12 Bottlenose dolphins are also listed under Annex II of the Habitats Directive as a species of Community Interest. There are several SACs screened in for stage 2 AA where bottlenose dolphin are listed as a qualifying feature, though all are transboundary sites. The species has a 'favourable' conservation status and a 'stable' population trend (NPWS, 2019).

6.3.1.13 Only one group of bottlenose dolphin was recorded during the site-specific surveys which has confirmed their presence.

Grey seal

6.3.1.14 Grey seals are listed under Annex II of the Habitats Directive as a species of Community Interest. There are several SACs screened in for stage 2 AA where grey seal are listed as a qualifying feature. Within Ireland this comprises of Lambay Island SAC and Saltee Islands SAC , the species has a 'favourable' conservation status and an 'increasing' population trend (NPWS, 2019).

6.3.1.15 A total of 15 grey seals were recorded within the survey area across eight of the 25 site-specific DAS.

Harbour seal

6.3.1.16 Harbour seals are listed under Annex II of the Habitats Directive as a species of Community Interest. There is one SAC screened in for stage 2 AA where harbour seal are listed as a qualifying feature. Within Ireland this comprises of Slaney River Valley SAC , the species has a 'favourable' conservation status and a 'stable' population trend (NPWS, 2019).

6.3.1.17 Harbour seal were recorded twice during the site-specific DAS which has confirmed their presence.

6.3.2 Avoidance through Design and Standard Project Environmental Protection Measures of the Proposed Development

6.3.2.1 The design of the Proposed Development is such that some potential impact can be avoided as seen by applying the design features and management measures relevant to Marine Mammal receptors which are presented in Table 6.7.

Table 6.7: Project design and environmental protection measures relevant for Annex II marine mammal receptors

Measure	Justification
Impact avoidance/ reduction through the implementation of an Environmental Management Plan (EMP) providing the overarching framework for environment management during construction and operational phase. The EMP will include mitigation/monitoring measures and commitments made within the EIAR and a Marine Pollution Contingency Plan (MPCP) which will include key emergency contact details (e.g. EPA)). An EMP is included in Volume III, Appendix 25.1: Environmental Management Plan.	Measures will be adopted to ensure that the potential for release of pollutants from construction, operational and maintenance, and decommissioning is minimised. These mitigation measures are: Storage of chemicals in secure designated areas in line with appropriate regulations and guidelines, specifically: • The Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001 (as amended) (Schedule 4, Part 5);International Convention for the Prevention of Pollution from Ships (MARPOL) 1973 (as amended). (Annex II, and Annex III regulations); • International Convention for the Safety of Life at Sea (SOLAS) (Chapter VII); and • OSPAR Annex III: On the Prevention and Elimination of Pollution from Offshore Sources. Double skinning and labelling (direction of flow and contents) of pipes and clearly labelled storage tanks containing hazardous substances: • Storage of these substances in impenetrable bunds; • Working vessels shall handle all wastes in accordance with International Maritime Organisation (IMO) requirements and in accordance with the requirements of national legislation (i.e. Sea Pollution Acts 1991 to 1999; Sea Pollution (Miscellaneous Provisions) Act 2006) as applicable; • All waste and/or litter, including potential pollutants produced during construction, operational and maintenance, and decommissioning of the Proposed Development shall be stored and returned to shore for authorised disposal at suitable facilities; and • Vessel refuelling to take place in port or under permit from the Irish Coast Guard (IRCG). In this manner, accidental release of contaminants from vessels will be strictly controlled, thus providing protection for marine life across all phases of the Proposed Development.

Measure	Justification
	Any accidental pollution of the marine environment shall be immediately reported to the IRCG and to any other local authorities who are likely to be affected by such pollution.
Impact avoidance/ reduction through implementation of a Marine Mammal Mitigation Plan (MMMP) detailing the piling methodology, duration of piling, soft-start procedures, maximum piling energy and details of mitigation and monitoring parameters (Volume III, Appendix 25.2).	The implementation of a MMMP will mitigate for the risk of permanent auditory injury to marine mammals within a 'mitigation zone'. The mitigation zone is determined considering the potential for instantaneous auditory injury based on the initial hammer strike energy of 825kJ (i.e. soft start hammer energy). The soft start will provide an audible cue to allow marine mammals to flee the area before piling at increased hammer energy commences. The soft start will help to mitigate any potential for auditory injury. Acoustic Deterrent Devices (ADDs) will be used prior to the soft start to ensure marine mammals are deterred.
Impact avoidance/ reduction through implementation of a MMMP for UXO clearance detailing the clearance methodologies, and details of the mitigation and monitoring parameters (Volume III, Appendix 25.2).	A UXO MMMP will be implemented during any UXO clearance required. The MMMP will include measures to ensure the risk of instantaneous Permanent Threshold Shift (PTS) to marine mammals is negligible. The exact mitigation measures contained with the UXO MMMP are yet to be determined but will be in line with the latest relevant guidance. Multiple measures are available and have been implemented elsewhere for UXO clearance, such as the use of ADDs and scarer charges to displace animals to beyond the instantaneous PTS impact range, or noise abatement techniques where appropriate.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339)	The Developer was granted a Foreshore Licence (FS007339) for Site Investigations (associated with the Proposed Development) from the Minister for Housing, Local Government and Heritage in May 2022. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339) being carried out. As such there is no temporal overlap between the activities consented in this Foreshore Licence and the Proposed Development and there will be no potential for cumulative effects.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried	The Developer submitted a Foreshore Licence Application for Site Surveys to the Minister for Housing, Local Government and Heritage in April 2023 (FS007555) and this application is pending determination. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried out.

Measure	Justification
	As such there is no temporal overlap between the activities proposed in the Foreshore Licence Application and the Proposed Development.
Impact avoidance/ reduction through implementation of an Environmental Vessel Management Plan (EVMP) (Volume III, Appendix 25.10).	Implementation of an EVMP in order to: • Minimise the risk of collision and injury to marine wildlife; • Minimise the risk of disturbance to marine wildlife; • Offer guidance to contractors conducting activities on behalf of the Developer in proximity to wildlife; and • Provide contractors with the procedures for reporting vessel collisions with marine wildlife.

6.3.3 Impacts and Parameters Assessed

6.3.3.1 Both Project Design Options identified in Table 6.8 have the potential to result in AEoI on European Sites screened in for Annex II marine mammal QIs.

Table 6.8: Project Design Options 1 and 2 considered for the assessment of potential impacts on European Sites Screened in for Annex II marine mammal QIs

Potential impact	Phase C	Phase O	Phase D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
Injury and/or disturbance to marine mammals from underwater noise during piling	✓	X	X	Project Design Option 1 **Construction Phase:** Foundation installation: WTGs installed on monopile foundations: • Installation of 56 WTGs with a pile diametre between 7 m and 11 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy up to 6,600 kJ, average hammer energy up to 4,400 kJ and a strike rate of 30 strikes per minute; • Soft start energy of 825 kJ modelled with slow ramp up of energy for 30 minutes; • Anticipated maximum duration of piling at 5 hours and 10 minutes per pile with an average duration of 4 hours per pile and; • Total of 75 days when piling may occur over a maximum construction period of 5 years. Offshore Substations Platforms (OSP) installed on monopile foundations: • Installation of 2 OSPs with a pile diametre between 7 and 14 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy up to 6,600 kJ and an average hammer energy up to 6,000 kJ; • Soft start energy of 825 kJ modelled with slow ramp up of energy for 30 minutes; • Average maximum duration of 5 hours and 10 minutes per pile; and	Within the construction phase Project Design Option 1 consists of a larger number of foundations to be installed –58 monopile foundations in total (56 for WTGs and 2 for OSPs), whilst Project Design Option 2 comprises of 49 foundations in total (47 for WTGs and 2 for OSPs). Therefore, Project Design Option 1 will have a greater potential for UWN from piling activities. Therefore, overall Project Design Option 1 has a higher potential for impact than Project Design Option 2.

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		• Total of 4 days when piling may occur over a maximum construction period of 5 years.	
		Project Design Option 2 **Construction Phase:** Foundation installation: WTGs installed on monopile foundations: • Installation of 47 WTGs with a pile diametre between 7 m and 11 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy up to 6,600 kJ, average hammer energy up to 4,400 kJ and a strike rate of 30 strikes per minute; • Soft start energy of 825 kJ modelled with slow ramp up of energy for 30 minutes; • Maximum duration of piling at 5 hours 10 minutes per pile with an average duration of 4 hours per pile; and • Total of 63 days when piling may occur over a maximum construction period of 5 years. OSPs installed on monopile foundations: • Installation of 2 OSPs with a pile diametre between 7 m and 14 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy up to 6,600 kJ and an average hammer energy up to 6,000kJ; • Soft start energy of 825 kJ modelled with slow ramp up of energy for 30 minutes; • Maximum duration of 5 hours 10 minutes per pile; and • Total of 4 days when piling may occur over a maximum construction period of 5 years.	

Potential impact	Phase C	Phase O	Phase D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
Changes in electromagnetic fields (EMF) from subsea electrical cabling	X	✓	X	Project Design Option 1 **Operational and Maintenance phase:** Presence of inter-array, OSP interconnector, and offshore export cables: • 66 kV inter-array cables between 110 – 122 km in length; • 220 kV OSP interconnector cables between 25 – 28 km in length; • 220 kV offshore export cables between 35 – 40 km in length; • Burial depth between 0-1.5 m for inter-array cables and 0-2.5 m for OSP interconnector and offshore export cables; • Up to 15% of inter-array cable routes, up to 50% of OSP interconnector cable routes, and 20% of Cable Corridor and Working Area requiring protection; • Maximum three third party export cable crossings; and Operational phase up to 36.5 years.	No differences in parameters for EMF for Project Design Option 1 and Project Design Option 2.
				Project Design Option 2 **Operational and Maintenance phase:** Presence of inter-array, OSP interconnector, and offshore export cables: • 66 kV inter-array cables between 110 – 122 km in length; • 220 kV OSP interconnector cables between 25 – 28 km in length; • 220 kV offshore export cables between 35 – 40 km in length; • Burial depth between 0-1.5 m for inter-array cables and 0-2.5 m for OSP interconnector and offshore export cables; • Up to 15% of inter-array cable routes, up to 50% of OSP interconnector cable routes, and 20% of Cable Corridor and Working Area requiring protection; • Maximum three third party export cable crossings; and • Operational phase up to 36.5 years.	

Potential impact	Phase C	Phase O	Phase D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
Injury and/or disturbance to marine mammals from vessel activities	✓	✓	✓	<u>Project Design Option 1</u> **Construction Phase:** Injury and/or disturbance to marine mammals from vessel activities during construction: • Maximum of 66 installation vessels in the Array Area at any one time (including 12 installation vessels along the Cable Corridor and Working Area at any one time, and maximum of seven installation vessels in the vicinity of the landfall at any one time); • A maximum of 4,150 vessel return trips over the construction phase and a maximum of 1,797 vessel return trips per year during the construction phase, comprised of jack-up vessels, tug/anchor handlers, cable installation vessels, guard vessels, survey vessels, crew transfer vessels, scour/cable protection installation vessels, pre-installation boulder clearance vessels, sandwave clearance vessels, UXO clearance vessels and other support vessels; and • Maximum construction schedule of 24 hours a day, 7 days a week for a maximum construction period of 5 years. Within this period, offshore export cable installation may take place over a period of 12 months. **Operational and Maintenance phase:** Injury and/or disturbance to marine mammals from vessel activities during the operational and maintenance phase: • Maximum of 1,359 vessel round trips per year comprised of crew transfer vessels, jack-up vessels, cable repair vessels and other vessels, from local ports or transiting from a previously operational location; • Up to 30 operational and maintenance (O&M) vessels on site at any one time; and • Operational phase up to 36.5 years. **Decommissioning Phase:** Injury and/or disturbance during the decommissioning phase is anticipated to be similar in nature, but of lower magnitude, to the construction phase.	No differences in parameters for Injury and/or disturbance to marine mammals from vessel activities for Project Design Option 1 and Project Design Option 2.

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		<u>Project Design Option 2</u> **Construction Phase:** Injury and/or disturbance to marine mammals from vessel activities during construction: • Maximum of 66 installation vessels in the Array Area at any one time (including 12 installation vessels along the Cable Corridor and Working Area at any one time, and maximum of 7 installation vessels in the vicinity of the landfall at any one time); • A maximum of 4,150 vessel return trips over the construction phase and a maximum of 1,797 vessel return trips per year during the construction phase, comprised of jack-up vessels, tug/anchor handlers, cable installation vessels, guard vessels, survey vessels, crew transfer vessels, scour/cable protection installation vessels, pre-installation boulder clearance vessels, sandwave clearance vessels, UXO clearance vessels and other support vessels; and • Maximum construction schedule of 24 hours a day, 7 days a week for a maximum construction period of 5 years. Within this period, offshore export cable installation may take place over a period of 12 months. **Operational and Maintenance phase:** Injury and/or disturbance to marine mammals from vessel activities during the operational and maintenance phase: • Up to 1,359 vessel round trips per year during the operational maintenance phase, comprised of crew transfer vessels, jack-up vessels, cable repair vessels and other vessels; • Up to 30 operational and maintenance (O&M) vessels on site at any one time; and • Operational phase up to 36.5 years. **Decommissioning Phase:** Injury and/or disturbance during the decommissioning phase is anticipated to be similar in nature, but of lower magnitude, to the construction phase.	

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
Changes in fish and shellfish community affecting prey resources	✓ ✓ ✓	Project Design Option 1 **Construction Phase:** • Temporary subtidal habitat loss/disturbance; • Increased suspended sediment concentrations (SSC) and associated sediment deposition; • Injury and/or disturbance to fish and shellfish from underwater noise and vibration during pile driving and cable installation; and • Accidental pollution. **Operational and maintenance phase:** • Temporary subtidal habitat loss/disturbance; • Increased SSC and associated sediment deposition; • Accidental pollution; • Long-term habitat loss as a result of the presence of foundation structures, scour protection, and cable protection; • Alteration of seabed habitats arising from changes in physical processes as a result of the presence of foundation structures, scour protection, and cable protection; and • Changes in Electromagnetic Fields (EMF) from subsea cabling. **Decommissioning Phase:** • Temporary subtidal habitat loss/disturbance; • Increased suspended sediment concentrations (SSC) and associated sediment deposition; and • Accidental pollution. Project Design Option 2 **Construction Phase:** • Temporary subtidal habitat loss/disturbance; • Increased suspended sediment concentrations (SSC) and associated sediment deposition;	Within the construction phase Project Design Option 1 consists of a larger number of foundations to be installed – 58 monopile foundations in total (56 for WTGs and 2 for OSPs), whilst Project Design Option 2 comprises of 49 foundations in total (47 for WTGs and 2 for OSPs). Therefore, Project Design Option 1 will have a greater potential for changes in fish and shellfish community affecting prey resource. Within the Decommissioning Phase Project Design Option 1 will result in the deconstruction and removal of all 56 WTG topsides and 2 OSP topsides, with both to be cut at seabed level, whilst Project Design Option 2 consists of the deconstruction and removal of all 47 WTG topsides and 2 OSP topsides , with both to be cut at seabed level . Therefore, Project Design Option 1 will have a greater potential for changes in fish and shellfish community affecting prey resource. Therefore, overall Project Design Option 1 has a higher potential for impact than Project Design Option 2.

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		• Injury and/or disturbance to fish and shellfish from underwater noise and vibration during pile driving and cable installation; and • Accidental pollution. **Operational and maintenance phase:** • Temporary subtidal habitat loss/disturbance; • Increased SSC and associated sediment deposition; • Accidental pollution; • Long-term habitat loss as a result of the presence of foundation structures, scour protection, and cable protection; • Alteration of seabed habitats arising from changes in physical processes as a result of the presence of foundation structures, scour protection, and cable protection; and • Changes in Electromagnetic Fields (EMF) from subsea cabling. **Decommissioning Phase:** • Temporary subtidal habitat loss/disturbance; • Increased suspended sediment concentrations (SSC) and associated sediment deposition; and • Accidental pollution.	
Injury and/or disturbance to marine mammals from underwater noise during site surveys	✓ ✓ X	<u>Project Design Option 1</u> **Construction phase:** The exact equipment to be deployed during the site surveys are yet to be confirmed, therefore examples of different survey equipment and expected source levels have been used for this assessment. Injury and/or disturbance to marine mammals from underwater noise during site surveys: • Geophysical (non-impulsive sonar based) surveys including MultiBeam Echosounder (MBES), Side scan sonar (SSS), and Sub-bottom Profiler (SBP);	The parameters assessed are the same between Project Design Option 1 and 2

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		• Geophysical surveys including seismic refraction and sparker; and • Geotechnical surveys including seismic cone penetration test (CPT), vibrocore, and grab sampling. **Operational and maintenance phase:** Injury and/or disturbance to marine mammals from underwater noise during site surveys: • Geophysical surveys (inter-array cables) every six months for the first two years and annually thereafter; • Geophysical surveys (inter-connector cables) every six months for the first two years and annually thereafter; and • Geophysical surveys (export cables) every six months for the first two years and annually thereafter. The exact equipment to be deployed during the geophysical site surveys is unknown. Therefore, it is assumed that the equipment described in the construction phase will be used for the purposes of this assessment. Injury and/or disturbance during operational and maintenance phase is anticipated to be similar in nature to the construction phase.	
		Project Design Option 2 **Construction phase:** The exact equipment to be deployed during the site surveys are yet to be confirmed, therefore examples of different survey equipment and expected source levels have been used for this assessment. Injury and/or disturbance to marine mammals from underwater noise during site surveys: • Geophysical (non-impulsive sonar based) surveys including MultiBeam Echosounder (MBES), Side scan sonar (SSS), and Sub-bottom Profiler (SBP);	

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		• Geophysical surveys including seismic refraction and sparker; and • Geotechnical surveys including seismic cone penetration test (CPT), vibrocore, and grab sampling. **Operational and maintenance phase** Injury and/or disturbance to marine mammals from underwater noise during site surveys: • Geophysical surveys (inter-array cables) every six months for the first two years and annually thereafter; • Geophysical surveys (inter-connector cables) every six months for the first two years and annually thereafter; and • Geophysical surveys (export cables) every six months for the first two years and annually thereafter. The exact equipment to be deployed during the geophysical site surveys is unknown. Therefore, it is assumed that the equipment described in the construction phase will be used for the purposes of this assessment. Injury and/or disturbance during operational and maintenance phase is anticipated to be similar in nature to the construction phase.	
Injury and/or disturbance to marine mammals from underwater noise during UXO clearance	✓ X X	Project Design Option 1 **Construction phase:** The type, size, and number of possible UXO that may require clearance is currently unknown. An illustrative assessment is presented using charge weights (TNT equivalent) ranging from 25 to 800 kg, with an additional donor weight of 0.5 kg, for high order detonation. A charge weight of 0.5 kg is used to provide an illustrative assessment of a low order (deflagration) detonation.	The parameters assessed are the same between Project Design Option 1 and 2

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		Project Design Option 2 **Construction phase:** The type, size, and number of possible UXO that may require clearance is currently unknown. An illustrative assessment is presented using charge weights (TNT equivalent) ranging from 25 to 800 kg, with an additional donor weight of 0.5 kg, for high order detonation. A charge weight of 0.5 kg is used to provide an illustrative assessment of a low order (deflagration) detonation.	
Accidental pollution	✓ ✓ ✓	Project Design Option 1 **Construction phase:** Accidental pollution in the Array Area during construction from: • Installation of 56 WTGs and 2 OSPs within the Array Area; • Installation of inter-array cables between 110 – 122 km in length, OSP interconnector cables between 25 – 28 km in length, and offshore export cables between 35 – 40 km in length; • Maximum of 66 installation vessels in the Array Area at any one time (including 12 installation vessels along the offshore Cable Corridor and Working Area at any one time, and maximum of 7 installation vessels in the vicinity of the landfall at any one time; • A maximum of 4,150 vessel return trips over the construction phase and a maximum of 1,797 vessel return trips per year during the construction phase, comprised of jack-up vessels, tug/anchor handlers, cable installation vessels, guard vessels, survey vessels, crew transfer vessels, scour/cable protection installation vessels, pre-installation boulder clearance vessels, sandwave clearance vessels, UXO clearance vessels and other support vessels; and	Within the construction phase Project Design Option 1 consists of a larger number of foundations to be installed – – 58 monopile foundations in total (56 for WTGs and 2 for OSPs), whilst Project Design Option 2 comprises of 49 foundations in total (47 for WTGs and 2 for OSPs). Therefore, Project Design Option 1 will have a greater potential for accidental pollution. Within the Decommissioning Phase Project Design Option 1 will result in the deconstruction and removal of all 56 WTG topsides and 2 OSP topsides, with both to be cut at seabed level, whilst Project Design Option 2 consists of the deconstruction and removal of all 47 WTG topsides and 2 OSP topsides , with both to be cut at seabed level . Therefore, Project Design Option 1 will have a greater potential for accidental pollution. Therefore, overall Project Design Option 1 has a higher potential for impact than Project Design Option 2.

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		• A maximum of 294 helicopter return trips over the construction phase and a maximum of 118 helicopter return trips per year. **Operational and maintenance phase:** Accidental pollution in the Array Area during O&M from: • Up to 30 O&M vessels on site at any one time; • Up to 1,359 vessel round trips per year comprised of crew transfer vessels, jack-up vessels, cable repair vessels and other vessels, from local ports or transiting from a previously operational location; • A maximum of 485 helicopter return trips per year; • Presence of 56 WTGs and 2 OSPs; and • Maintenance activities of 56 WTGs and 2 OSPs **Decommissioning phase:** Accidental pollution in the Array Area during decommissioning from: • Decommissioning of 56 WTGs and 2 OSPs.	
		Project Design Option 2 **Construction phase:** Accidental pollution in the Array Area during construction from: • Installation of 47 WTGs and 2 OSPs within the Array Area; • Installation of inter-array cables between 110 – 122 km in length, OSP interconnector cables between 25 – 28 km in length, and offshore export cables between 35 – 40 km in length; and • Maximum of 66 installation vessels in the Array Area at any one time (including 12 installation vessels along the offshore Cable Corridor and Working Area at any one time, and maximum of 7 installation vessels in the vicinity of the landfall at any one time. **Operational and maintenance phase:** Accidental pollution in the Array Area during O&M from:	

Potential impact	Phase C O D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
		• Maximum of 1,359 vessel round trips per year comprised of crew transfer vessels, jack-up vessels, cable repair vessels and other vessels, from local ports or transiting from a previously operational location; • Up to 30 O&M vessels on site at any one time; • Presence of 47 WTGs and 2 OSPs; and • Maintenance activities of 47 WTGs and 2 OSPs. **Decommissioning phase:** Accidental pollution in the Array Area during decommissioning from: • Decommissioning of 47 WTGs and 2 OSPs.	

6.4 Assessment of Proposed Development alone for Marine Mammal QIs

Sites within Ireland

6.4.1 Blackwater Bank SAC

Harbour porpoise

6.4.1.0 The conservation objectives for harbour porpoise at this designated site have yet to be provided as it has only recently been designated as a site with harbour porpoise as a qualifying interest. Therefore, on a precautionary basis, we will be basing our assessment on the conservation objectives for West Wales Marine SAC as it is the next closest designated site with the same QI of harbour porpoise. The COs are to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.1.1 There are five key potential impacts on harbour porpoise associated with the construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development.

INJURY AND/OR DISTURBANCE FROM UNDERWATER NOISE

6.4.1.2 Underwater noise has the potential to impact marine mammals if the frequency is within their hearing range, and in particular if the sound levels are greater than the relevant thresholds. With consideration of harbour porpoise, they are within the Very High Frequency (VHF) cetacean hearing group and have a hearing range of 275 hz to 160 kHz. The impacts can range from auditory injury, disturbance and displacement, to changes in behaviour including masking depending on the severity of the underwater noise.

6.4.1.3 With consideration of the risk and impacts of auditory injury, all species of cetaceans rely on sonar for navigation, finding prey and communication (Southall *et al.*, 2007). The ecological consequences of PTS (a permanent and irreversible hearing impairment) are uncertain, although a loss of hearing could affect key life functions such as communication, predator detection, foraging, mating and maternal fitness, and could lead to a change in an animal's health or vital rates (Erbe *et al.*, 2018). Relating a potential loss in hearing to a biologically significant response is challenging due to a paucity of empirical data, however a potential consequence of a disruption in key life functions is that the health of impacted animals would deteriorate and potentially lead to reduced birth rate in females and mortality of individuals.

6.4.1.4 At a Department of Business, Energy, and Industrial Strategy (BEIS)-funded expert elicitation workshop in 2018, experts discussed the nature, extent, and potentially consequences of PTS to marine mammal species in the UK (Booth and Heinis, 2018). Using the best and most recent data available on the effects of PTS on marine mammals, the experts concluded that PTS did not mean animals were deaf, and the magnitude and frequency band in which PTS occurs is critical to assessing the effect on vital rates.

6.4.1.5 Exposure to loud underwater noises can lead to a reduction in hearing sensitivity which may be temporary (TTS) or permanent (PTS). PTS is defined by Southall *et al.* (2007) as a non-recoverable elevation of the hearing threshold of 6 dB. It has been assumed that PTS-onset occurs after TTS has grown to 40 dB, based on TTS growth rates obtained from scientific literature. Studies of auditory injury in relation to a typical piling sequence have suggested that hearing impairment caused by exposure to piling noise is likely to occur where the source frequencies overlap the range of peak sensitivity for the receptor species rather than across the whole frequency hearing spectrum (Kastelein *et al.*, 2013a). For piling noise, most energy is between ~30 – 500 Hz, with a peak between 100-300 Hz and energy extending above 2 kHz (Kastelein *et al.*, 2015; Kastelein *et al.*, 2016). Studies have shown that exposure to impulsive pile driving noise induces TTS in a relatively narrow frequency band in harbour porpoise (Finneran, 2015), with statistically significant TTS occurring at 4 and 8 kHz, respectively (Kastelein *et al.*, 2016) and centred at 4 kHz (Kastelein *et al.*, 2012a; Kastelein *et al.*, 2012b; Kastelein *et al.*, 2013b; Kastelein *et al.*, 2017). As a result, at an expert elicitation workshop, it was agreed that any threshold shifts to hearing caused by pile driving would manifest in the range of 2 – 10 kHz (Kastelein *et al.*, 2017). It was also agreed that a PTS of 6 – 18 dB in a narrow frequency band in the 2 – 10 kHz region is unlikely to significantly affect the ability of individuals to survive and reproduce (Kastelein *et al.*, 2017).

6.4.1.6 Despite harbour porpoises' potential sensitivity to PTS and TTS, in Booth and Heins (2018) they concluded that the probability of PTS significantly affecting the survival and reproduction of harbour porpoises is very low. With consideration that TTS is temporary, this poses an entirely negligible risk of impacting survivability and reproduction.

6.4.1.7 With regards to underwater noise produced by UXO clearance, there are two activities that produce noise, higher order detonation, and low-order clearance methods. It is unknown if there are UXO that require clearance at the time of this assessment, and therefore is unknown to what level of clearance will be carried out. Therefore, this assessment is based on high-order UXO clearance being carried out which is viewed as the worst-case scenario in terms of underwater noise generation.

6.4.1.8 The main underwater noise produced by high-order detonation is outside of the region of greatest sensitivity for harbour porpoise (Southall *et al.,* 2019), and there is a pronounced reduction in energy levels above ~5-10 kHz (von Beckmann *et al.,* 2015 and Salomons *et al.,* 2021). Due to this, with consideration of the above sensitivity, it is concluded that harbour porpoises have a low sensitivity to this effect.

6.4.1.9 With regards to underwater noise produced by geophysical surveys, exact surveys and equipment is yet to be decided, therefore as a precautionary approach we have considered all types of noise generation from the varied survey types. Surveys such as multibeam EchoSounder (MBES) and side scan sonar (SSS) produce sounds which are sonar based and impulsive. Surveys comprising of vibrocoring typically produce non-implusive sound. The equipments noise source levels is provided in Table 6.9 and Table 6.10**.**

Table 6.9: Underwater noise produced by geophysical survey techniques

Survey type	Equipment type	SEL (unweighted) (dB re 1μPa^{2}s @1 m)	SPL $_{rms}$ T90 (dB re 1μPa @1 m)	SPL $_{pk}$ (dB re 1μPa @ 1 m)
Non-impulsive sonar-based surveys / equipment				
Multibeam EchoSounder (MBES)	Konsberg EM2040 or Reason Seabat 7125	N/A	213	N/A
Side scan sonar (SSS)	Edgetech FS4200 or Klein 5000	N/A	210	N/A
Sub-bottom profiler (SBP)	Innomar SES Standard / Medium or Applied Acoustics	N/A	245	N/A

Survey type	Equipment type	SEL (unweighted) (dB re 1μPa^{2}s @1 m)	SPL $_{rms}$ T90 (dB re 1μPa @1 m)	SPL $_{pk}$ (dB re 1μPa @ 1 m)
	AA251 or Edgetech 6205S			
Impulsive surveys / equipment				
Seismic refraction	TI sleeve 10CU	195	214	224
Sparker (2DUHRS and 3DUHRS)	Geosource 200 – 400	182	214	219

Table 6.10: Underwater noise produced by geotechnical survey techniques

Survey type	Source level (dB re 1μPa re 1 m (peak)	Source SEL (dB re 1 μPa^{2}s re 1 m) (unweighted)	SPL rms T90
Seismic Cone Penetration Test (CPT)[1]	220	189	203
Vibrocore	190	223[2]	187
Grab sample	N/A	N/A	N/A

[1]Equipment is pushed into the seabed and therefore would not result in a measurable noise source.

[2]Based on one hour of operation for a single core sample.

6.4.1.10 A study by Lucke *et al.* (2009) indicated that TTS could be induced in harbour porpoise at 350 m when exposed to an airgun impulse at a peak pressure of 200 dB$_{pk-pk}$ re 1 μPa with corresponding SEL of 164.5 dB re μPa^2$_s$) in shallow waters (~4 m), however this study is highly conservative as it assumes that the animal would remain stationary throughout the exposure. Evidence from other studies suggests that harbour porpoises exposed to such noise sources would likely move away from the source, and therefore leave the impact range of PTS-onset (Hermannsen *et al.,* 2015). Furthermore, it is expected that vessel presence will act as a deterrent to harbour porpoise, reducing the risk of auditory injury (Benhemma-Le Gall *et al.*, 2023). Therefore, it is highly unlikely that harbour porpoise will be present in the immediate vicinity at the start of any survey activity.

6.4.1.11 While PTS is a permanent effect which cannot be recovered from, the most likely response of a marine mammal to noise levels that could induce TTS is to flee the area (Southall *et al.,* 2007). Therefore, animals exposed to these noise levels that could induce TTS are likely to actively avoid hearing damage by moving away from the source.

6.4.1.12 Data collected during the construction of offshore windfarms have shown that harbour porpoise detections around the pile driving area decline for several hours prior to the commencement of pile driving (Benhemma-Le Gall *et al.*, 2021; Benhemma-Le Gall *et al.*, 2023; Brandt *et al.*, 2018; Graham *et al.*, 2019). For example, during the installation campaigns of both Beatrice and Moray East offshore windfarms, harbour porpoise acoustic detections gradually declined by up to 33% during the 48-hour period prior to piling (Benhemma-Le Gall *et al.*, 2023). It is assumed that this is due to an increase in other construction-related activities and the presence of vessels in advance of pile driving which act as a deterrent to harbour porpoise, therefore reducing the risk of auditory injury (Benhemma-Le Gall *et al.*, 2023). Therefore, it is highly unlikely that harbour porpoise will be present in the immediate vicinity of the pile driving at the start of the activity. Consequently, the assessment of underwater noise in relation to pile driving, which assumes harbour porpoises will be present in the immediate vicinity during pile driving, is extremely precautionary.

6.4.1.13 With consideration of the risks and impacts of disturbance and behavioural change harbour porpoises are particularly vulnerable to disturbance because they are small cetaceans which makes them susceptible to heat loss and as a result, requires them to forage frequently in order to maintain a high metabolic rate with little energy remaining for fat storage (Rojano-Doñate *et al.*, 2018; Wisniewska *et al.*, 2016). Therefore, there is a risk of changes to their overall fitness if they are displaced from high-quality foraging grounds or if their foraging efficiency is disturbed, and they are unable to find alternative suitable foraging grounds that will provide sufficient food to meet their metabolic needs. However, results from studies using Digital Acoustic Recording Tags (DTAGs) suggest that harbour porpoises are able to respond to short-term reductions in food intake and may have some resilience to disturbance (Wisniewska *et al.*, 2016).

6.4.1.14 As established in Section 6.4.1.12, harbour porpoises are displaced by piling activities. However, the same studies further establishing that likelihood of displacement diminished over the construction period (Graham *et al.* 2019), which supports the conclusion that these effects are temporary and short-term and therefore negligible.

6.4.1.15 Recent studies at two offshore windfarms in Scotland showed that detections of clicks, associated with echolocation, and buzzing, associated with prey capture, in the short range (2 km) did not cease in response to piling, suggesting that porpoises were not completely displaced from the piling area (Benhemma-Le Gall *et al.*, 2021). Furthermore, the study suggests that animals that experience displacement may be able to compensate for missed foraging opportunities and increased energy expenditure of fleeing the piling area as detections of both clicks and buzzing were positively related to the distance from the piling activity (Benhemma-Le Gall *et al.*, 2021) which could be due to an increase in foraging activities beyond the piling impact range.

6.4.1.16 At an expert elicitation workshop in 2019, experts agreed that juvenile and adult survival were unlikely to be significantly affected by missed foraging opportunities as a result of disturbance from piling (Booth *et al.*, 2019).

6.4.1.17 Available guidance on assessing the significance of noise disturbance from UXO detonation against the conservation objectives of SACs with harbour porpoise as qualifying interests within England, Wales and Northern Ireland recommend an effective deterrence range (EDR) of 26 km for high-order detonations (JNCC, 2020). It should be noted that this EDR is based upon avoidance from piling, not UXO clearance, and the same guidance states that '*a one off explosion would probably only elicit a startle response and would not cause widespread and prolonged displacement*''. With consideration of the resilience of the species highlighted above, it is concluded that harbour porpoise are not sensitive to UXO clearance behavioural disturbance effects when considering the integrity of the designated site.

6.4.1.18 The assessment has been informed by the Underwater Noise Assessment by Subacoustech (Volume III, Appendix 11.1) which includes the results of numerical modelling using the INSPIRE underwater noise model.

6.4.1.19 Piling will only be carried out during the construction phase of the Proposed Development. Based on calculations and data presented in Table 6.11 it is calculated that the maximum instantaneous PTS-onset impact range was 750 m (11 m monopile in the south-west (SW) location), with other piling locations having a reduced range. Based on this calculation this equates to a maximum of one harbour porpoise experience auditory injury (based on worst-case-scenario densities). The cumulative PTS-onset thresholds maximum impact range is 10,000 m (11 m monopile in the SW, or 14 m monopile in the S-OSP). Based on this calculation this equates to a maximum of 68 animals experience auditory injury (based on worst-case-scenario densities).

6.4.1.20 With regards to UXO clearance, based on the modelling presented in Table 6.12, the maximum PTS-onset impact range is 14 km. This would result in up to 234 harbour porpoise (0.37% of the population) experiencing PTS from a high-order detonation with the greatest charge weight.

Table 6.11: PTS-onset from pile driving and disturbance at array locations with harbour porpoise densities estimates

Piling location and Monopile		Site specific DAS density estimate/ SCANS-IV density estimate (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
Instantaneous PTS-onset (unweighted SPL_{peak})						
NW	7 m	0.38 / 0.2803	0.70	490	<1	<0.01
	11 m		0.73	500	<1	<0.01
C	7 m	0.38 / 0.2803	1.5	690	1 / <1	<0.01
	11 m		1.5	700	1 / <1	<0.01
SW	7 m	0.38 / 0.2803	1.6	740	1 / <1	<0.01
	11 m		1.6	750	1 / <1	<0.01
N-OSP	7 m	0.38 / 0.2803	1	570	<1	<0.01
	14 m		1	580	<1	<0.01
S-OSP	7 m	0.38 / 0.2803	1.4	670	1 / <1	<0.01

Piling location and Monopile		Site specific DAS density estimate/ SCANS-IV density estimate (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
	14 m		1.4	680	1 / <1	<0.01
Cumulative PTS-onset (weighted SEL_{cum})						
NW	7 m	0.38 / 0.2803	31	4,600	12 / 9	0.02 / 0.01
	11 m		31	4,600	12 / 9	0.02 / 0.01
C	7 m	0.38 / 0.2803	150	9,100	57 / 42	0.09 / 0.07
	11 m		150	9,100	57 / 42	0.09 / 0.07
SW	7 m	0.38 / 0.2803	180	10,000	68 / 50	0.11 / 0.08
	11 m		180	10,000	68 / 50	0.11 / 0.08
N-OSP	7 m	0.38 / 0.2803	49	5,400	19 / 14	0.03 / 0.02
	14 m		49	5,400	19 / 14	0.03 / 0.02

Piling location and Monopile		Site specific DAS density estimate/ SCANS-IV density estimate (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
S-OSP	7 m	0.38 / 0.2803	170	10,000	65 / 48	0.10 / 0.08
	14 m		170	10,000	65 / 48	0.10 / 0.08
Predicted disturbance						
NW	7 m	0.38 / 0.2803	-	-	1,933 / 1,426	3.09 / 2.28
	11 m		-	-	1,951 / 1,439	3.12 / 2.30
C	7 m	0.38 / 0.2803	-	-	3,117 / 2,299	4.99 / 3.68
	11 m		-	-	3,111 / 2,295	4.98 / 3.67
SW	7 m	0.38 / 0.2803	-	-	3,363 / 2,481	5.38 / 3.97
	11 m		-	-	3,380 / 2,493	5.41 / 3.99
N-OSP	7 m	0.38 / 0.2803	-	-	2,174 / 1,604	3.48 / 2.57

Piling location and Monopile		Site specific DAS density estimate/ SCANS-IV density estimate (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
	14 m		-	-	2,190 / 1,615	3.50 / 2.58
S-OSP	7 m	0.38 / 0.2803	-	-	3,335 / 2,460	5.33 / 3.93
	14 m		-	-	3,355 / 2,475	5.37 / 3.96

Table 6.12: PTS-onset ranges and numbers of harbour porpoise modelled to be within range for all potential charge weights

Charge Weight (kg)	Maximum range (km)	Site specific DAS density estimate/ SCANS-IV density estimate (animals/km²)	Number of animals	% of reference population
PTS-onset (unweighted SPLpeak)				
0.5 (low order)	1.2	0.38/ 0.2803	2 / 1	<0.01 / <0.01
25 + donor	4.6		25 / 19	0.04 / 0.03
55 + donor	6.0		43 / 32	0.07 / 0.05
120 +donor	7.8		73 / 54	0.12 / 0.09
240 + donor	9.8		115 / 85	0.18 / 0.14
525 + donor	12.0		172 / 127	0.27 / 0.20
700 + donor	14.0		234 / 173	0.37 / 0.28
800 + donor	14.0		234 / 173	0.37 / 0.28
PTS-onset (weighted SELss)				
0.5 (low order)	0.11	0.38/ 0.2803	<1	<0.01
25 + donor	0.57		<1	<0.01
55 + donor	0.74		1 / <1	<0.01
120 +donor	0.95		1	<0.01
240 + donor	1.1		1	<0.01
525 + donor	1.4		2	<0.01

Charge Weight (kg)	Maximum range (km)	Site specific DAS density estimate/ SCANS-IV density estimate (animals/km²)	Number of animals	% of reference population
700 + donor	1.5		3 / 2	<0.01
800 + donor	1.6		3 / 2	<0.01
Disturbance				
High Order Clearance	26	0.38/ 0.2803	807/ 595	1.29
Low Order Clearance	5	0.38/ 0.2803	30/ 22	0.05

6.4.1.21 **With consideration of low level of impact PTS has on harbour porpoise, and that the predicted range of effect falls outside of the SAC (greatest impact range predicted to be 14 km) and that at most 0.37% of the wider population may be impacted, it is concluded there will be no AEoI upon the integrity of Blackwater Bank SAC, as defined by the COs of the site, as a result of injury from underwater noise impacting harbour porpoise from Project Design Option 1.**

6.4.1.22 **Based on the increased risk of effect of Project Design Option 1, it can be reasonably assumed that the same conclusion of no AEoI would also apply to Project Design Option 2.**

6.4.1.23 With regards to behavioural changes caused by underwater noise, per our assessment in Table 6.11 total of up to 3,380 harbour porpoise (5.41% of the population) may experience disturbance during the Proposed Development's construction phase based on the highest population density estimates, which we consider to be highly precautionary. Other sources of disturbance (UXO clearance and surveys) are anticipated to result in less disturbance than the piling.

6.4.1.24 **With consideration of the low proportion of the population to be impacted and the recoverable and short-term (although repeated) nature of the impact, it is concluded there will be no AEoI upon the integrity of Blackwater Bank SAC, as defined by the COs of the site, as a result of behavioural disturbance from underwater noise impacting harbour porpoise from Project Design Option 1.**

6.4.1.25 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE

6.4.1.26 There are no piling activities proposed for the operational and maintenance phase of the Proposed Development. Any underwater noise produced will be due to vessel movements which is assessed in Section 6.4.1.28 to 6.4.1.50.

6.4.1.27 **There is no potential for AEoI from underwater noise in the operational and maintenance phase of the Proposed Development on this site and feature, as defined by the COs of the site, for both Project Design Option 1 and 2.**

INJURY AND/ OR DISTURBANCE FROM VESSEL MOVEMENTS

6.4.1.28 There will be increased vessel movements compared to baseline levels during all phases of the Proposed Development, which can result in injury and/ or mortality from vessel collision, or disturbance though presence and the generation of underwater noise.

6.4.1.29 The area surrounding the Proposed Development experiences a relatively low level of vessel traffic due to the presence of the shallow Arklow Bank sandbank, with higher traffic in the coastal areas and immediate surrounding waters.

6.4.1.30 The shipping and navigation baseline study recorded 29 days of vessel traffic data between 7 July and 14 August 2023. There was an average of 36 to 37 unique vessels per day recorded within the shipping and navigation Study Area (which is defined as Array Area and a 10 nm buffer). The busiest day recorded 59 unique vessels within the shipping and navigation Study Area. The main vessel types within the shipping and navigation Study Area were cargo vessels (40%), recreational vessels (31%) and fishing vessels (10%).

6.4.1.31 During construction of the windfarm, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. In general, three consequences of vessel collision are defined: direct (injuries to the animals that are the immediate result of collision), long-term (a decrease in the fitness of the animal over time), and population consequences (Schoeman et al., 2020). With regards to injuries, both fatal and non-fatal injuries between marine mammals and vessels have been documented (Laist et al., 2001; Vanderlaan et al., 2008; Cates et al., 2017). Fatal collisions have been evidenced via carcasses washing up on beaches (Laist et al., 2001; Peltier et al., 2019); carcasses caught on vessel bows (Laist et al., 2001; Peltier et al., 2019); and floating carcasses which have strong evidence of ship strike, such as propeller cuts, significant bruising, oedema, internal bleeding radiating from a specific impact site, fractures and ship paint marks (Jensen and Silber, 2003; Douglas et al., 2008). Fatalities from ship strikes, however, often go unreported (Authier et al., 2014). For non-fatal injuries, evidence of animals which have survived ship strikes with non-fatal injuries from propellers has been widely documented (Wells et al., 2008; Luksenburg, 2014).

6.4.1.32 Although many species of marine mammals are able to detect and avoid vessels, it is unclear why some individuals do not always move out of the path of an approaching vessel (Schoeman et al., 2020), although it has been suggested that behaviours such as resting, foraging, nursing, and socialising could distract animals from detecting the risk posed by vessels (Dukas, 2002). It is also possible that animals do not hear vessels when they are near the surface. Collisions between cetaceans and vessels, however, are not necessarily lethal on all occasions.

6.4.1.33 Whilst a broad range of vessel types have been involved in collisions with marine mammals (Laist et al., 2001), vessels travelling at higher speeds pose a higher risk because of the potential for a stronger strike impact (Schoeman *et al*., 2020). For example, a study by Laist et al. (2001) found that in 89% of collisions in which the whale was killed or seriously injured vessels were travelling at speeds of 14 kn (7 m/s) or more, and the vessel exceeded a length of 80 m. Therefore, larger vessels travelling at 7 m/s or faster are those most likely to cause death or serious injury to marine mammals (Laist et al., 2001).

6.4.1.34 Harbour porpoises are relatively small and highly mobile, and given observed responses to noise, are expected to detect vessels in close proximity and largely avoid collision. Several studies have shown that harbour porpoise typically avoid vessels (Benhemma-Le Gall et al., 2021; Benhemma-Le Gall et al., 2023; Brandt et al., 2018; Heinänen and Skov, 2015). There is a lack of information on the frequency of vessel collisions with marine mammals in Irish waters, and there is a lack of evidence from marine mammals stranded in the Irish Sea to suggest that injury from vessel collisions is a significant cause of marine mammal mortality. In the UK, the Cetacean Strandings Investigation Programme (CSIP) documents the annual number of reported strandings and the cause of death for those individuals examined at post-mortem. Based on the most recent CSIP report, post-mortems were conducted on 69 out of the 532 reported harbour porpoise strandings in 2018. A cause of death was established in 60 examined individuals and, of these, one individual died from physical trauma due to vessel strike and two individuals had died from physical trauma of an unknown cause, which could have been due to vessel strike (CSIP, 2019). It is not considered that vessel collisions to be a significant cause of mortality within the Irish Sea.

6.4.1.35 Overall, the assessment concludes that there is a high likelihood that harbour porpoise will avoid vessels and therefore collision risk is viewed as negligible, although they have a high sensitivity to the impact should it occur.

6.4.1.36 With consideration to behavioural impacts from the presence of the noise generated by vessel movements, harbour porpoises are particularly sensitive to high frequency noise, and it is well documented that they typically avoid vessels (e.g. Culloch et al., 2016; Benhemma-Le Gall et al., 2021). During the construction of Beatrice and Moray East offshore windfarms in the Moray Firth, harbour porpoise occurrence decreased with increasing vessel presence, with the magnitude of decrease depending on the distance to the vessel (Benhemma-Le Gall et al., 2021). As such, the probability of harbour porpoise occurrence at a mean vessel distance of 2 km decreased by up to 95% to 0.02 for the highest vessel intensity (Benhemma-Le Gall et al., 2021). At a mean vessel distance of 3 km, the probability decreased by up to 57% to 0.16 for the highest vessel intensity, and no apparent response was observed at 4 km (Benhemma-Le Gall et al., 2021).

6.4.1.37 In a large-scale study of harbour porpoise density in UK waters, increased vessel activity was generally associated with lower harbour porpoise densities (Heinänen and Skov, 2015). Furthermore, Wisniewska et al., (2018) collected telemetry data to study the change in foraging rates of harbour porpoise in response to vessel noise in highly trafficked coastal waters in the inner Danish waters and Belt seas. The results show that occasional high-noise levels coincided with vigorous fluking, bottom diving, interrupted foraging and even cessation of echolocation, leading to significantly fewer prey capture attempts at received levels greater than 96 dB re 1 μPa (16 kHz third-octave band) (Wisniewska et al., 2018).

6.4.1.38 The studies discussed above evidence some changes in harbour porpoise behaviour and presence as a result of disturbance from vessel activity. Behavioural responses include increased fluking, interrupted foraging, change to vocalisations, prolonged dives and directed movement away from the sound source (Oakley et al., 2017; Wisniewska et al., 2018). Several studies have also evidenced an increase in vessel presence correlates with a decrease in harbour porpoise presence (Benhemma-Le Gall et al., 2021; Benhemma-Le Gall et al., 2023; Brandt et al., 2018). However, harbour porpoises occur widely throughout the Irish Sea (Berrow et al., 2010; Rogan et al., 2018a; Wall et al., 2013) and therefore it is assumed (since they have a requirement to feed regularly) that there is suitable foraging habitat across their range. Therefore, relatively short-term localised disturbance within the vicinity of the Proposed Development is unlikely to lead to any population-level effects on harbour porpoise. As a result, it is concluded that harbour porpoises are considered to be of reasonable adaptability, limited tolerance and have high recoverability. As such, they are generally not sensitive to impacts from vessel movements. **Therefore there is no potential for AEoI on the Blackwater Bank SAC, as defined by the COs of the site, as a result of injury or disturbance as a result of vessel movements.**

CONSTRUCTION AND DECOMMISSIONING

6.4.1.39 During the construction phase, a maximum of 66 installation vessels will be present within the Proposed Development at any one time, resulting in a maximum of 4,150 vessel return trips over the five-year construction period, and a maximum of 1,797 vessel return trips per year. A similar number of vessels are anticipated for the decommissioning phase.

6.4.1.40 The majority of vessels used during the construction phase are likely to be large vessels that will either be travelling considerably slower than 7 m/s (the key risk is when this speed is exceeded with large vessels) or will be stationary for significant periods of time. Therefore, the actual increase in vessel traffic moving within the Proposed Development and to/from port will occur over short periods of the offshore construction activity. Smaller vessels involved in construction activities (i.e. tug/anchor handlers, guard vessels, survey vessels, and crew transfer vessels) are able to move to avoid marine mammals (when detected), even when an animal is close and the vessel is going at high speed, due to better manoeuvrability compared to larger vessels (Schoeman et al., 2020). In contrast, large vessels, such as jack-up vessels, have low manoeuvrability and may require larger distances to avoid an animal, but travel at slower speeds. In addition, the factored-in measures (see Table 6.7) which includes an Environmental VMP (EVMP), will ensure that vessel traffic will move along predictable routes, which is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al., 2001; Lusseau 2003; 2006). The EVMP also sets out a Code of Conduct to minimise interactions with marine mammals and to define how vessels should behave in the presence of them.

6.4.1.41 It is also anticipated that noise produced by the vessels will be detectable by harbour porpoise and therefore enable avoidance.

6.4.1.42 **It is concluded that there is no potential for AEoI upon the integrity of Blackwater Bank SAC, as defined by the COs of the site, as a result of injury from vessel collision impacting harbour porpoise from Project Design Option 1.**

6.4.1.43 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.1.44 With consideration of disturbance and displacement, the coastal areas and immediate surrounding waters of the Proposed Development are already subject to high levels of vessel traffic. With consideration of this, it is concluded that it is unlikely there will be a significant change in the level of disturbance that harbour porpoise naturally present are subject to. In addition to this, Heinänen and Skov (2015) suggested that harbour porpoise density was significantly lower in areas with vessel transit rates of greater than 20,000 vessels/year (80 per day within an area of 5 km^2). Comparatively, vessel traffic in the Proposed Development Study Area averages 36 vessels per day. The EVMP will serve to ensure that vessels follow predictable routes in addition to setting out how they should behave in the presence of the species. It is concluded that any disturbance above current baseline levels of activity will only result in a short-term and temporary effect on behaviour.

6.4.1.45 The proposed implementation of a EVMP will reduce the risk of vessel disturbance by controlling the speed and movement of vessels, resulting in slower moving vessels travelling more predictable routes which are less likely to cause disturbance. This is supported by vessel simulation modelling by Findlay et al. (2023) which predicted that, when animals were exposed to vessels at a given distance with both a 20% and a 50% reduction in speed, all potential noise impacts were reduced. At a 20% reduction in speed, the vessel noise swath halved, reducing the average number of animals exposed by 50% and therefore reducing the number of animals that are likely to be disturbed (Findlay et al., 2023). In addition, the study demonstrated that moderate slowdowns strongly reduce vessel source levels, with a 20% reduction in speed decreasing mean source levels by 6 dB and a 50% speed reduction by 18 dB (Findlay et al., 2023).

6.4.1.46 **Therefore, it is concluded that there will be no AEoI upon the integrity of Blackwater Bank SAC, as defined by the COs of the site, as a result of disturbance from vessel movement impacting harbour porpoise from Project Design Option 1.**

6.4.1.47 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE

6.4.1.48 During the operational and maintenance phase, a maximum of 22 vessels will be present within the Array Area at any one time, resulting in a maximum of 1,294 vessel return trips per year. With consideration that this is a significant reduction in the number of vessels present in comparison to the construction and decommissioning phase, it is concluded that based on the assessment for that phase, there is no potential for a significant effect.

6.4.1.49 **Therefore, it is concluded that there are no AEoI upon the integrity of Blackwater Bank SAC, as defined by the COs of the site, as a result of disturbance or collision risk from vessel movement impacting harbour porpoise from Project Design Option 1 in this phase.**

6.4.1.50 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

EMF

6.4.1.51 The conduction of electricity through subsea power cables has the potential for emit localised EMF, which has the potential to affect the sensory mechanisms of harbour porpoise (CMACS, 2003; Copping, 2018; Normandeau et al., 2011), though the effects are not well understood. This impact may only occur during the operational and maintenance phase of the Proposed Development when there is power generation occurring.

6.4.1.52 Anthropogenic sources of EMF are primarily subsea cables used for power generation and telecommunications or submarine communications (Normandeau et al., 2011). Therefore, the presence and operation of between 110 and 122 km of 66 kV inter-array cables, between 35 and 40 km of 220 kV offshore export cables, and between 25 and 28 km of 220 kV OSP interconnector cables during the lifetime of the Proposed Development may lead to localised EMF effects on marine mammals.

6.4.1.53 Submarine cables can cause three different types of EMFs: electrical I fields, magnetic (B) fields, and induced electric (iE) fields. E-fields are measured in volts per metre (V/m) and are generated by the voltage of the cable. B-fields are measured in microtesla (μT) or milligauss (mG) where 1 μT = 10 mG and are generated by the current of the power through the cable. They attenuate both horizontally and vertically away from the cable, with field strength directly related to the power of the current passing through the cable, rather than being specifically related to the voltage. iE-fields are measured in V/m and are generated by the fluctuation of the B-fields (in AC transmission) or by the motion of the seawater (or an organism) through the B-field. Therefore, they are dependent on the strength of the B-field, thus the strength of the iE-field is directly related to the B-field, which is strongest closest to the cable, attenuating horizontally and vertically away from it.

6.4.1.54 EMFs also occur naturally in the marine environment from a variety of sources including background levels from the Earth's magnetic field, and very small fields generated by electrical currents moving through organisms (Tricas and Gill, 2011). The Earth's static B-field is present in both terrestrial and aquatic environments and lies in the range 25 to 65 μT (Hutchison et al., 2018). The B-field strength of the Irish Sea is approximately 49 μT (National Oceanic and Atmospheric Administration (NOAA), 2020).

6.4.1.55 Measurements of EMF for subsea cables associated with offshore windfarms vary, with the strength of the B-field generated generally related to the wind speed captured by the turbines. A variety of design and installation factors affect EMF levels in the vicinity of the cables such as current flow, distance between cables, cable insulation, number of conductors, configuration of cable and burial depth. For example, EMFs produced by inter-array cables are smaller than those of export and OSP interconnector cables as they are lower powered in comparison. Furthermore, the B-fields generated by High Voltage Alternating Current (HVAC) and High Voltage Direct Current (HVDC) cables are significantly different, with HVDC cables typically generating much larger EMFs than HVAC cables (Tricas and Gill, 2011). The transmission system used for the Proposed Development will only comprise HVAC.

6.4.1.56 CMACS (2003) reported that for a 132 kV three-phase AC cable with perfect shielding, the predicted B-field in close proximity to the cable was 1.6 µT and the respective iE-field was 91.25 µV/m above the cable if buried to 1 m depth, which reduced to 10 µV m-1 8 m from the cable. Gill et al. (2009) measured iE-fields of 30 µV/m and 110 µV/m at two different offshore windfarm cables (both three-phase AC, 36 kV, 100 A) close to the cables and B-fields of 0.23 µT and 6.5 µT, respectively. Continental Shelf Associates (CSA, 2019) compared offshore windfarm subsea cables and found EMF levels directly over live AC undersea power cables associated with offshore wind energy projects ranged between 5 to 15 mG (0.5 to 1.5 µT) for inter-array cables and 10 to 40 mG (1 to 4 µT) for export cables, at heights of 1 m above the seabed. At lateral distances of between 3 m and 7.5 m from the cable, B-fields greatly reduced to <0.1 to 7 mG (<0.01 to 0.7 µT) for inter-array cables, and <0.1 to 12 mG (<0.01 to 1.2 µT) for export cables, at heights of 1 m above the seabed. Measurements of the iE-fields directly over live AC undersea power cables in the same study ranged between 0.1 to 1.2 mV/m for the inter-array cables and 0.2 to 2.0 mV/m for export cables, at heights of 1 m above the seabed (CSA, 2019). At lateral distances of between 3 m and 7.5 m, iE-fields reduced to between 0.01 to 0.9 m V/m for inter-array cables and 0.02 to 1.1 mV/m for export cables at heights of 1 m above the seabed.

6.4.1.57 The strength of the B-field (and consequently, iE-fields) decreases rapidly horizontally and vertically with distance from source (Normandeau et al., 2011). Burial of cables, in particular, can therefore reduce the strength of the B- and iE-fields. However, it is unlikely that cables can be buried to sufficient depths that will reduce the magnitude of the B-field, and hence the sediment-seawater interface iE-field, to the extent that these fields could not be detected by certain marine organisms on or close to the seabed (Gill et al., 2005). A study conducted by CSA (2019) found that inter-array and export cables buried between depths of 1 m to 2 m reduces the magnetic field at the seabed surface four-fold. For cables that are unburied and instead protected by thick concrete mattresses or rock berms, the field levels were found to be similar to buried cables.

6.4.1.58 Overall, based on the above assessment it is concluded that any potential impact will be highly localised, with strength dissipating rapidly with distance from the buried cables.

6.4.1.59 There is evidence to suggest that some species of cetacean may be able to detect variations in magnetic fields, therefore it is plausible that they are magneto-sensitive (Normandeau et al., 2011). Kirschvink et al. (1986) suggested that species that were sensitive to changes in the Earth's magnetic field and that are likely to be present within the Proposed Development include harbour porpoise. However, the majority of these have had a theoretical evidence base, coming to differing conclusions regarding species' sensitivity to changes in electric and magnetic fields (Normandeau et al., 2011). The only evidence of electro-sensitivity in marine mammals to date is reported in Guiana dolphin (*Sotalia guianensis*) as they have been shown to possess an electroreceptive system which is used to detect electrical stimuli (Czech-Damal et al., 2013).

6.4.1.60 Potential responses of cetaceans from EMF could include avoidance behaviour, disruption in orientation, and effects on feeding or social interaction (Normandeau et al., 2011), although it is important to note that these responses are all currently hypothetical. Whilst subsea cables could create a very localised change in the geomagnetic field (Taormina et al., 2018), modelling studies of EMF from cables suggests that the likelihood of such a change affecting a large enough area to elicit a significant course alteration would be low (Normandeau et al., 2011).

6.4.1.61 With consideration that the evidence of impact is only theoretical, and the highly localised nature of potential impacts, and the effects are recoverable, it is concluded that any EMF effects, if there are any at all, are entirely negligible of impacting this QI.

6.4.1.62 **Therefore, it is concluded that there would be no AEoI upon the integrity of Blackwater Bank SAC, as defined by the COs of the site, from EMF impacting harbour porpoise from Project Design Option 1 in this phase.**

6.4.1.63 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

CHANGES IN PREY

6.4.1.64 Harbour porpoise are primarily dependent on whiting, herring and poor cod for food (Hernandez-Milian *et al.*, 2011). This demonstrates a varied diet and ability to adapt to changes in availability of prey types where needed and so we view harbour porpoise as generalist feeders.

6.4.1.65 Potential impacts on prey species comprise of temporary habitat loss/disturbance, increased SSC and associated deposition, injury and/ or disturbance as a result of underwater noise and vibration during pile driving and cable installation activities, and accidental pollution.

6.4.1.66 With regards to temporary habitat loss/disturbance and increased SSC and associated deposition, only a proportion of harbour porpoises prey species are vulnerable to these effects. The only consideration for the wider more mobile species is if their spawning grounds are affected. The baseline assessment concludes that the main spawning areas for the majority of fish and shellfish within the vicinity do not overlap with the ZoI for harbour porpoises and therefore, it is concluded that any effects, if there are any at all, are entirely negligible for potential to impact a harbour porpoises ability to forage. Furthermore, of the species that are vulnerable to these impacts, these impacts only have potential to impact on a highly localised basis, and it is calculated that it will impact <1% of the habitats present. This consideration, and the highly recoverable nature of the species and temporary nature of the works, it is concluded this impact has no potential of AEoI through changes in prey.

6.4.1.67 With regards to underwater noise and vibration, this impact can have a range of effects comprising behavioural changes, TTS, recoverable injury and mortality, with the extent of impact dependent on the prey species group.

6.4.1.68 Table 6.13 clarifies the various risk and impact thresholds based on scientific evidence.

Table 6.13: Mortality, potential injury, TTS, behaviour criteria for various fish groupings in relation to underwater noise (Popper *et al.* 2014)

Fish grouping	Mortality and potential mortal injury	Impairment: Recoverable injury	Impairment: Temporary Threshold Shift	Impairment: Behaviour
Pile driving noise				
No swim bladder (particle motion detection)	>219 dB SEL_{cum} or >213 dB SPL_{peak}	>216 dB SEL_{cum} or >213 dB SPL_{peak}	>186 dB SEL_{cum}	(N) High (I) Moderate (F) Low
Swim bladder is not involved in hearing (particle motion detection)	>210 dB SEL_{cum} or >207 dB SPL_{peak}	>203 dB SEL_{cum} or >207 dB SPL_{peak}	>186 dB SEL_{cum}	(N) High (I) Moderate (F) Low
Swim bladder is involved in hearing (primarily pressure detection)	>207 dB SEL_{cum} or >207 dB SPL_{peak}	>203 dB SEL_{cum} or >207 dB SPL_{peak}	>186 dB SEL_{cum}	(N) High (I) High (F) Moderate
Vessel noise or other continuous sources of noise				
No swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Moderate (F) Low
Swim bladder is not involved in hearing (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Moderate (F) Low
Swim bladder is involved in hearing (primarily pressure detection)	(N) Low (I) Low (F) Low	170 dB SPL_{rms} for 48 hrs	158 dB SPL_{rms} for 12 hours	(N) High (I) Moderate (F) Low

Notes: peak and rms sound pressure levels dB re 1 µPa; SEL dB re 1 µPa2·s. All criteria are presented as sound pressure even for fish without swim bladders since no data for particle motion exist. Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N; tens of metres from source), intermediate (I; hundreds of metres from source), and far (F; thousands of metres from source).

6.4.1.69 With regards to TTS and behaviour, it is concluded that this level of impact on prey would not result in a significant change in prey with consideration of the temporary and recoverable nature of the effect.

6.4.1.70 With consideration of species with no swim bladder the modelling indicates this threshold may be exceeded up to 130 m away from the sound source at the SW site, covering an area of up to 0.05 km^2. At the other WTG foundation sites modelled, the maximum distance range was 90-120 m (0.03-0.04 km^2). For the two OSP foundation sites modelled, the maximum distance range was 110-120 m (0.03-0.04 km^2). This is the distance at which underwater noise and vibration may cause mortality or a recoverable injury to fish with no swim bladder. This is further reduced for fleeing species.

6.4.1.71 With consideration of species with swim bladders not involved in hearing, modelling indicates this threshold may be exceeded up to 340 m away from the sound source at the SW site, covering an area of up to 0.33 km^2. At the other WTG foundation sites modelled, the maximum distance range varied between 230-310 m (0.16-0.3 km^2) based on location on piling type. For the two OSP foundation sites modelled, the maximum distance range was 207-310 m (0.22-0.29 km^2). This is the distance at which underwater noise and vibration may cause mortality or a recoverable injury to fish that have a swim bladder that is not involved in hearing.

6.4.1.72 With consideration of species with swim bladders that are involved in hearing, modelling indicates this threshold may be exceeded up to 330 m away from the sound source at the SW site, covering an area of up to 0.33 km^2. At the other WTG foundation sites modelled, the maximum distance range was 230 – 310 m (0.16 – 0.3 km^2). For the two OSP foundation sites modelled, the maximum distance range was 207 – 310 m (0.22 – 0.29 km^2). This is the distance at which underwater noise and vibration may cause mortality or a recoverable injury to fish that have a swim bladder that is involved in hearing.

6.4.1.73 With regards to accidental pollution, this is considered as a negligible risk based on avoidance through design of the Proposed Development. The EVMP, EMP and MPCP will be implemented reducing the risk of accidental pollution such that any effects, if there are any at all, are entirely negligible.

6.4.1.74 **It is concluded, with consideration of the highly localised nature of the impacts above, low sensitivity, and generalist diets of the qualifying interest, there is no potential for AEoI upon the integrity of Blackwater Bank SAC, as defined by the COs of the site, as a result of changes in prey impacting harbour porpoise from Project Design Option 1 in this phase.**

6.4.1.75 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

ACCIDENTAL POLLUTION

6.4.1.76 There is the potential for an accidental release of pollutants to occur from vessels and equipment associated with the construction, operational and maintenance and decommissioning phases of the Proposed Development, which may result in adverse effects on marine mammals. Pollutants may include diesel fuel, bentonite (from drilling activities), lubricants, grease and oils, anti-fouling biocides, and grout.

6.4.1.77 In the event of an accidental spill, given the density and distribution of marine mammals in the Marine Mammal Study Area, it is possible that individuals could come into contact with contaminants.

6.4.1.78 Direct impacts include ingestion, inhalation, and absorption. All of which may result in physiological responses with health and long-term survival and/or reproduction consequences, the most serious of which could be damage to the respiratory system (Helm *et al.*, 2015).

6.4.1.79 Indirect impacts include short- and long-term reductions in food availability, disruption to social bonds, reduced reproduction, and/or cumulative effects on individuals, populations, and the ecosystem (Helm *et al.*, 2015).

6.4.1.80 Harbour porpoise are at risk from oil pollution in the marine environment because they lack the ability to leave the water to avoid oil. They are however highly mobile and wide ranging, therefore any contact with a spill would be expected to be brief. Cetaceans are also capable of detecting surface slicks, for example, experiments with captive bottlenose dolphins have shown that they can visually discriminate between oil and uncontaminated water and avoid oil on the surface of the water (Geraci and St. Aubin, 1984).

6.4.1.81 However, harbour porpoise must surface periodically to breathe, potentially bringing them into contact with floating oil and volatile toxic components. The more extensive the slick, the more likely that an animal will surface within it (Geraci and St. Aubin, 1980). While oil does not readily penetrate cetacean skin, exposure could affect mucus membranes, eyes, and other external soft tissue areas, potentially resulting in mortality (Helm *et al.*, 2015).

6.4.1.82 Overall, accidental pollution has the potential to cause LSE on harbour porpoise features.

CONSTRUCTION AND DECOMMISSIONING PHASE

6.4.1.83 The installation of the offshore infrastructure for the Proposed Development may lead to the accidental release of pollutants through spills and leaks from vessels and equipment. The project design parameters for Project Design Option 1 during the construction phase are outlined in Table 6.8 and include the installation of 56 WTGs, two OSPs, between 110 and 122 km of inter-array cables, between 25 and 28 km of interconnector cables, and between 35 and 40 km offshore export cables. There will also be up to 4,150 vessel round trips and 294 helicopter round trips during the construction phase (including activities at the landfall site).

6.4.1.84 The potential impact to marine mammals from accidental pollution during the decommissioning phase is expected to be the same or less than the construction phase.

6.4.1.85 The magnitude of the impact of accidental pollution will be dependent on the quantities of potential pollutants carried by construction vessels and within equipment. The release of a large inventory of fuel oil from a construction vessel is, however, considered to represent the greatest potential accidental pollution event from installation activities. In the event of an accidental spill from vessels, equipment or from construction activities, the spill would be subject to immediate dilution and rapid dispersal (Marappan *et al.,* 2022).

6.4.1.86 Considering avoidance through design and management (see Table 6.7), the likelihood of accidental release is considered extremely low. The measures in the EMP include storage of chemicals in secure designated areas on vessels in line with appropriate regulations and guidelines, and double skinning of any tanks and pipes containing hazardous substances. All chemicals used will be subject to a chemical risk assessment to ensure risks are understood and minimised. The EMP also includes a MPCP which will contain key emergency contact details and response procedures in the event of a spill of any magnitude to ensure minimal impact. Complying with these procedures will also reduce the magnitude of any spill. Adherence to the avoidance design and management measures outlined in Table 6.7, including the EMP and MPCP will significantly reduce the likelihood of an accidental pollution incident occurring, and the magnitude of its impact.

6.4.1.87 **Given the inherent low likelihood of accidental pollution from vessel activity and other activities, as well as the proposed avoidance/ impacts reduction measures (as set out in Table 6.7), there is no potential for AEoI from accidental pollution on Blackwater Bank SAC, as defined by the COs of the site, impacting harbour porpoise from Project Design Option 1.**

6.4.1.88 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE PHASE

6.4.1.89 There is the potential for the accidental release of pollutants during this phase of the Proposed Development as a result of the presence of offshore infrastructure, associated equipment, and vessel movements. The project design parameters for Project Design Option 1 during the operational and maintenance phase are outlined in Table 6.8. This includes synthetic compound, for example from antifouling biocides, heavy metal, and hydrocarbon contamination as a result of the presence of 56 WTGs and two OSPs as well as from maintenance activities. There will also be up to 1,294 vessel round trips and 485 helicopter round trips per year during this phase of the proposed development.

6.4.1.90 The assessment for this phase is the same as for the construction phase, with the same avoidance by design and management measures being implemented to reduce the risk to negligible levels (see Table 6.7 and Section 6.4.1.86). **It is concluded that the potential for AEoI upon the integrity of Blackwater Bank SAC, as defined by the COs of the site, from accidental pollution impacting harbour porpoise from Project Design Option 1 is entirely negligible.**

6.4.1.91 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.2 Slaney River Valley SAC

Harbour Seal

6.4.2.1 The conservation objectives for harbour seal at this designated site is to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.2.2 There are four key potential impacts on harbour seal associated with the construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development.

INJURY AND/ OR DISTURBANCE FROM UNDERWATER NOISE

6.4.2.3 Underwater noise has the potential to impact marine mammals if the frequency is within their hearing range, and in particular if the sound levels are greater than the relevant thresholds. With consideration of harbour seals, they are within the Phocid (in water, PCW) hearing group with a hearing range of 50 hz to 86 kHz. The impacts can range from auditory injury, disturbance and displacement, to changes in behaviour including masking depending on the severity of the underwater noise. The sources of underwater noise within this assessment are piling, UXO clearance, and pre-construction geophysical surveys. Noise disturbance from vessel movements and presence is assessed in the vessel movements assessment (Section 6.4.2.26 to 6.4.2.49).

6.4.2.4 Exposure to loud underwater noises can lead to a reduction in hearing sensitivity which may be temporary (TTS) or permanent (PTS). PTS is defined by Southall *et al.* (2007) as a non-recoverable elevation of the hearing threshold of 6 dB. It has been assumed that PTS-onset occurs after TTS has grown to 40 dB, based on TTS growth rates obtained from scientific literature.

6.4.2.5 Any threshold shifts in hearing caused by pile driving would manifest in the range of 2 – 10 kHz (Kastelein *et al.*, 2017). At a BEIS-funded export elicitation workshop in 2018, experts concluded that the probability of PTS significantly affecting the survival and reproduction of grey and harbour seals was very low, assuming a 6 dB PTS in the 2 – 10 kHz range (Booth and Heinis, 2018). This was further supported by conclusions found in the study of tagged seals during the construction of the Lincs offshore windfarm which concluded that neither the survival or fitness of individuals is affected or that seals are not developing PTS despite predictions of exposure that indicate that they should be.

6.4.2.6 With regards to underwater noise produced by UXO clearance, there are two activities that produce noise, higher order detonation, and low-order clearance methods. It is unknown if there are UXO that require clearance at the time of this assessment, and therefore is unknown to what level of clearance will be carried out. Therefore, this assessment is based on high-order UXO clearance being carried out which is viewed as the worst-case scenario in terms of underwater noise generation.

6.4.2.7 The main underwater noise produced by high-order detonation is outside of the region of greatest sensitivity for seal species (Southall *et al.,* 2019), and there is a pronounced reduction in energy levels above ~5-10 kHz (von Beckmann *et al.,* 2015 and Salomons *et al.,* 2021). Due to this, with consideration of the above sensitivity, it is concluded that harbour seals have a low sensitivity to this effect.

6.4.2.8 With regards to underwater noise produced by geophysical surveys, exact surveys and equipment is yet to be decided, therefore as a precautionary approach we have considered all types of noise generation from the varied survey types. Surveys such as multibeam EchoSounder (MBES) and side scan sonar (SSS) produce sounds which are sonar based and impulsive. Surveys comprising of vibrocoring typically produce non-implusive sound. The equipment's noise source levels is provided in Table 6.9 and Table 6.10.

6.4.2.9 Very limited information exists on the impacts of site surveys (geophysical and geotechnical) to marine mammals, with most available studies investigating the use of seismic airguns and focused on cetaceans, not seals. With consideration that seals have a lower sensitivity to underwater noise compared to cetaceans, we will consider studies on cetaceans on a precautionary basis, assuming that any predicted impact would be reduced with the species low sensitivity.

6.4.2.10 A study by Lucke *et al.* (2009) indicated that TTS could be induced in harbour porpoise at 350 m when exposed to an airgun impulse at a peak pressure of 200 dB_{pk-pk} re 1 μPa with corresponding SEL of 164.5 dB re $\mu Pa^2{}_s$) in shallow waters (~4 m), however this study is highly conservative as it assumes that the animal would remain stationary throughout the exposure. Evidence from other studies suggests that harbour porpoises exposed to such noise sources would likely move away from the source, and therefore leave the impact range of PTS-onset (Hermannsen *et al.,* 2015).

6.4.2.11 Furthermore, it is expected that vessel presence will act as a deterrent to harbour porpoise, reducing the risk of auditory injury (Benhemma-Le Gall *et al.*, 2023). Therefore, it is highly unlikely that harbour porpoise will be present in the immediate vicinity at the start of any survey activity. The same can be applied to harbour seal which we view would be highly unlikely to be present within the immediate vicinity, and with consideration of their reduced sensitive, conclude this is a negligible risk for injury.

6.4.2.12 While PTS is a permanent effect which cannot be recovered from, the most likely response of a marine mammal to noise levels that could induce TTS is to flee the area (Southall et al., 2007). Therefore, animals exposed to these noise levels that could induce TTS are likely to actively avoid hearing damage by moving away from the source.

6.4.2.13 With consideration of disturbance and displacement caused by activities such as piling, studies have shown that 19-83% of tagged harbour seals are displaced during piling, with significant reduction in abundance up to 25 km from the piling activity (Russel *et al.* 2016). However, seals returned to the area in similar densities to beforehand within 2 hours of cessation of the piling activity, suggesting the displacement caused by piling activities is only short-term. Furthermore, evidence supports the assessment that harbour seals are able to reasonable compensate for missed foraging opportunities caused by disturbance and can range to up to 273 km from a haul-out to forage (Carter *et al.* 2022, Booth *et al.* 2019). During the expert elicitation workshop in 2018, the experts also agreed that harbour seals have a reasonable ability to compensate for missed foraging opportunities from disturbance (from exposure to low frequency broadband pulsed noise such as piling driving) due to their generalist diet, adequate fat stores, mobility, and life-history traits (Booth *et al.*, 2019), for example, they have a thick layer of blubber for energy storage that enables them to tolerate periods of fasting when hauled out between foraging trips or during breeding and moulting periods.

6.4.2.14 Available guidance on assessing the significance of noise disturbance from UXO detonation against the conservation objectives of SACs with harbour seals as qualifying interests is limited, however the closest relevant guidance is with regards to harbour porpoise SACs within England, Wales and Northern Ireland. As a species is considered to be more sensitive to these impacts than seals we have adopted that guidance on a precautionary basis, and impacts are viewed to likely be lesser. The guidance recommends an effective deterrence range (EDR) of 26 km for high-order detonations (JNCC, 2020). It should be noted that this EDR is based upon avoidance from piling, not UXO clearance, and the same guidance states that '*a one off explosion would probably only elicit a startle response and would not cause widespread and prolonged displacement*''. With consideration of the resilience of the species highlighted above, it is concluded that harbour seal are not sensitive to UXO clearance behavioural disturbance effects when considering the integrity of the designated site.

6.4.2.15 With consideration of disturbance caused by geophysical and geotechnical surveys, there are also few studies on the effects of seismic airguns on seals. Detailed observations of the behavioural and physiological responses of harbour seal were recorded by Thompson *et al.* (1998) using controlled exposure experiments with small air guns (source levels of 215-224 dB re 1µPa peak-to-peak). These experiments showed that grey seals exhibit avoidance behaviour when exposed to a single airgun or small array, switching from foraging to transiting behaviour, whilst harbour seals exhibited dramatic avoidance behaviour and stopped feeding (Thompson *et al.,* 1998). With consideration of the above behavioural effects of piling, it is anticipated that harbour seals will show similar levels of avoidance and return behaviours, just within a smaller area based on the reduced distance the noise produced will go in comparison to piling.

6.4.2.16 The assessment has been informed by the Underwater Noise Assessment by Subacoustech (Volume III, Appendix 11.1) which includes the results of numerical modelling using the INSPIRE underwater noise model.

CONSTRUCTION AND DECOMMISSIONING

6.4.2.17 Piling will only be carried out during the construction phase of the Proposed Development. Decommissioning would be undertaken using similar plant and techniques to the construction phase without piling and with fewer vessels and equipment used. It is therefore viewed to have a lower potential for impact compared to the construction phase. Based on calculations and data presented in Table 6.14 it is calculated that the maximum instantaneous PTS-onset impact range is 60 m (11 m monopile at the SW location and 7 m or 14 m monopile at the S-OSP location) with other piling locations having a reduced range. Based on this modelling and the survey results no seals are expected to be impacted. Using the cumulative PTS-onset thresholds, the maximum impact range is 500 m (for an 11 m monopile at the C location, all other locations have a reduced impact range), which still calculates as no seals being impacted by these activities. With consideration of TTS, it is only a temporary physical and behavioural impact, and considering evidence clarified above with the assessment of the PTS impacts, and further consideration of behavioural impacts within this assessment, it poses a negligible risk of AEoI to the QI as all impacts are short term and temporary. With additional consideration of the avoidance through project design incorporated into the activities, specifically the MMMP, this will serve to further minimise any risk posed to harbour seals.

6.4.2.18 With regards to UXO clearance, based on the modelling presented in Table 6.15, the maximum PTS-onset impact range is 2.8 km. This would result in <1 harbour seal (<0.01% of the population) experiencing PTS from a high-order detonation with the greatest charge weight.

Table 6.14 : PTS-onset from pile driving and disturbance at array locations with harbour seal densities estimates

Piling location and Monopile		Density (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
Instantaneous PTS-onset (unweighted SPLpeak)						
NW	7 m	0.0003	<0.001	<50	0	0.00
	11 m		0.01	<50	0	0.00
C	7 m	0.0003	0.01	50	0	0.00
	11 m		0.01	50	0	0.00
SW	7 m	0.0003	0.01	<50	0	0.00
	11 m		0.01	60	0	0.00
N-OSP	7 m	0.0003	0.01	<50	0	0.00
	14 m		0.01	<50	0	0.00
S-OSP	7 m	0.0003	0.01	60	0	0.00

Piling location and Monopile		Density (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
	14 m		0.01	60	0	0.00
Cumulative PTS-onset (weighted SELcum)						
NW	7 m	0.0003	<0.001	<50	0	0.00
	11 m		0.01	<50	0	0.00
C	7 m	0.0003	0.3	400	0	0.00
	11 m		0.3	500	0	0.00
SW	7 m	0.0003	0.1	380	0	0.00
	11 m		0.2	400	0	0.00
N-OSP	7 m	0.0003	<0.1	<100	0	0.00
	14 m		<0.1	<100	0	0.00
S-OSP	7 m	0.0003	<0.1	200	0	0.00
	14 m		<0.1	200	0	0.00

Piling location and Monopile		Density (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
Predicted disturbance						
NW	7 m	0.0003	-	-	<1	0.23
	11 m		-	-	<1	0.24
C	7 m	0.0003	-	-	<1	0.48
	11 m		-	-	<1	0.48
SW	7 m	0.0003	-	-	<1	0.53
	11 m		-	-	<1	0.53
N-OSP	7 m	0.0003	-	-	<1	0.28
	14 m		-	-	<1	0.28
S-OSP	7 m	0.0003	-	-	<1	0.53
	14 m		-	-	<1	0.54

Table 6.15: PTS-onset ranges and numbers of harbour seal modelled to be within range for all potential charge weights

Charge Weight (kg)	Maximum range (m)	Density of species (animals/km^2)	Number of animals	% of reference population
PTS-onset (unweighted SPLpeak)				
0.5 (low order)	240	0.0003	0	0
25 + donor	910		0	0
55 + donor	1,100		0	0
120 +donor	1,500		0	0
240 + donor	1,900		0	0
525 + donor	2,500		<1	<0.01
700 + donor	2,700		<1	<0.01
800 + donor	2,800		<1	<0.01
PTS-onset (weighted SELss)				
0.5 (low order)	60	0.0003	0	0
25 + donor	390		0	0
55 + donor	570		0	0
120 +donor	830		0	0
240 + donor	1,100		0	0
525 + donor	1,600		0	0
700 + donor	1,900		0	0

Charge Weight (kg)	Maximum range (m)	Density of species (animals/km^2)	Number of animals	% of reference population
800 + donor	2,000		0	0
Disturbance				
High Order Clearance	26,000	0.0003	1	0.35
Low Order Clearance	5,000	0.0003	<1	0.01

6.4.2.19 **Therefore, it is concluded there will be no AEoI upon the integrity of Slaney River Valley SAC as a result of injury from underwater noise impacting harbour seal from Project Design Option 1.**

6.4.2.20 **Based on the increased risk of effect of design option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.2.21 Based on the conclusions within Table 6.14, it is estimated that less than one harbour seal will experience behavioural disturbance from underwater noise from piling. Other sources of disturbance (UXO clearance and surveys) are anticipated to result in less disturbance than the piling. Within consideration of the minimal number of seals predicted to be impacted and the negligible severity, that this impact is short-term and temporary, it is concluded it is highly unlikely to affect the features' population trends or integrity.

6.4.2.22 **Therefore, it is concluded there will be no AEoI upon the integrity of Slaney River Valley SAC, as defined by the COs of the site, as a result of behavioural disturbance from underwater noise impacting harbour seal from Project Design Option 1.**

6.4.2.23 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE PHASE

6.4.2.24 There are no piling activities or UXO clearance activities proposed for the Operational and Maintenance phase of the Proposed Development. Any underwater noise produced will be due to vessel movements which is assessed in Section 6.4.2.26 to 6.4.2.49.

6.4.2.25 **There is no potential for AEoI from underwater noise in the operational and maintenance phase of the Proposed Development on this site SAC, as defined by the COs of the site, and feature in both Project Design Option 1 and 2.**

INJURY AND/ OR DISTURBANCE FROM VESSEL MOVEMENTS

6.4.2.26 There will be increased vessel movements compared to baseline levels during all phases of the Proposed Development, which can result injury and/ or mortality from vessel collision, or disturbance though presence and the generation of underwater noise.

6.4.2.27 The area surrounding the Proposed Development experiences a relatively low level of vessel traffic due to the presence of the shallow Arklow Bank sandbank, with higher traffic in the coastal areas and immediate surrounding waters.

6.4.2.28 The shipping and navigation baseline study recorded 29 days of vessel traffic data between 7 July and 14 August 2023. There was an average of 36 to 37 unique vessels per day recorded within the shipping and navigation Study Area (which is defined as Array Area and a 10 nm buffer). The busiest day recorded 59 unique vessels within the shipping and navigation Study Area. The main vessel types within the shipping and navigation Study Area were cargo vessels (40%), recreational vessels (31%) and fishing vessels (10%).

6.4.2.29 During construction of the windfarm, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. In general, three consequences of vessel collision are defined: direct (injuries to the animals that are the immediate result of collision), long-term (a decrease in the fitness of the animal over time), and population consequences (Schoeman et al., 2020). With regards to injuries, both fatal and non-fatal injuries between marine mammals and vessels have been documented (Laist et al., 2001; Vanderlaan et al., 2008; Cates et al., 2017). Fatal collisions have been evidenced via carcasses washing up on beaches (Laist et al., 2001; Peltier et al., 2019); carcasses caught on vessel bows (Laist et al., 2001; Peltier et al., 2019); and floating carcasses which have strong evidence of ship strike, such as propeller cuts, significant bruising, oedema, internal bleeding radiating from a specific impact site, fractures and ship paint marks (Jensen and Silber, 2003; Douglas et al., 2008). Fatalities from ship strikes, however, often go unreported (Authier et al., 2014). For non-fatal injuries, evidence of animals which have survived ship strikes with non-fatal injuries from propellers has been widely documented (Wells et al., 2008; Luksenburg, 2014).

6.4.2.30 Although many species of marine mammals are able to detect and avoid vessels, it is unclear why some individuals do not always move out of the path of an approaching vessel (Schoeman et al., 2020), although it has been suggested that behaviours such as resting, foraging, nursing, and socialising could distract animals from detecting the risk posed by vessels (Dukas, 2002). It is also possible that animals do not hear vessels when they are near the surface. Collisions between cetaceans and vessels, however, are not necessarily lethal on all occasions.

6.4.2.31 Whilst a broad range of vessel types have been involved in collisions with marine mammals (Laist et al., 2001), vessels travelling at higher speeds pose a higher risk because of the potential for a stronger strike impact (Schoeman et al., 2020). For example, a study by Laist et al. (2001) found that in 89% of collisions in which the whale was killed or seriously injured the vessels were travelling at speeds of 14 kn (7 m/s) or more, and the vessel exceeded a length of 80 m. Therefore, larger vessels travelling at 7 m/s or faster are those most likely to cause death or serious injury to marine mammals (Laist et al., 2001).

6.4.2.32 Harbour seals are relatively small and highly mobile, and given observed responses to noise, are expected to detect vessels in close proximity and largely avoid collision. Collision risk for seals is not well understood, however trauma ascribed to collisions with vessels has been identified in a small proportion of both live stranded (Goldstein et al., 1999) and dead stranded seals in the USA (Swails, 2005). In these cases, however, less than 2% of all dead necropsied seals had vessel collision attributed to cause of death. A study in the Moray Firth showed that seals use the same areas as vessels during trips between haul-outs and foraging sites but that seals tended to remain beyond 20 m from vessels (only three instances over 2,241 days of seal activity resulted in passes at less than 20 m) (Onoufriou et al., 2016), suggesting that the possibility of a risk of collision is very low.

6.4.2.33 Overall, the assessment concludes that there is a high likelihood that harbour seals will avoid vessels and therefore collision risk is viewed as negligible, although they have a high sensitivity to the impact should it occur.

6.4.2.34 With regards to vessel disturbance, harbour seals demonstrate sensitivity to disturbance in regions where vessel traffic overlaps with productive coastal waters (Robards et al. 2016). Vessel disturbance may be particularly detrimental to harbour seal if it changes their haul-out patterns or reduces the time they are able to spend resting or nursing pups during the breeding season.

When disturbed, seals that are hauled-out typically 'flush' (enter) into the water which could be detrimental during pupping season (Johnson and Acevedo-Gutiérrez, 2007). Key haul-outs for harbour seal in proximity to the Proposed Development are at Arklow, co. Wicklow, along the coast of co. Dublin, and around Wexford Harbour (Duck and Morris, 2013; Morris and Duck, 2019). None of these sites fall within the European protected site.

6.4.2.35 Avoidance behaviour or alert reactions have been reported in harbour seal when vessels approach within 100 m of a haul-out (Richardson et al., 1995). A study in which 37 harbour seals were telemetry tagged on the east coast of Scotland did not show any apparent response of seals at sea to close passing vessels (they neither moved towards nor away from them) (Onoufriou et al., 2016).

6.4.2.36 Noise levels from introduced vessels will result in an increase in non-impulsive, continuous sounds primarily from propellers, thrusters, and various rotating machinery (e.g., power generation, pumps) in the vicinity of the Proposed Development. The main drivers influencing the magnitude of potential impact with respect to noise disturbance from vessels are vessel type, speed and ambient noise levels (Wilson et al., 2007). Disturbance from vessel noise is likely to occur only when vessel noise associated with the construction of the Proposed Development exceeds the background ambient noise level.

6.4.2.37 Vessel noise levels are typically in the range of 10 to 100 Hz (although higher frequencies will also be produced) (Erbe et al., 2019) with an estimated source level of 168 SELcum dB re 1 μPa @ 1 m (Root Mean Square (RMS)) for large construction vessels and 161 SELcum dB re 1 μPa @ 1 m (RMS) for medium construction vessels, travelling at a speed of 10 knots. In general, support and supply vessels (50-100 m) are expected to have broadband source levels in the range 165-180 dB re 1μPa, with the majority of energy below 1 kHz (OSPAR, 2009). Large commercial vessels (>100 m) produce relatively loud and predominately low frequency sounds, with the strongest energy concentrated below several hundred Hz (OSPAR, 2009).

6.4.2.38 Another telemetry study that included the tagging of 28 harbour seals in the UK found high exposure levels of harbour seals to shipping noise, and as a result 20 individuals may have experienced a TTS due to cumulative SELs exceeded the TTS-threshold for pinnipeds exposed to continuous underwater noise (183dB re 1 μPa2s) (Jones et al., 2017). The overlap between seals and vessel activity most frequently occurred within 50 km of the coast and in proximity to seal haul-outs. The study concluded that there was no evidence of reduced harbour seal presence as a result of vessel traffic, despite the spatial overlap and cumulative SELs (Jones et al., 2017).

6.4.2.39 **Overall, the assessment concludes that although harbour seals demonstrate they are disturbed by vessel movements, evidence supports the assessment that all impacts are temporary and overall do not result in reduced harbour seal presence as a result of the activities. Therefore, there is no AEoI on the Slaney River Valley SAC, as defined by the COs of the site, as a result of injury or disturbance form vessel movement.**

CONSTRUCTION AND DECOMMISSIONING

6.4.2.40 During the construction phase, a maximum of 66 installation vessels will be present within the Proposed Development at any one time, resulting in a maximum of 4,150 vessel return trips over the five-year construction period, and a maximum of 1,797 vessel return trips per year. A similar number of vessels are anticipated for the decommissioning phase.

6.4.2.41 The majority of vessels used during the construction phase are likely to be large vessels that will either be travelling considerably slower than 7 m/s (the key risk is when this speed is exceeded with large vessels) or will be stationary for significant periods of time. Therefore, the actual increase in vessel traffic moving within the Proposed Development and to/from port will occur over short periods of the offshore construction activity. Smaller vessels involved in construction activities (i.e. tug/anchor handlers, guard vessels, survey vessels, and crew transfer vessels) are able to move to avoid marine mammals (when detected), even when an animal is close and the vessel is going at high speed, due to better manoeuvrability compared to larger vessels (Schoeman et al., 2020). In contrast, large vessels, such as jack-up vessels, have low manoeuvrability and may require larger distances to avoid an animal, but travel at slower speeds. In addition, the factored-in measures (Table 6.7) which include a EVMP, will ensure that vessel traffic will move along predictable routes, which is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al., 2001; Lusseau 2003; 2006). The EVMP also sets out a Code of Conduct to minimise interactions with marine mammals and define how vessels should behave in the presence of them.

6.4.2.42 It is also anticipated that noise produced by the vessels will be detectable by the harbour seals and therefore enable avoidance. **With consideration of this and the above assessment it is concluded that there is no potential for AEoI upon the integrity of Slaney River Valley SAC, as defined by the COs of the site, as a result of injury from vessel collision impacting harbour seal from design Project Design Option 1.**

6.4.2.43 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.2.44 With consideration of disturbance and displacement the coastal areas and immediate surrounding waters of the Proposed Development are already subject to high levels of vessel traffic. With consideration of this, it is concluded that it is unlikely there will be a significant change in the level of disturbance harbour seals naturally present are subject to. The EVMP will serve to ensure that vessels follow predictable routes in addition to setting out how vessels should behave in the presence of the species. It is concluded that any disturbance above the current baseline levels of activity will only result in a short-term and temporary impact on behaviour, and the above assessments of the impact of underwater noise support the assessment that harbour seals typically return to similar abundance as before within 2 hours of cessation of the activities causing disturbance.

6.4.2.45 **Therefore, it is concluded there will be no AEoI upon the integrity of Slaney River Valley SAC, as defined by the COs of the site, as a result of disturbance from vessel movement impacting harbour seal from Project Design Option 1.**

6.4.2.46 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE

6.4.2.47 During the operational and maintenance phase, a maximum of 22 vessels will be present within the Array Area at any one time, resulting in a maximum of 1,294 vessel return trips per year. With consideration that this is a significant reduction in the number of vessels present in comparison to the construction and decommissioning phase it is concluded that based on the assessment for that phase, there is no potential for significant effect.

6.4.2.48 **Therefore, no AEoI upon the integrity of Slaney River Valley SAC, as defined by the COs of the site, as a result of disturbance or collision risk from vessel movement impacting harbour seal from Project Design Option 1 in this phase.**

6.4.2.49 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

CHANGES IN PREY

6.4.2.50 Harbour seal are primarily dependent on sandeel, sole, poor cod, dragonet, whiting, rockling, Atlantic horse mackerel, crustaceans, squid species and octopus species for food (Kavangah et al. 2010). This demonstrates a highly varied diet and ability to adapt to changes in availability of prey types where needed and so we view harbour seals as generalist feeders. It is concluded that they have low sensitivity to changes in prey.

6.4.2.51 Impacts to prey resources will be largely restricted to the boundaries of the Proposed Development and, therefore, harbour seal occurring within this area also have the potential to be impacted. The impacts on prey species are not qualifying interest species specific, with prey species for harbour seal subject to the same impacts as the prey species as the other Annex 2 marine mammal species considered within this assessment (bottlenose dolphin, harbour porpoise and harbour seal). A full assessment on the impacts of the Proposed Development on prey species has been considered within the assessment on Blackwater Bank SAC (Section 6.4.1) which is located 19.76 km from the Proposed Development, significantly closer than Slaney River Valley SAC (44.54 km).

6.4.2.52 **Therefore, it is concluded that there is no AEoI upon the integrity of Slaney River Valley SAC, as defined by the COs of the site, from changes in prey impacting harbour seal from Project Design Option 1 in this phase.**

6.4.2.53 **Based on the increased risk of effect of Project Design Option 1, it can be reasonably assumed that the same conclusion of no AEoI would also apply Project Design Option 2.**

ACCIDENTAL POLLUTION

6.4.2.54 There is the potential for an accidental release of pollutants to occur from vessels and equipment associated with the construction, operational and maintenance and decommissioning phases of the Proposed Development, which may result in adverse effects on marine mammals. Pollutants may include diesel fuel, bentonite (from drilling activities), lubricants, grease and oils, anti-fouling biocides, and grout.

6.4.2.55 In the event of an accidental spill, given the density and distribution of marine mammals in the Marine Mammal Study Area, it is possible that individuals could come into contact with contaminants.

6.4.2.56 Direct impacts include ingestion, inhalation, and absorption. All of which may result in physiological responses with health and long-term survival and/or reproduction consequences, the most serious of which could be damage to the respiratory system (Helm *et al.*, 2015).

6.4.2.57 Indirect impacts include short- and long-term reductions in food availability, disruption to social bonds, reduced reproduction, and/or cumulative effects on individuals, populations, and the ecosystem (Helm *et al.*, 2015).

6.4.2.58 Harbour seals are reliant on terrestrial haul-out sites for resting, moulting, and breeding which makes them particularly vulnerable to the effects of pollution. Seals have been shown to develop conjunctivitis, corneal abrasion, and swollen eyelid membranes in response to exposure to crude oil (Geraci and St. Aubin, 1980). While external oiling is not expected to significantly impact the ability of adult seals to maintain their core body temperature as they rely on blubber for insulation, seal pups entering the water could be vulnerable as oil residues can reduce the thermal properties of neonate animals, increasing their susceptibility to hypothermia (Helm *et al.*, 2015),

6.4.2.59 Overall, accidental pollution has the potential to cause LSE on harbour seal features.

CONSTRUCTION AND DECOMMISSIONING PHASE

6.4.2.60 The installation of the offshore infrastructure for the Proposed Development may lead to the accidental release of pollutants through spills and leaks from vessels and equipment. The project design parameters for Project Design Option 1 during the construction phase are outlined in Table 6.8 and include the installation of 56 WTGs, two OSPs, between 110 and 122 km of inter-array cables, between 25 and 28 km of interconnector cables, and between 35 and 40 km offshore export cables. There will also be up to 4,150 vessel round trips and 294 helicopter round trips during the construction phase (including activities at the landfall site).

6.4.2.61 The potential impact to marine mammals from accidental pollution during the decommissioning phase is expected to be the same or less than the construction phase.

6.4.2.62 The magnitude of the impact of accidental pollution will be dependent on the quantities of potential pollutants carried by construction vessels and within equipment. The release of a large inventory of fuel oil from a construction vessel is, however, considered to represent the greatest potential accidental pollution event from installation activities. In the event of an accidental spill from vessels, equipment or from construction activities, the spill would be subject to immediate dilution and rapid dispersal (Marappan *et al.,* 2022).

6.4.2.63 Considering avoidance through design and management (see Table 6.7), the likelihood of accidental release is considered extremely low. The measures in the EMP include storage of chemicals in secure designated areas on vessels in line with appropriate regulations and guidelines, and double skinning of any tanks and pipes containing hazardous substances. All chemicals used will be subject to a chemical risk assessment to ensure risks are understood and minimised. The EMP also includes a MPCP which will contain key emergency contact details and response procedures in the event of a spill of any magnitude to ensure minimal impact. Complying with these procedures will also reduce the magnitude of any spill. Adherence to the avoidance design and management measures outlined in Table 6.7, including the EMP and MPCP will significantly reduce the likelihood of an accidental pollution incident occurring, and the magnitude of its impact.

6.4.2.64 **Given the inherent low likelihood of accidental pollution from vessel activity and other activities, as well as the proposed avoidance/ impacts reduction measures (as set out in Table 6.7), there is no potential for AEoI from accidental pollution on Slaney River Valley SAC, as defined by the COs of the site, impacting harbour seal from Project Design Option 1.**

6.4.2.65 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE PHASE

6.4.2.66 There is the potential for the accidental release of pollutants during this phase of the Proposed Development as a result of the presence of offshore infrastructure, associated equipment, and vessel movements. The project design parameters for Project Design Option 1 during the operational and maintenance phase are outlined in Table 6.8. This includes synthetic compound, for example from antifouling biocides, heavy metal, and hydrocarbon contamination as a result of the presence of 56 WTGs and two OSPs as well as from maintenance activities. There will also be up to 1,294 vessel round trips and 485 helicopter round trips per year during this phase of the proposed development.

6.4.2.67 The assessment for this phase is the same as for the construction phase, with the same avoidance by design and management measures being implemented to reduce the risk to negligible levels (see Table 6.7 and Section 6.4.2.63). **It is concluded that the potential for AEoI upon the integrity of Slaney River Valley SAC, as defined by the COs of the site, from accidental pollution impacting harbour seal from Project Design Option 1 is entirely negligible.**

6.4.2.68 Based **on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.3 Lambay Island SAC

Grey Seal

6.4.3.1 The conservation objectives for grey seal at this designated site is to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.3.2 There are four key potential impacts on grey seal associated with the construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development.

INJURY AND/ OR DISTURBANCE FROM UNDERWATER NOISE

6.4.3.3 Underwater noise has the potential to impact marine mammals if the frequency is within their hearing range, and in particular if the sound levels are greater than the relevant thresholds. With consideration of grey seals, they are within the Phocid (in water, PCW) hearing group with a hearing range of 50 hz to 86 kHz. The impacts can range from auditory injury, disturbance and displacement, to changes in behaviour including masking depending on the severity of the underwater noise. The sources of underwater noise within this assessment are piling, UXO clearance, and pre-construction geophysical surveys.

6.4.3.4 Exposure to loud underwater noises can lead to a reduction in hearing sensitivity which may be temporary (TTS) or permanent (PTS). PTS is defined by Southall *et al.* (2007) as a non-recoverable elevation of the hearing threshold of 6 dB. It has been assumed that PTS-onset occurs after TTS has grown to 40 dB, based on TTS growth rates obtained from scientific literature.

6.4.3.5 Any threshold shifts in hearing caused by pile driving would manifest in the range of 2 – 10 kHz (Kastelein *et al.*, 2017). At a BEIS-funded export elicitation workshop in 2018, experts concluded that the probability of PTS significantly affecting the survival and reproduction of grey and harbour seals was very low, assuming a 6 dB PTS in the 2 – 10 kHz range (Booth and Heinis, 2018). This was further supported by conclusions found in the study of tagged seals during the construction of the Lincs offshore windfarm which concluded that either the survival and fitness of individuals is not affected or that seals are not developing PTS despite predictions of exposure that indicate that they should be.

6.4.3.6 With regards to underwater noise produced by UXO clearance, there are two activities that produce noise, higher order detonation, and low-order clearance methods. It is unknown if there are UXO that require clearance at the time of this assessment, and therefore is unknown to what level of clearance will be carried out. Therefore, this assessment is based on high-order UXO clearance being carried out which is viewed as the worst-case scenario in terms of underwater noise generation.

6.4.3.7 The main underwater noise produced by high-order detonation is outside of the region of greatest sensitivity for seal species (Southall *et al.,* 2019), and there is a pronounced reduction in energy levels above ~5-10 kHz (von Beckmann *et al.,* 2015 and Salomons *et al.,* 2021). Due to this, with consideration of the above sensitivity, it is concluded that grey seals have a low sensitivity to this effect.

6.4.3.8 With regards to underwater noise produced by geophysical surveys, exact surveys and equipment is yet to be decided, therefore as a precautionary approach we have considered all types of noise generation from the varied survey types. Surveys such as multibeam EchoSounder (MBES) and side scan sonar (SSS) produce sounds which are sonar based and impulsive. Surveys comprising of vibrocoring typically produce non-implusive sound. The equipment's noise source levels are provided in Table 6.9 and Table 6.10.

6.4.3.9 Very limited information exists on the impacts of site surveys (geophysical and geotechnical) to marine mammals, with most available studies investigating the use of seismic airguns and focused on cetaceans, not seals. With consideration that seals have a lower sensitivity to underwater noise compared to cetaceans, we will consider studies on cetaceans on a precautionary basis, assuming that any predicted impact would be reduced with the species low sensitivity.

6.4.3.10 A study by Lucke *et al.* (2009) indicated that TTS could be induced in harbour porpoise at 350 m when exposed to an airgun impulse at a peak pressure of 200 dB_{pk-pk} re 1 μPa with corresponding SEL of 164.5 dB re $\mu Pa^2{}_s$) in shallow waters (~4 m), however this study is highly conservative as it assumes that the animal would remain stationary throughout the exposure. Evidence from other studies suggests that harbour porpoises exposed to such noise sources would likely move away from the source, and therefore leave the impact range of PTS-onset (Hermannsen *et al.,* 2015). Furthermore, it is expected that vessel presence will act as a deterrent to harbour porpoise, reducing the risk of auditory injury (Benhemma-Le Gall *et al*., 2023). Therefore, it is highly unlikely that harbour porpoise will be present in the immediate vicinity at the start of any survey activity. The same can be applied to harbour seal which we view would be highly unlikely to be present within the immediate vicinity, and with consideration of their reduced sensitive, conclude this is a negligible risk for injury.

6.4.3.11 While PTS is a permanent effect which cannot be recovered from, the most likely response of a marine mammal to noise levels that could induce TTS is to flee the area (Southall *et al.,* 2007). Therefore, animals exposed to these noise levels that could induce TTS are likely to actively avoid hearing damage by moving away from the source.

6.4.3.12 With consideration of disturbance and displacement caused by activities such as piling, there is limited information on the behavioural responses of grey seals to underwater noise. Studies in the Netherlands collected telemetry data from 20 grey seals in 2014 during the during the construction of the Luchterduinen windfarm and from 16 grey seals in 2015 during the construction of the Gemini windfarm (Aarts *et al*., 2018). The most common response suggested a change in behaviour from foraging to horizontal movement, although various other responses were recorded including, altered surfacing and diving behaviour, changes in swim direction, and no response (Aarts *et al*., 2018). Data from this study also showed that seals returned to the area on subsequent trips, despite receiving multiple exposures.

6.4.3.13 During an expert elicitation workshop in 2018, it was concluded that grey seals were considered to have a reasonable ability to compensate for missed foraging opportunities due to disturbance from underwater noise given their generalist diet, adequate fat stores, mobility, and life history (Booth *et al*., 2019). In general, experts agreed that grey seals would be more robust to the effects of disturbance than harbour seals as they have larger energy store and are more generalist in their diet and more adaptable in their foraging strategies (Booth *et al*., 2019). Experts also agreed that moderate-high levels of repeated disturbance would be required for any effect on grey seal fertility rates (Booth *et al*., 2019).

6.4.3.14 Grey seals are highly adaptable to a changing environment. They can adjust their metabolic rate and foraging strategies and can compensate for lost opportunities due to their generalist diet, mobility, and adequate fat stores (Smout *et al*., 2014; Stansbury *et al*., 2015). They are also able to tolerate periods of fasting as part of their life history because of their large body size and thick layer of blubber (i.e. more energy reserve) (Pomeroy *et al*., 1999). In addition, they are wide ranging and can travel large distances (up to 488 km) between different haul out and foraging regions, although on average, distances tend to be approximately 65 km (McConnell *et al*., 1999). Therefore, we consider grey seals to be of high adaptability, have reasonable to high tolerance and have high recoverability to underwater noise.

6.4.3.15 Available guidance on assessing the significance of noise disturbance from UXO detonation against the conservation objectives of SACs with grey seals as qualifying interests is limited, however the closest relevant guidance is with regards to harbour porpoise SACs within England, Wales and Northern Ireland. As a species is considered to be more sensitive to these impacts than seals we have adopted that guidance on a precautionary basis, and impacts are viewed to likely be lesser. The guidance recommends an effective deterrence range (EDR) of 26 km for high-order detonations (JNCC, 2020). It should be noted that this EDR is based upon avoidance from piling, not UXO clearance, and the same guidance states that '*a one off explosion would probably only elicit a startle response and would not cause widespread and prolonged displacement*''. With consideration of the resilience of the species highlighted above, it is concluded that grey seal are not sensitive to UXO clearance behavioural disturbance effects when considering the integrity of the designated site.

6.4.3.16 With consideration of disturbance caused by geophysical and geotechnical surveys, there are also few studies on the effects of seismic airguns on seals. Detailed observations of the behavioural and physiological responses of harbour seal were recorded by Thompson *et al.* (1998) using controlled exposure experiments with small air guns (source levels of 215-224 dB re 1μPa peak-to-peak). These experiments showed that grey seals exhibit avoidance behaviour when exposed to a single airgun or small array, switching from foraging to transiting behaviour, whilst harbour seals exhibited dramatic avoidance behaviour and stopped feeding (Thompson *et al.,* 1998). With consideration of the above behavioural effects of piling, it is anticipated that grey seals will show similar levels of avoidance and return behaviours, just within a smaller area based on the reduced distance the noise produced will go in comparison to piling.

6.4.3.17 The assessment has been informed by the Underwater Noise Assessment by Subacoustech (Volume III, Appendix 11.1) which includes the results of numerical modelling using the INSPIRE underwater noise model.

CONSTRUCTION AND DECOMMISSIONING

6.4.3.18 Piling will only be carried out during the construction phase of the Proposed Development. Based on calculations and data presented in Table 6.16, it is calculated that the maximum instantaneous PTS-onset impact range is 60 m (11 m monopile at the SW location and 7 m or 14 m monopile at the S-OSP location) with other piling locations having a reduced range. Based on this modelling and the survey results, no seals are expected to be impacted. Using the cumulative PTS-onset thresholds, the maximum impact range is 500 m (for an 11 m monopile at the C location, all other locations have a reduced impact range), which still calculates as no seals being impacted by these activities. TTS is only a temporary impact and within consideration of the evidence clarified above with the assessment of the PTS impacts, although potentially impacting a much larger area, when in consideration of the integrity of the SAC poses a negligible risk as all impacts are short term and temporary. With additional consideration of the avoidance through design of the Proposed Development incorporated into the activities, specifically the MMMP, this will serve to further minimise any risk posed to grey seals.

6.4.3.19 With regards to UXO clearance, based on the modelling presented in Table 6.17 the maximum PTS-onset impact range is 2.8 km. This would result in 2 grey seal (0.12% of the population) experiencing PTS from a high-order detonation with the greatest charge weight.

Table 6.16: PTS-onset from pile driving and disturbance at array locations with grey seal densities estimates

Piling location and Monopile		Density (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
Instantaneous PTS-onset (unweighted SPLpeak)						
NW	7 m	0.08	<0.01	<50	0	0.00
	11 m		0.01	<50	0	0.00
C	7 m	0.08	0.01	50	0	0.00
	11 m		0.01	50	0	0.00
SW	7 m	0.08	0.01	<50	0	0.00
	11 m		0.01	60	0	0.00
N-OSP	7 m	0.08	0.01	<50	0	0.00
	14 m		0.01	<50	0	0.00
S-OSP	7 m	0.08	0.01	60	0	0.00
	14 m		0.01	60	0	0.00
Cumulative PTS-onset (weighted SELcum)						

Piling location and Monopile		Density (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
NW	7 m	0.08	<0.01	<100	0	0.00
	11 m		<0.01	<100	0	0.00
C	7 m	0.08	0.3	400	0	0.00
	11 m		0.3	500	0	0.00
SW	7 m	0.08	0.1	380	0	0.00
	11 m		0.2	400	0	0.00
N-OSP	7 m	0.08	<0.1	<100	0	0.00
	14 m		<0.1	<100	0	0.00
S-OSP	7 m	0.08	<0.1	200	0	0.00
	14 m		<0.1	200	0	0.00
Predicted disturbance						
NW	7 m	0.08	-	-	130	7.83

Piling location and Monopile		Density (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
	11 m		-	-	132	7.95
C	7 m	0.08	-	-	269	16.21
	11 m		-	-	271	16.32
SW	7 m	0.08	-	-	297	17.86
	11 m		-	-	299	18.00
N-OSP	7 m	0.08	-	-	155	9.31
	14 m		-	-	157	9.42
S-OSP	7 m	0.08	-	-	297	17.89
	14 m		-	-	300	18.07

Table 6.17: PTS-onset from UXO clearance and disturbance at array locations with grey seal densities estimates

Charge Weight (kg)	Maximum range (m)	Density of species (animals/km^2)	Number of animals	% of reference population
PTS-onset (unweighted SPLpeak)				
0.5 (low order)	240	0.08	<1	<0.01
25 + donor	910		<1	0.01
55 + donor	1,100		<1	0.02
120 +donor	1,500		1	0.03
240 + donor	1,900		1	0.05
525 + donor	2,500		2	0.09
700 + donor	2,700		2	0.11
800 + donor	2,800		2	0.12
PTS-onset (weighted SELss)				
0.5 (low order)	60	0.08	0	0.0
25 + donor	390		<1	<0.01
55 + donor	570		<1	<0.01
120 +donor	830		<1	0.01
240 + donor	1,100		<1	0.02

Charge Weight (kg)	Maximum range (m)	Density of species (animals/km^2)	Number of animals	% of reference population
525 + donor	1,600		1	0.04
700 + donor	1,900		1	0.05
800 + donor	2,000		1	0.06
Disturbance				
High Order Clearance	26,000	0.08	170	10.22
Low Order Clearance	5,000	0.08	10	0.38

6.4.3.20 **Therefore, it is concluded there will be no AEoI upon the integrity of Lambay Island SAC, as defined by the COs of the site, as a result of injury from underwater noise impacting grey seal from Project Design Option 1.**

6.4.3.21 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.3.22 Based on the conclusions within Table 6.16, it is estimated that up to 300 grey seal will experience behavioural disturbance from piling in the S-OSP location with a 14 m monopile (the other locations having reduced numbers disturbed). This comprises of 18.07% of the estimated population. Underwater noise from UXO clearance and surveys are not anticipated to increase this, disturbing up to 170 grey seal. With consideration that it is concluded that grey seal had negligible sensitivity to this impact, despite the relatively moderate proportion of the population that may be subject to disturbance, the qualifying interests population trends or integrity will be unaffected.

6.4.3.23 **Therefore, it is concluded there will be no AEoI upon the integrity of Lambay Island SAC, as defined by the COs of the site, as a result of behavioural disturbance from underwater noise impacting grey seal from Project Design Option 1.**

6.4.3.24 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE PHASE

6.4.3.25 There are no piling activities proposed for the Operational and Maintenance phase of the Proposed Development. Any underwater noise produced will be due to vessel movements which is assessed in Section 6.4.3.27 to 6.4.3.49. **There is no potential for AEoI from underwater noise in the operational and maintenance phase of the Proposed Development on this site and feature, as defined by the COs of the site, for Project Design Option 1.**

6.4.3.26 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

INJURY AND/ OR DISTURBANCE FROM VESSEL MOVEMENTS

6.4.3.27 There will be increased vessel movements compared to baseline levels during all phases of the Proposed Development, which can result in injury and/ or mortality from vessel collision, or disturbance though presence and the generation of noise.

6.4.3.28 The area surrounding the Proposed Development experiences a relatively low level of vessel traffic due to the presence of the shallow Arklow Bank sandbank, with higher traffic in the coastal areas and immediate surrounding waters.

6.4.3.29 The shipping and navigation baseline study recorded 29 days of vessel traffic data between 7 July and 14 August 2023. There was an average of 36 to 37 unique vessels per day recorded within the shipping and navigation Study Area (which is defined as Array Area and a 10 nm buffer). The busiest day recorded 59 unique vessels within the shipping and navigation Study Area. The main vessel types within the shipping and navigation Study Area were cargo vessels (40%), recreational vessels (31%) and fishing vessels (10%).

6.4.3.30 During construction of the windfarm, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. In general, three consequences of vessel collision are defined: direct (injuries to the animals that are the immediate result of collision), long-term (a decrease in the fitness of the animal over time), and population consequences (Schoeman *et al*., 2020). With regards to injuries, both fatal and non-fatal injuries between marine mammals and vessels have been documented (Laist *et al*., 2001; Vanderlaan *et al*., 2008; Cates *et al.*, 2017). Fatal collisions have been evidenced via carcasses washing up on beaches (Laist *et al.*, 2001; Peltier *et al*., 2019); carcasses caught on vessel bows (Laist *et al*., 2001; Peltier *et al.*, 2019); and floating carcasses which have strong evidence of ship strike, such as propeller cuts, significant bruising, oedema, internal bleeding radiating from a specific impact site, fractures and ship paint marks (Jensen and Silber, 2003; Douglas *et al*., 2008). Fatalities from ship strikes, however, often go unreported (Authier *et al*., 2014). For non-fatal injuries, evidence of animals which have survived ship strikes with non-fatal injuries from propellers has been widely documented (Wells *et al*., 2008; Luksenburg, 2014).

6.4.3.31 Although many species of marine mammals are able to detect and avoid vessels, it is unclear why some individuals do not always move out of the path of an approaching vessel (Schoeman *et al*., 2020), although it has been suggested that behaviours such as resting, foraging, nursing, and socialising could distract animals from detecting the risk posed by vessels (Dukas, 2002). It is also possible that animals do not hear vessels when they are near the surface. Collisions between cetaceans and vessels, however, are not necessarily lethal on all occasions.

6.4.3.32 Whilst a broad range of vessel types have been involved in collisions with marine mammals (Laist *et al*., 2001), vessels travelling at higher speeds pose a higher risk because of the potential for a stronger strike impact (Schoeman *et al*., 2020). For example, a study by Laist *et al.* (2001) found that in 89% of collisions in which the whale was killed or seriously injured vessels were travelling at speeds of 14 kn (7 m/s) or more, and the vessel exceeded a length of 80 m. Therefore, larger vessels travelling at 7 m/s or faster are those most likely to cause death or serious injury to marine mammals (Laist *et al*., 2001).

6.4.3.33 Grey seals are relatively small and highly mobile, and given observed responses to noise, are expected to detect vessels in close proximity and largely avoid collision. Collision risk for seals is not well understood, however trauma ascribed to collisions with vessels has been identified in a small proportion of both live stranded (Goldstein *et al*., 1999) and dead stranded seals in the USA (Swails, 2005). In these cases, however, less than 2% of all dead necropsied seals had vessel collision attributed to cause of death. A study in the Moray Firth showed that seals use the same areas as vessels during trips between haul-outs and foraging sites but that seals tended to remain beyond 20 m from vessels (only three instances over 2,241 days of seal activity resulted in passes at less than 20 m) (Onoufriou *et al*., 2016), suggesting that the possibility of a risk of collision is very low.

6.4.3.34 Overall, the assessment concludes that there is a high likelihood that grey seals will avoid vessels and therefore collision risk is viewed as negligible, although they have a high sensitivity to the impact should it occur.

6.4.3.35 With regards to behavioural disturbance caused by noise from presence of vessels and their movements, grey seals are particularly sensitive to disturbance in regions where vessel traffic overlaps with productive coastal waters (Robards *et al*., 2016). Vessel disturbance may be particularly detrimental to grey seal if it changes their haul-out patterns or reduces the time they are able to spend resting or nursing pups during the breeding season. When disturbed, seals that are hauled-out typically 'flush' (enter) into the water which could be detrimental during pupping season (Johnson and Acevedo-Gutiérrez, 2007). Key haul-outs for grey seal in proximity to the Proposed Development are at Arklow, co. Wicklow, along the coast of co. Dublin, and around Wexford Harbour (Duck and Morris, 2013; Morris and Duck, 2019). A study of vessel traffic and marine mammal presence at Broadhaven Bay, northwest Ireland found grey seals sightings decreased with increased vessel activity in the surrounding area, though the effect size was small, and the relationships between sightings and vessel numbers were weaker than those with environmental variables such as sea state (Anderwald *et al*., 2013).

6.4.3.36 Overall, it is concluded that with consideration that grey seals are adaptable, with a moderate tolerance and high recoverability, grey seals have a low sensitivity to this kind of impact. **Therefore, there is no AEoI for the Lambay Island SAC, as defined by the COs of the site, as a result of injury or disturbance from vessel movement.**

CONSTRUCTION AND DECOMMISSIONING

6.4.3.37 During the construction phase, a maximum of 66 installation vessels will be present within the Proposed Development at any one time, resulting in a maximum of 4,150 vessel return trips over the five-year construction period, and a maximum of 1,797 vessel return trips per year. A similar number of vessels are anticipated for the decommissioning phase.

6.4.3.38 The majority of vessels used during the construction phase are likely to be large vessels that will either be travelling considerably slower than 7 m/s (the key risk is when this speed is exceeded with large vessels) or will be stationary for significant periods of time. Therefore, the actual increase in vessel traffic moving within the Proposed Development and to/from port will occur over short periods of the offshore construction activity. Smaller vessels involved in construction activities (i.e. tug/anchor handlers, guard vessels, survey vessels, and crew transfer vessels) are able to move to avoid marine mammals (when detected), even when an animal is close and the vessel is going at high speed, due to better manoeuvrability compared to larger vessels (Schoeman et al., 2020). In contrast, large vessels, such as jack-up vessels, have low manoeuvrability and may require larger distances to avoid an animal, but travel at slower speeds. In addition, the factored-in measures (see Table 6.7) which includes an EVMP, will ensure that vessel traffic will move along predictable routes, which is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al., 2001; Lusseau 2003; 2006). The EVMP also sets out a Code of Conduct to minimise interactions with marine mammals and to define how vessels should behave in the presence of them.

6.4.3.39 It is also anticipated that noise produced by the vessels will be detectable by the grey seals and therefore enable avoidance.

6.4.3.40 **It is concluded that there is no potential for AEoI upon the integrity of Lambay Island SAC, as defined by the COs of the site, as a result of injury from vessel collision impacting grey seal from Project Design Option 1.**

6.4.3.41 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.3.42 When considering the disturbance and displacement, the coastal areas and immediate surrounding waters of the Proposed Development are already subject to high levels of vessel traffic. However, evidence shows there is no decrease in seal populations with high levels of co-occurrence between ships and seals. In areas where seal populations are showing high levels of growth (such as southeast England), ship co-occurrences are highest (Jones et al., 2017). With consideration of this, it is concluded that it is unlikely there will be a significant change in the level of disturbance grey seals naturally present are subject to. The EVMP will serve to ensure that vessels follow predictable routes in addition to setting out how the vessels should behave in the presence of the species.

6.4.3.43 The proposed implementation of a EVMP (Table 6.7) will reduce the risk of vessel disturbance by controlling the speed and movement of vessels, resulting in slower moving vessels travelling more predictable routes which are less likely to cause disturbance. This is supported by vessel simulation modelling by Findlay et al. (2023) which predicted that, when animals were exposed to vessels at a given distance with both a 20% and a 50% reduction in speed, all potential noise impacts were reduced. At a 20% reduction in speed, the vessel noise swath halved, reducing the average number of animals exposed by 50% and therefore reducing the number of animals that are likely to be disturbed (Findlay et al., 2023). In addition, the study demonstrated that moderate slowdowns strongly reduce vessel source levels, with a 20% reduction in speed decreasing mean source levels by 6 dB and a 50% speed reduction by 18 dB (Findlay et al., 2023).

6.4.3.44 It is concluded that the any disturbance above current baseline levels of activity will only result in a short-term and temporary impact on behaviour, and the above assessments of the impact of underwater noise supports the conclusion that grey seals typically return to similar abundance as before within two hours of cessation of the activities causing disturbance.

6.4.3.45 **Therefore, it is concluded there will be no AEoI upon the integrity of Lambay Island SAC, as defined by the COs of the site, as a result of disturbance from vessel movement impacting grey seal from Project Design Option 1.**

6.4.3.46 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE PHASE

6.4.3.47 During the operational and maintenance phase, a maximum of 22 vessels will be present within the Array Area at any one time, resulting in a maximum of 1,294 vessel return trips per year. With consideration that this is a significant reduction in the number of vessels present in comparison to the Construction and decommissioning phase, it is concluded that based on the assessment for that phase, there is no potential for significant effect.

6.4.3.48 **Therefore, there is no AEoI upon the integrity of Lambay Island SAC, as defined by the COs of the site, as a result of disturbance or collision risk from vessel movement impacting grey seal from Project Design Option 1 in this phase.**

6.4.3.49 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

CHANGES IN PREY

6.4.3.50 Grey seal are primarily dependent on poor cod, salmonids, sandeel, dragonet, whiting, bib, blue whiting, haddock, pollock, saithe, herring, rockling, Norway pout, mackerel, hake, eels, wrasse, perch, sole, halibut, dab, flatfish species, squid species and octopus species for food (Gosch *et al.,* 2014; Wilson and Hammond, 2019). This demonstrates a very highly varied diet and ability to adapt to changes in availability of prey types where needed and so harbour porpoise are considered generalist feeders.

6.4.3.51 Impacts to prey resources will be largely restricted to the boundaries of the Proposed Development and, therefore, grey seal occurring within this area also have the potential to be impacted. The impacts on prey species are not qualifying interest species specific, with prey species for grey seal subject to the same impacts as the prey species as the other Annex 2 marine mammal species considered within this assessment (bottlenose dolphin, harbour porpoise and harbour seal). A full assessment on the impacts of the Proposed Development on prey species has been considered within the assessment on Blackwater Bank SAC (Section 6.4.1) which is located 19.76 km from the Proposed Development, significantly closer than Lambay Island SAC (62.87 km).

6.4.3.52 **Therefore, it is concluded that there is no AEoI upon the integrity of Lambay Island SAC, as defined by the COs of the site, from changes in prey impacting grey seal from Project Design Option 1 in this phase.**

6.4.3.53 **Based on the increased risk of effect of Project Design Option 1, it can be reasonably assumed that the same conclusion of no AEoI would also apply Project Design Option 2.**

ACCIDENTAL POLLUTION

6.4.3.54 There is the potential for an accidental release of pollutants to occur from vessels and equipment associated with the construction, operational and maintenance and decommissioning phases of the Proposed Development, which may result in adverse effects on marine mammals. Pollutants may include diesel fuel, bentonite (from drilling activities), lubricants, grease and oils, anti-fouling biocides, and grout.

6.4.3.55 In the event of an accidental spill, given the density and distribution of marine mammals in the Marine Mammal Study Area, it is possible that individuals could come into contact with contaminants.

6.4.3.56 Direct impacts include ingestion, inhalation, and absorption. All of which may result in physiological responses with health and long-term survival and/or reproduction consequences, the most serious of which could be damage to the respiratory system (Helm *et al.*, 2015).

6.4.3.57 Indirect impacts include short- and long-term reductions in food availability, disruption to social bonds, reduced reproduction, and/or cumulative effects on individuals, populations, and the ecosystem (Helm *et al.*, 2015).

6.4.3.58 Grey seals are reliant on terrestrial haul-out sites for resting, moulting, and breeding which makes them particularly vulnerable to the effects of pollution. Seals have been shown to develop conjunctivitis, corneal abrasion, and swollen eyelid membranes in response to exposure to crude oil (Geraci and St. Aubin, 1980). While external oiling is not expected to significantly impact the ability of adult seals to maintain their core body temperature as they rely on blubber for insulation, seal pups entering the water could be vulnerable as oil residues can reduce the thermal properties of neonate animals, increasing their susceptibility to hypothermia (Helm *et al.*, 2015),

6.4.3.59 Overall, accidental pollution has the potential to cause LSE on grey seal features.

CONSTRUCTION AND DECOMMISSIONING PHASE

6.4.3.60 The installation of the offshore infrastructure for the Proposed Development may lead to the accidental release of pollutants through spills and leaks from vessels and equipment. The project design parameters for Project Design Option 1 during the construction phase are outlined in Table 6.8 and include the installation of 56 WTGs, two OSPs, between 110 and 122 km of inter-array cables, between 25 and 28 km of interconnector cables, and between 35 and 40 km offshore export cables. There will also be up to 4,150 vessel round trips and 294 helicopter round trips during the construction phase (including activities at the landfall site).

6.4.3.61 The potential impact to marine mammals from accidental pollution during the decommissioning phase is expected to be the same or less than the construction phase.

6.4.3.62 The magnitude of the impact of accidental pollution will be dependent on the quantities of potential pollutants carried by construction vessels and within equipment. The release of a large inventory of fuel oil from a construction vessel is, however, considered to represent the greatest potential accidental pollution event from installation activities. In the event of an accidental spill from vessels, equipment or from construction activities, the spill would be subject to immediate dilution and rapid dispersal (Marappan *et al.,* 2022).

6.4.3.63 Considering avoidance through design and management (see Table 6.7), the likelihood of accidental release is considered extremely low. The measures in the EMP include storage of chemicals in secure designated areas on vessels in line with appropriate regulations and guidelines, and double skinning of any tanks and pipes containing hazardous substances. All chemicals used will be subject to a chemical risk assessment to ensure risks are understood and minimised. The EMP also includes a MPCP which will contain key emergency contact details and response procedures in the event of a spill of any magnitude to ensure minimal impact. Complying with these procedures will also reduce the magnitude of any spill. Adherence to the avoidance design and management measures outlined in Table 6.7, including the EMP and MPCP will significantly reduce the likelihood of an accidental pollution incident occurring, and the magnitude of its impact.

6.4.3.64 **Given the inherent low likelihood of accidental pollution from vessel activity and other activities, as well as the proposed avoidance/ impacts reduction measures (as set out in Table 6.7), there is no potential for AEoI from accidental pollution on Lambay Island SAC, as defined by the COs of the site, impacting grey seal from Project Design Option 1.**

6.4.3.65 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE PHASE

6.4.3.66 There is the potential for the accidental release of pollutants during this phase of the Proposed Development as a result of the presence of offshore infrastructure, associated equipment, and vessel movements. The project design parameters for Project Design Option 1 during the operational and maintenance phase are outlined in Table 6.8. This includes synthetic compound, for example from antifouling biocides, heavy metal, and hydrocarbon contamination as a result of the presence of 56 WTGs and two OSPs as well as from maintenance activities. There will also be up to 1,294 vessel round trips and 485 helicopter round trips per year during this phase of the proposed development.

6.4.3.67 The assessment for this phase is the same as for the construction phase, with the same avoidance by design and management measures being implemented to reduce the risk to negligible levels (see Table 6.7 and Section 6.4.3.63). **It is concluded that the potential for AEoI upon the integrity of Lambay Island SAC, as defined by the COs of the site, from accidental pollution impacting grey seal from Project Design Option 1 is entirely negligible.**

6.4.3.68 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Harbour porpoise

6.4.3.69 The conservation objectives for harbour porpoise at this designated site have yet to be provided as this has only recently been designated as a site with harbour porpoise as a qualifying interest. Therefore, on a precautionary basis, we will be basing our assessment on the conservation objectives for Rockabill and Dalkey Island SAC as it is the next closest designated site with the same qualifying feature of harbour porpoise. The conservation objectives are to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.3.70 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development.

6.4.3.71 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as Lambay Island SAC (62.87 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.1 it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.3.72 **Therefore, there is no AEoI for Lambay Island SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.3.73 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.4 Codling Fault Zone SAC

Harbour Porpoise

6.4.4.0 The conservation objectives for harbour porpoise at this designated site have yet to be provided as this has only recently been designated as a site with harbour porpoise as a qualifying interest. Therefore, on a precautionary basis, we will be basing our assessment on the conservation objectives for West Wales Marine SAC as it is the next closest designated site with the same qualifying feature of harbour porpoise. The conservation objectives are to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.4.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental Pollution.

6.4.4.2 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as Codling Fault Zone SAC (63.31 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.5 it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.4.3 **Therefore, there is no AEoI for Codling Fault Zone SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.4.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.5 Rockabill to Dalkey Island SAC

Harbour Porpoise

6.4.5.0 The conservation objectives for harbour porpoise at this designated site is to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.5.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental Pollution.

6.4.5.2 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as Rockabill to Dalkey Island SAC (70.39 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.5 it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.5.3 **Therefore, there is no AEoI for Rockabill to Dalkey Island SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.5.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.6 Carnsore Point SAC

Harbour Porpoise

6.4.6.0 The conservation objectives for harbour porpoise at this designated site have yet to be provided as this has only recently been designated as a site with harbour porpoise as a qualifying interest. Therefore, on a precautionary basis, we will be basing our assessment on the conservation objectives for Rockabill and Dalkey Island SAC as it is the next closest designated site with the same qualifying feature of harbour porpoise. The conservation objectives are to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.6.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental Pollution.

6.4.6.2 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as Carnsore Point SAC (73.83 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.5 it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.6.3 **Therefore, there is no AEoI for Carnsore Point SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.6.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.7 Saltee Islands SAC

Grey Seal

6.4.7.0 The conservation objectives for grey seal at this designated site is to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.7.1 There are four key potential impacts on grey seal associated with the construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey and Accidental Pollution.

6.4.7.2 With consideration that the impact severity is based on distance from the site of works, Lambay Island SAC (62.87 km) is designated for the same QIs as Saltee Islands SAC (90.70 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.3 it has been concluded that none of the potential effects on grey seal would result in an AEoI of the QIs.

6.4.7.3 **Therefore, there is no AEoI for Saltee Islands SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting grey seal from Project Design Option 1 in this phase.**

6.4.7.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.8 Hook Head SAC

Harbour porpoise

6.4.8.0 The conservation objectives for harbour porpoise at this designated site have yet to be provided as this has only recently been designated as a site with harbour porpoise as a qualifying interest. Therefore, on a precautionary basis, we will be basing our assessment on the conservation objectives for West Wales Marine SAC as it is the next closest designated site with the same qualifying feature of harbour porpoise. The conservation objectives are to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.8.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and accidental pollution.

6.4.8.2 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as Hook Head SAC (109.96 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.5, it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.8.3 **Therefore, there is no AEoI for Hook Head SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.8.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Bottlenose dolphin

6.4.8.5 The conservation objectives for bottlenose dolphin at this designated site have yet to be provided as this has only recently been designated as a site with bottlenose dolphin as a qualifying interest. Therefore, on a precautionary basis, we will be basing our assessment on the conservation objectives for Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC as it is the next closest designated site with the same qualifying feature of bottlenose dolphin. The conservation objectives are to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.8.6 There are five key potential impacts on bottlenose dolphin associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental Pollution.

6.4.8.7 With consideration that the impact severity is based on distance from the site of works, Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC (73.32 km) is designated for the same QIs as Hook Head (109.96 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.18 it has been concluded that none of the potential effects on bottlenose dolphin would result in an AEoI of the QIs.

6.4.8.8 **Therefore, there is no AEoI for Hook Head SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting bottlenose dolphin from Project Design Option 1 in this phase.**

6.4.8.9 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.9 Roaringwater Bay and Islands SAC

Harbour Porpoise

6.4.9.0 The conservation objectives for harbour porpoise at this designated site is to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.9.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental Pollution.

6.4.9.2 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as Roaringwater Bay and Islands SAC (310.71 km via marine pathway) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.5 it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.9.3 **Therefore, there is no AEoI for Roaringwater Bay and Islands SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.9.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.10 Kenmare River SAC

Harbour Porpoise

6.4.10.0 The conservation objectives for harbour porpoise at this designated site have yet to be provided as this has only recently been designated as a site with harbour porpoise as a qualifying interest. Therefore, on a precautionary basis, we will be basing our assessment on the conservation objectives for Blasket Islands SAC as it is the next closest designated site with the same qualifying feature of harbour porpoise. The conservation objectives are to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.10.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental Pollution.

6.4.10.2 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as, Kenmare River SAC (371.44 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.5 it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.10.3 **Therefore, there is no AEoI for Kenmare River SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.10.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.11 Blasket Islands SAC

Harbour Porpoise

6.4.11.0 The conservation objectives for harbour porpoise at this designated site is to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.11.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental Pollution.

6.4.11.2 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as Blasket Islands SAC (425.35 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.5, it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.11.3 **Therefore, there is no AEoI for Blasket Islands SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.11.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.12 Belgica Mound Province SAC

Harbour Porpoise

6.4.12.0 The conservation objectives for harbour porpoise at this designated site have yet to be provided as this has only recently been designated as a site with harbour porpoise as a qualifying interest. Therefore, on a precautionary basis, we will be basing our assessment on the conservation objectives for Blasket Islands SAC as it is the next closest designated site with the same qualifying feature of harbour porpoise. The conservation objectives are to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.12.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental Pollution.

6.4.12.2 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as Belgica Mound Province SAC (465.83 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.1, it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.12.3 **Therefore, there is no AEoI for Belgica Mound Province SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.12.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.13 Bunduff Lough and Machair / Trawalua / Mullaghmore SAC

Harbour Porpoise

6.4.13.0 The conservation objectives for harbour porpoise at this designated site have yet to be provided as this has only recently been designated as a site with harbour porpoise as a qualifying interest. Therefore, on a precautionary basis, we will be basing our assessment on the conservation objectives for Blasket Islands SAC as it is the next closest designated site with the same qualifying feature of harbour porpoise. The conservation objectives are to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.13.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental Pollution.

6.4.13.2 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as Bunduff Lough and Machair / Trawalua / Mullaghmore SAC (536.89 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.1, it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.13.3 **Therefore, there is no AEoI for Bunduff Lough and Machair / Trawalua / Mullaghmore SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.13.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.14 Inishmore Island SAC

Harbour Porpoise

6.4.14.0 The conservation objectives for harbour porpoise at this designated site have yet to be provided as this has only recently been designated as a site with harbour porpoise as a qualifying interest. Therefore, on a precautionary basis, we will be basing our assessment on the conservation objectives for Blasket Islands SAC as it is the next closest designated site with the same qualifying feature of harbour porpoise. The conservation objectives are to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.14.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental Pollution.

6.4.14.2 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as Inishmore Island SAC (549.28 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.1, it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.14.3 **Therefore, there is no AEoI for Inishmore Island SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1.**

6.4.14.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.15 Kilkieran Bay and Islands SAC

Harbour Porpoise

6.4.15.0 The conservation objectives for harbour porpoise at this designated site have yet to be provided as this has only recently been designated as a site with harbour porpoise as a qualifying interest. Therefore, on a precautionary basis, we will be basing our assessment on the conservation objectives for Blasket Islands SAC as it is the next closest designated site with the same qualifying feature of harbour porpoise. The conservation objectives are to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.15.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental Pollution.

6.4.15.2 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as Kilkieran Bay and Islands SAC (562.75 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.1, it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.15.3 **Therefore, there is no AEoI for Kilkieran Bay and Islands SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1.**

6.4.15.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.16 West Connacht Coast SAC

Harbour Porpoise

6.4.16.0 The conservation objectives for harbour porpoise at this designated site have yet to be provided as this has only recently been designated as a site with harbour porpoise as a qualifying interest. Therefore, on a precautionary basis, we will be basing our assessment on the conservation objectives for Blasket Islands SAC as it is the next closest designated site with the same qualifying feature of harbour porpoise. The conservation objectives are to maintain the favourable conservation condition of the feature, how this is defined is presented in Table 5.1.

6.4.16.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental Pollution.

6.4.16.2 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as West Connacht Coast SAC (605.46 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.1, it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.16.3 **Therefore, there is no AEoI for West Connacht Coast SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.16.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Transboundary sites within the UK

6.4.17 West Wales Marine/ Gorllewin Cymru Forol SAC

Harbour Porpoise

6.4.17.0 The conservation objectives for harbour porpoise at this designated site is to ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour Porpoise in UK waters, how this is defined is presented in Table 5.1.

6.4.17.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental pollution.

6.4.17.2 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as West Wales Marine/ Gorllewin Cymru Forol SAC (93.50 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.5, it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.17.3 **Therefore, there is no AEoI for West Wales Marine/ Gorllewin Cymru Forol SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.17.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.18 Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC

Bottlenose Dolphin

6.4.18.0 The conservation objectives for bottlenose dolphin at this designated site is to achieve favourable conservation status of the feature, how this is defined is presented in Table 5.1.

6.4.18.1 There are five key potential impacts on bottlenose dolphin associated with the construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development.

INJURY AND/ OR DISTURBANCE FROM UNDERWATER NOISE

6.4.18.2 Underwater noise has the potential to impact marine mammals if the frequency is within their hearing range, and in particular if the sound levels are greater than the relevant thresholds. With consideration of bottlenose dolphin, they are within the High Frequency (HF) cetacean hearing group and have a hearing range of 150 Hz to 160 kHz. The impacts can range from auditory injury, disturbance and displacement, to changes in behaviour including masking depending on the severity of the underwater noise.

6.4.18.3 With consideration of the risk and impacts of auditory injury, all species of cetaceans rely on sonar for navigation, finding prey and communication (Southall *et al.*, 2007). The ecological consequences of PTS (a permanent and irreversible hearing impairment) are uncertain, although a loss of hearing could affect key life functions such as communication, predator detection, foraging, mating and maternal fitness, and could lead to a change in an animal's health or vital rates (Erbe *et al.*, 2018). Relating a potential loss in hearing to a biologically significant response is challenging due to a paucity of empirical data, however a potential consequence of a disruption in key life functions is that the health of impacted animals would deteriorate and potentially lead to reduced birth rate in females and mortality of individuals.

6.4.18.4 At a Department of Business, Energy, and Industrial Strategy (BEIS)-funded expert elicitation workshop in 2018, experts discussed the nature, extent, and potentially consequences of PTS to marine mammal species in the UK (Booth and Heinis, 2018). Using the best and most recent data available on the effects of PTS on marine mammals, the experts concluded that PTS did not mean animals were deaf, and the magnitude and frequency band in which PTS occurs is critical to assessing the effect on vital rates.

6.4.18.5 Exposure to loud underwater noises can lead to a reduction in hearing sensitivity which may be temporary (TTS) or permanent (PTS). PTS is defined by Southall et al. (2007) as a non-recoverable elevation of the hearing threshold of 6 dB. It has been assumed that PTS-onset occurs after TTS has grown to 40 dB, based on TTS growth rates obtained from scientific literature. Studies of auditory injury in relation to a typical piling sequence have suggested that hearing impairment caused by exposure to piling noise is likely to occur where the source frequencies overlap the range of peak sensitivity for the receptor species rather than across the whole frequency hearing spectrum (Kastelein et al., 2013a). For piling noise, most energy is between ~30 – 500 Hz, with a peak between 100-300 Hz and energy extending above 2 kHz (Kastelein et al., 2015; Kastelein et al., 2016). There are not studies specific to impacts on bottlenose dolphin, however studies on harbour porpoise and harbour seal (bottlenose dolphin has a hearing range considered to be between the two) have shown that exposure to impulsive pile driving noise induces TTS in a relatively narrow frequency band (Finneran, 2015), with statistically significant TTS occurring at 4 and 8 kHz, respectively (Kastelein et al., 2016) and centred at 4 kHz (Kastelein et al., 2012a; Kastelein et al., 2012b; Kastelein et al., 2013b; Kastelein et al., 2017). As a result, at an expert elicitation workshop, it was agreed that any threshold shifts to hearing caused by pile driving would manifest in the range of 2 – 10 kHz (Kastelein et al., 2017). It was also agreed that a PTS of 6 – 18 dB in a narrow frequency band in the 2 – 10 kHz region is unlikely to significantly affect the ability of individuals to survive and reproduce (Kastelein et al., 2017).

6.4.18.6 As considered within the harbour porpoise underwater noise assessment in Section 6.4.5 studies have shown that there are frequency-specific differences in the onset and growth of noise-induced threshold shifts in relation to the characteristics of the noise source and hearing sensitivity of the receiving species. At a BEIS-funded export elicitation workshop in 2018, experts concluded that the probability of PTS significantly affecting the survival and reproduction of bottlenose dolphins was very low, assuming an impact a 6 dB PTS in the 2 – 10 kHz range (Booth and Heinis, 2018).

6.4.18.7 With regards to underwater noise produced by UXO clearance, there are two activities that produce noise, higher order detonation, and low-order clearance methods. It is unknown if there are UXO that require clearance at the time of this assessment, and therefore is unknown to what level of clearance will be carried out. Therefore, this assessment is based on high-order UXO clearance being carried out which is viewed as the worst-case scenario in terms of underwater noise generation.

6.4.18.8 The main underwater noise produced by high-order detonation is outside of the region of greatest sensitivity for bottlenose dolphin (Southall et al., 2019), and there is a pronounced reduction in energy levels above ~5-10 kHz (von Beckmann et al., 2015 and Salomons et al., 2021). Due to this, with consideration of the above sensitivity, it is concluded that bottlenose dolphin have a low sensitivity to this effect.

6.4.18.9 With regards to underwater noise produced by geophysical surveys, exact surveys and equipment is yet to be decided, therefore as a precautionary approach we have considered all types of noise generation from the varied survey types. Surveys such as multibeam EchoSounder (MBES) and side scan sonar (SSS) produce sounds which are sonar based and impulsive. Surveys comprising of vibrocoring typically produce non-implusive sound. The equipment's noise source levels are provided in Table 6.9 and Table 6.10.

6.4.18.10 Very limited information exists on the impacts of site surveys (geophysical and geotechnical) to marine mammals, with most available studies investigating the impact of seismic airguns. However, all species of cetaceans rely on sonar for navigation, finding prey and communication (Southall *et al.*, 2007). The ecological consequences of PTS are uncertain, although a loss of hearing could affect key life functions such as communication, predator detection, foraging, mating and maternal fitness, and could lead to a change in an animal's health or vital rates (Erbe *et al.*, 2018). Relating a potential loss in hearing to a biologically significant response is challenging due to a paucity of empirical data, however a potential consequence of a disruption in key life functions is that the health of impacted animals would deteriorate and potentially lead to reduced birth rate in females and mortality of individuals.

6.4.18.11 A study by Lucke *et al.* (2009) indicated that TTS could be induced in harbour porpoise at 350 m when exposed to an airgun impulse at a peak pressure of 200 dB_{pk-pk} re 1 μPa with corresponding SEL of 164.5 dB re $μPa^2{}_s$) in shallow waters (~4 m), however this study is highly conservative as it assumes that the animal would remain stationary throughout the exposure. Evidence from other studies suggests that harbour porpoises exposed to such noise sources would likely move away from the source, and therefore leave the impact range of PTS-onset (Hermannsen *et al.,* 2015).

6.4.18.12 Furthermore, it is expected that vessel presence will act as a deterrent to harbour porpoise, reducing the risk of auditory injury (Benhemma-Le Gall *et al.*, 2023). Therefore, it is highly unlikely that harbour porpoise will be present in the immediate vicinity at the start of any survey activity. The same can be applied to bottlenose dolphin which we view would be highly unlikely to be present within the immediate vicinity, and with consideration of their reduced sensitive, conclude this is a negligible risk for injury.

6.4.18.13 While PTS is a permanent effect which cannot be recovered from, the most likely response of a marine mammal to noise levels that could induce TTS is to flee the area (Southall *et al.,* 2007). Therefore, animals exposed to these noise levels that could induce TTS are likely to actively avoid hearing damage by moving away from the source.

6.4.18.14 Evidence does not suggest that bottlenose dolphins would be significantly impacted by PTS. They are highly adaptable and with reasonable tolerance for this kind of impact, and therefore have a low sensitivity to this kind of injury.

6.4.18.15 With consideration for behavioural changes from underwater noise caused by the Proposed Development, a study of bottlenose dolphin response to impulsive noise (including the piling campaigns of Beatrice offshore windfarm and Moray East offshore windfarm, northeast Scotland), suggest that these activities did not cause displacement of the species from the southern coast of the Moray Firth (Fernandez-Betelu et al., 2021). At the small temporal scale, dolphin detections increased, and the species remained within the predicted impacted area close to the offshore activities, for a median of two hours per day, on days with impulsive noise. This could be due to modifications in group size and/or behaviour, or changes in vocalisation rate or amplitude in response to impulsive noise generated by offshore activities. It is also important to note that bottlenose dolphin occurrence is largely influenced by various natural drivers, such as prey abundance, which could be deemed of higher importance in affecting their occurrence. Other studies in the Cromarty Firth, northeast Scotland have suggested small spatial and temporal scale disturbance of bottlenose dolphins from piling activities have occurred previously, as evidenced by a slight reduction of the presence, detection positive hours, and the encounter duration in the vicinity of construction works, although dolphins were not excluded entirely from the area (Graham et al., 2017a).

6.4.18.16 There is potential for behavioural disturbance due to underwater noise to result in disruption in foraging and resting activities and an increase in travel and energetic costs (Marley *et al.*, 2017a and b; Pirotta *et al.*, 2015), although evidence suggests that this will occur on a small spatial and temporal scale. Furthermore, New *et al.* (2013) showed that while there is potential for disturbance to affect bottlenose dolphin behaviour and health, which will then impact vital rates and population dynamics, individuals are able to compensate for immediate behavioural responses to disturbances caused by vessel activity. This suggests that they have some capability to adapt their behaviour and tolerate certain levels of temporary disturbance. As with the above conclusion for injury from underwater noise, with consideration of their high adaptability, recoverability and reasonable tolerance, it is concluded they have low sensitivity to this kind of impact. A full assessment on the behavioural impact of vessel movements is present in sections 6.4.18.35 to 6.4.18.74

6.4.18.17 Available guidance on assessing the significance of noise disturbance from UXO detonation against the conservation objectives of SACs with bottlenose dolphins as qualifying interests is limited, however the closest relevant guidance is with regards to harbour porpoise SACs within England, Wales and Northern Ireland. As a species is considered to be more sensitive to these impacts than seals we have adopted that guidance on a precautionary basis, and impacts are viewed to likely be lesser. The guidance recommends an effective deterrence range (EDR) of 26 km for high-order detonations (JNCC, 2020). It should be noted that this EDR is based upon avoidance from piling, not UXO clearance, and the same guidance states that '*a one off explosion would probably only elicit a startle response and would not cause widespread and prolonged displacement*''. With consideration of the resilience of the species highlighted above, it is concluded that bottlenose dolphin have negligible sensitivity to UXO clearance behavioural disturbance effects when considering the integrity of the designated site.

6.4.18.18 The assessment has been informed by the Underwater Noise Assessment by Subacoustech (Volume III, Appendix 11.1) which includes the results of numerical modelling using the INSPIRE underwater noise model.

CONSTRUCTION AND DECOMMISSIONING

6.4.18.19 Piling will only be carried out during this phase of the Proposed Development. Based on calculations and data presented in Table 6.19 it is calculated that the maximum instantaneous PTS-onset impact range was <50 m, therefore, no dolphins are expected to be impacted. Using the cumulative PTS-onset thresholds, the maximum impact range for dolphin species was <100 m, and as such, no dolphins are expected to be impacted.

6.4.18.20 With regards to UXO clearance, based on the modelling presented in Table 6.18, the maximum PTS-onset impact range is 840 m which is the smallest of all the species assessed. This would result in up to 1 bottlenose dolphin (up to 0.18% of the population) experiencing PTS from a high-order detonation with the greatest charge weight.

Table 6.18 : PTS-onset ranges and numbers of bottlenose dolphin modelled to be within range for all potential charge weights

Charge Weight (kg)	Maximum range (m)	Site specific DAS density estimate/ SCANS-IV density estimate (animals/km²)	Number of animals	% of reference population
PTS-onset (unweighted SPLpeak)				
0.5 (low order)	70	0.0201 / 0.2352	0	0.0
25 + donor	260		0 / <1	0.0 / 0.02
55 + donor	340		<1 / <1	<0.01 / 0.03

Charge Weight (kg)	Maximum range (m)	Site specific DAS density estimate/ SCANS-IV density estimate (animals/km²)	Number of animals	% of reference population
120 +donor	450		<1 / <1	<0.01 / 0.05
240 + donor	560		<1 / <1	0.01 / 0.08
525 + donor	730		<1 / <1	0.01 / 0.13
700 + donor	810		<1 / <1	0.01 / 0.17
800 + donor	840		<1 / 1	0.02 / 0.18
PTS-onset (weighted SELss)				
0.5 (low order)	<50	0.0201 / 0.2352	0	0
25 + donor	<50		0	0
55 + donor	<50		0	0
120 +donor	<50		0	0
240 + donor	<50		0	0
525 + donor	50		0	0
700 + donor	60		0	0
800 + donor	60		0	0
Disturbance				
High Order Clearance	26,000	0.0201/ 0.2352	43/ 499	14.57/ 170

Charge Weight (kg)	Maximum range (m)	Site specific DAS density estimate/ SCANS-IV density estimate (animals/km²)	Number of animals	% of reference population
Low Order Clearance	5,000	0.0201/ 0.2352	2/ 18	0.54/ 6.30

Table 6.19: PTS-onset from pile driving and disturbance at array locations with bottlenose dolphin densities estimates

Piling location and Monopile		Site specific DAS density estimate/ SCANS-IV density estimate (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
Instantaneous PTS-onset (unweighted SPLpeak)						
NW	7 m	0.0201 / 0.2352	<0.01	<50	0	0.00
	11 m		<0.01	<50	0	0.00
C	7 m	0.0201 / 0.23520.08	<0.01	<50	0	0.00
	11 m		<0.01	<50	0	0.00
SW	7 m	0.0201 / 0.23520.08	<0.01	<50	0	0.00
	11 m		<0.01	<50	0	0.00
N-OSP	7 m	0.0201 / 0.23520.08	<0.01	<50	0	0.00
	14 m		<0.01	<50	0	0.00
S-OSP	7 m	0.0201 / 0.23520.08	<0.01	<50	0	0.00

Piling location and Monopile		Site specific DAS density estimate/ SCANS-IV density estimate (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
	14 m		0.01	60	0	0.00
Cumulative PTS-onset (weighted SELcum)						
NW	7 m	0.0201 / 0.2352	<0.1	<100	0	0.00
	11 m		<0.1	<100	0	0.00
C	7 m	0.0201 / 0.23520.08	<0.1	<100	0	0.00
	11 m		<0.1	<100	0	0.00
SW	7 m	0.0201 / 0.23520.08	<0.1	<100	0	0.00
	11 m		<0.1	<100	0	0.00
N-OSP	7 m	0.0201 / 0.23520.08	<0.1	<100	0	0.00
	14 m		<0.1	<100	0	0.00
S-OSP	7 m	0.0201 / 0.23520.08	<0.1	<100	0	0.00

Piling location and Monopile		Site specific DAS density estimate/ SCANS-IV density estimate (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
	14 m		<0.1	<100	0	0.00
Predicted disturbance						
NW	7 m	0.0201 / 0.2352	-	-	102 / 1,197	34.90 / 408.41
	11 m		-	-	103 / 1,207	35.22 / 412.07
C	7 m	0.0201 / 0.23520.08	-	-	165 / 1,929	56.28 / 658.52
	11 m		-	-	165 / 1,925	56.16 / 657.13
SW	7 m	0.0201 / 0.23520.08	-	-	178 / 2,082	60.72 / 710.52
	11 m		-	-	179 / 2,092	61.01 / 713.96
N-OSP	7 m	0.0201 / 0.23520.08	-	-	115 / 1,346	39.25 / 459.29
	14 m		-	-	116 / 1,355	39.53 / 462.59
S-OSP	7 m	0.0201 / 0.23520.08	-	-	176 / 2,064	60.20 / 704.44

Piling location and Monopile	Site specific DAS density estimate/ SCANS-IV density estimate (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
14 m		-	-	177 / 2,077	60.57 / 708.81

6.4.18.21 **Therefore, it is concluded there will be no AEoI upon the integrity of Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC, as defined by the COs of the site, as a result of injury from underwater noise impacting bottlenose dolphin from Project Design Option 1.**

6.4.18.22 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.18.23 Using the uniform density estimate of 0.0201 animals/km^2 from the ObSERVE surveys, it was estimated that a maximum of 179 animals (61.01% of the reference population) will experience behavioural disturbance as a result of pile driving of the 11 m monopile at the SW WTG location. This is considered to be conservative because it assumes that the density within stratum 5 (western Irish Sea) is the same across the wider extent of the Irish Sea of which the noise contours extend across.

6.4.18.24 Using the uniform density estimate of 0.2352 animals/km^2 from the wider SCANS-IV surveys, it was estimated that a maximum of 2,092 animals (713.96% of the reference population) will experience behavioural disturbance as a result of pile driving of the 11 m monopile at the SW WTG location. This is not considered to be realistic as it assumes a uniform density and does not capture the variability in coastal and offshore population densities and distributions within the Irish Sea.

6.4.18.25 In order to account for the non-uniform density of bottlenose dolphin across the Irish Sea, modelled density surfaces derived from SCANS-III were also used to calculate the number of animals disturbed. Using this approach, it was estimated that a maximum of 187 animals (63.79% of the reference population) will experience behavioural disturbance as a result of pile driving of the 14 m monopile at the S-OSP location. Both of these approaches are over-predicting the number of animals available in the area that could be disturbed by pile driving as the number of animals calculated exceeds the reference population size of 293. Therefore, these calculations are not considered to be robust.

6.4.18.26 The noise contours extend to cover the majority of the Irish Sea Management Unit (MU) (Figure 6.5 and Figure 6.6), which is used as the reference population for bottlenose dolphin. Therefore, it is anticipated that the majority of the reference population of 293 dolphins will be within the disturbance contours. However, the number and proportion of bottlenose dolphin disturbed during pile driving was calculated using the dose-response curve for harbour porpoise from Graham et al. (2017b), as there is no corresponding species-specific data available for bottlenose dolphin. However, studies suggest that bottlenose dolphins are typically less sensitive to behavioural disturbance than harbour porpoise (e.g. Culloch et al., 2016; Kastelein et al., 2006; Stone et al., 2017). Therefore, it is expected that the probability of response to underwater noise from pile driving would be lower, resulting in a very conservative calculation of the number and proportion of bottlenose dolphins disturbed.

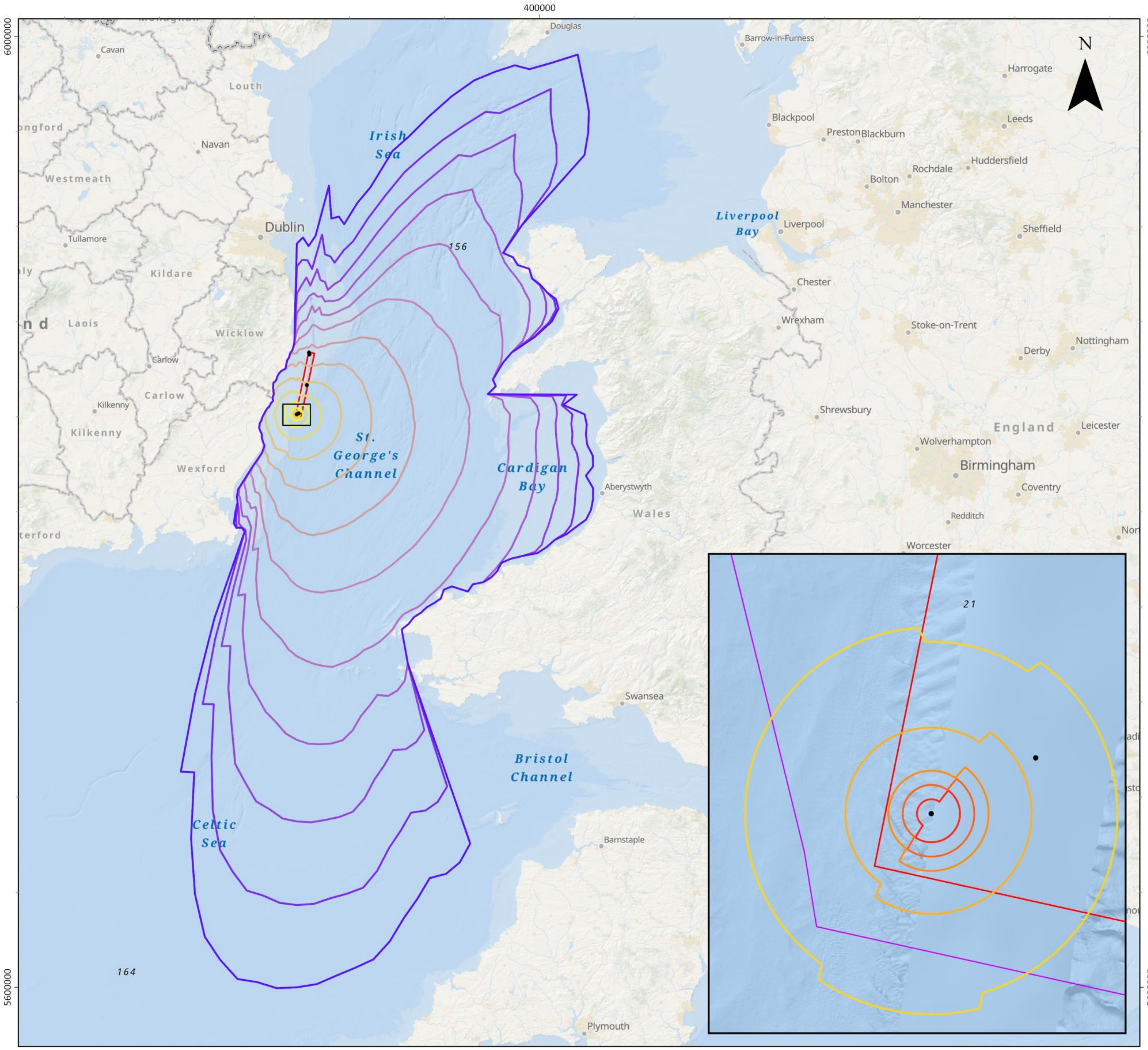

Figure Reference: Ark_005_5dB11mMonopileSWFig6.5

Arklow Bank Wind Park 2

Behavioural Disturbance Dose-response Contours for the Installation of an 11m Monopile at the SW Location

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- Noise Modelling Locations

dBht Level:

- 120 dB SELss
- 125 dB SELss
- 130 dB SELss
- 135 dB SELss
- 140 dB SELss
- 145 dB SELss
- 150 dB SELss
- 155 dB SELss
- 160 dB SELss
- 165 dB SELss
- 170 dB SELss
- 175 dB SELss
- 180 dB SELss
- 185 dB SELss
- 190 dB SELss
- 195 dB SELss
- 200 dB SELss

Notes

Esri, TomTom, FAO, NOAA, USGS, GSI, Esri, Garmin, NaturalVue, OceanWise, Esri, GEBCO, Garmin, NaturalVue, Esri UK, Esri, TomTom, Garmin, Foursquare, GeoTechnologies, Inc, METI/NASA, USGS, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri, GEBCO, Garmin, NaturalVue. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 30 60 km

0 10 20 nm

Scale	Date	Drawn By	Checked By	Approved By
1:1,573,563 @ A3	05/04/2024	GB	PM	LK

Suites B2 & C2
Higher Mill
Higher Mill Lane
Buckfastleigh
Devon
TQ11 0EN
www.gobeconsultants.com
+44 (0)1626 323890

Figure Number 6.5

Figure 6.5: Behavioural Disturbance Dose-response Contours for the installation of the 11m Monopile

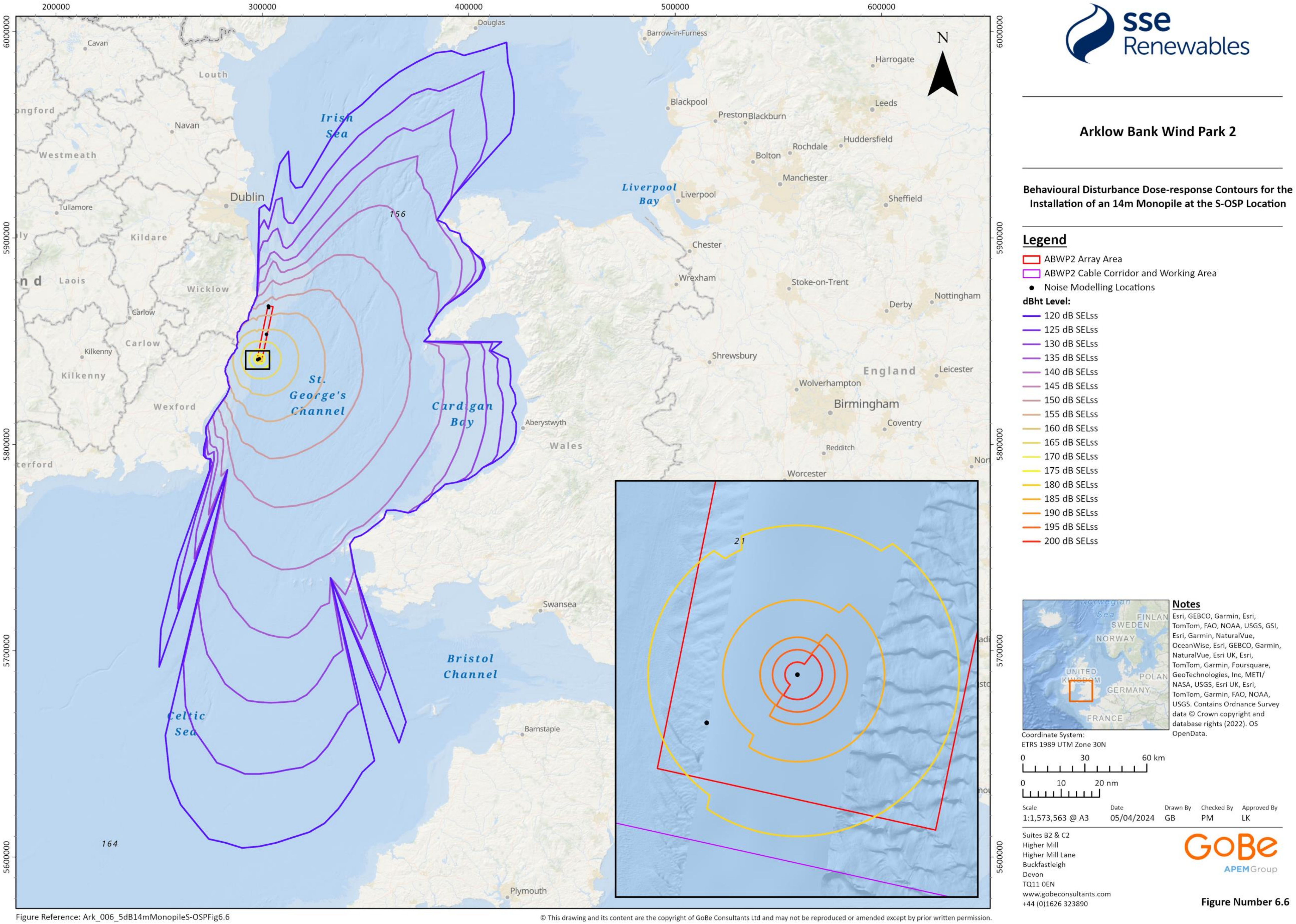

Figure 6.6: Behavioural Disturbance Dose-response Contours for the installation of the 14m monopile

6.4.18.27 Furthermore, the reference population does not take into account the connectivity of the reference population with other areas. Studies have shown large scale movement of bottlenose dolphins around Ireland and indicated connectivity with the population on the west coast of the Ireland (O'Brien *et al.*, 2009). Long distance movements from the Atlantic to the North Sea between populations in the UK and Ireland have also been reported by Robinson *et al.* (2012). Therefore, the size of the reference population used from the Irish Sea MU is likely to be an under-representation of the number of bottlenose dolphins that may be present in the MU Study Area. Equally, the most recent abundance estimates from the semi-resident population at Cardigan Bay in West Wales (which is within the Irish Sea MU) alone were 147 individuals (95% CI: 127 to 194; NRW, 2018b). The design of broad scale surveys, such as SCANS, used to derive MU population estimates are not able to capture localised, coastal populations such as that of Cardigan Bay, providing further evidence to suggest that the reference population size has been under-estimated.

6.4.18.28 Overall, it is likely that a significant proportion of the MU population will experience disturbance from underwater noise. However, considering the low sensitivity of the species and evidence clarified above, it is not anticipated that this will result in a significant change in behaviour, or impact reproductive success or physiology.

6.4.18.29 Furthermore, as detailed in Section 6.3.2 and Table 6.7, a MMMP will be implemented which will further minimise any potential impacts.

6.4.18.30 With consideration of the low sensitivity of the species, high recoverability and adaptability, the short term nature of this impact, implementation of the MMMP, and the likely underestimation of population numbers and overestimation of proportion disturbed, **it is concluded there is no potential for AEoI upon the integrity of Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC, as defined by the COs of the site, as a result of disturbance from underwater noise impacting bottlenose dolphin from Project Design Option 1.**

6.4.18.31 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE

6.4.18.32 There are no piling activities proposed for the Operational and Maintenance phase of the Proposed Development. Any underwater noise produced will be due to vessel movements which is assessed in Section 6.4.18.35 to 6.4.18.74.

6.4.18.33 **There is no potential for AEoI, as defined by the COs of the site, from underwater noise in the operational and maintenance phase of the Proposed Development on this site and feature for Project Design Option 1.**

6.4.18.34 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

INJURY AND/ OR DISTURBANCE FROM VESSEL MOVEMENTS

6.4.18.35 There will be increased vessel movements compared to baseline levels during all phases of the Proposed Development, which can result in injury and/ or mortality from vessel collision, or disturbance though presence and the generation of underwater noise.

6.4.18.36 The area surrounding the Proposed Development experiences a relatively low level of vessel traffic due to the presence of the shallow Arklow Bank sandbank, with higher traffic in the coastal areas and immediate surrounding waters.

6.4.18.37 The shipping and navigation baseline study recorded 29 days of vessel traffic data between 7th July and 14th August 2023. There was an average of 36 to 37 unique vessels per day recorded within the shipping and navigation Study Area (which is defined as Array Area and a 10 nm buffer). The busiest day recorded 59 unique vessels within the shipping and navigation Study Area. The main vessel types within the shipping and navigation Study Area were cargo vessels (40%), recreational vessels (31%) and fishing vessels (10%).

6.4.18.38 During construction of the windfarm, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. In general, three consequences of vessel collision are defined: direct (injuries to the animals that are the immediate result of collision), long-term (a decrease in the fitness of the animal over time), and population consequences (Schoeman et al., 2020). With regards to injuries, both fatal and non-fatal injuries between marine mammals and vessels have been documented (Laist et al., 2001; Vanderlaan et al., 2008; Cates et al., 2017). Fatal collisions have been evidenced via carcasses washing up on beaches (Laist et al., 2001; Peltier et al., 2019); carcasses caught on vessel bows (Laist et al., 2001; Peltier et al., 2019); and floating carcasses which have strong evidence of ship strike, such as propeller cuts, significant bruising, oedema, internal bleeding radiating from a specific impact site, fractures and ship paint marks (Jensen and Silber, 2003; Douglas et al., 2008). Fatalities from ship strikes, however, often go unreported (Authier et al., 2014). For non-fatal injuries, evidence of animals which have survived ship strikes with non-fatal injuries from propellers has been widely documented (Wells et al., 2008; Luksenburg, 2014).

6.4.18.39 Although many species of marine mammals are able to detect and avoid vessels, it is unclear why some individuals do not always move out of the path of an approaching vessel (Schoeman et al., 2020), although it has been suggested that behaviours such as resting, foraging, nursing, and socialising could distract animals from detecting the risk posed by vessels (Dukas, 2002). It is also possible that animals do not hear vessels when they are near the surface. Collisions between cetaceans and vessels, however, are not necessarily lethal on all occasions.

6.4.18.40 Whilst a broad range of vessel types have been involved in collisions with marine mammals (Laist et al., 2001), vessels travelling at higher speeds pose a higher risk because of the potential for a stronger strike impact (Schoeman et al., 2020). For example, a study by Laist et al. (2001) found that in 89% of collisions in which the whale was killed or seriously injured, vessels were travelling at speeds of 14 kn (7 m/s) or more, and the vessel exceeded a length of 80 m. Therefore, larger vessels travelling at 7 m/s or faster are those most likely to cause death or serious injury to marine mammals (Laist et al., 2001).

6.4.18.41 Bottlenose dolphins are relatively small and highly mobile, and given observed responses to noise, are expected to detect vessels in close proximity and largely avoid collision.

6.4.18.42 There is a lack of information on the frequency of vessel collisions with marine mammals in the Irish waters, and there is a lack of evidence from marine mammals stranded in the Irish sea to suggest that injury from vessel collisions is an important cause of marine mammal mortality. In the UK, the Cetacean Strandings Investigation Programme (CSIP) documents the annual number of reported strandings and the cause of death for those individuals examined at post-mortem. Based on the most recent CSIP report for bottlenose dolphin, post-mortems were conducted on one out of the nine reported strandings in 2018; the cause of death was not associated with vessel collision (CSIP, 2019). With consideration of the low numbers of bottlenose dolphins stranded we also looked at the post-mortems for common dolphin on a precautionary basis. Post-mortems were conducted on 45 out of the 191 reported strandings in 2018 and a cause of death was established for 43 individuals. Of these, two individuals had died from physical trauma of an unknown cause, which could have been due to vessel strike (CSIP, 2019), however this is unknown. With consideration that only 2 of the 43 individuals where it was possible the conclude the cause of death had the potential to be caused by vessel collision, it is concluded that vessel collisions are not a significant cause of mortality within the Irish sea with dolphins.

6.4.18.43 Overall, the assessment concludes that there is a high likelihood that bottlenose dolphin will avoid vessels and therefore collision risk is viewed as negligible, although they have a high sensitivity to the impact should it occur.

6.4.18.44 With regards to behavioural changes due to vessel movements, studies on the interactions of bottlenose dolphins with vessels have shown various responses. In the Moray Firth, a passive acoustic monitoring study showed that the presence of vessels resulted in a short-term reduction in foraging activity by 49%, with animals resuming foraging after the vessel had travelled through the area, suggesting that disturbance was limited to the time the vessel was physically present (Pirotta et al., 2015). As a result, the study concluded that the physical presence of vessels plays a larger role in disturbance, as vessel noise was not taken into consideration (Pirotta et al., 2015).

6.4.18.45 In a modelling study by Lusseau et al. (2011), it was predicated that increased vessels movements associated with offshore wind development in the Moray Firth did not have a negative effect on the local population of bottlenose dolphins, although it did note that foraging may be disrupted by disturbance from vessels. Mathematical modelling was also conducted by New et al. (2013) to simulate the complex interactions of the bottlenose dolphin population in the Moray Firth and determine whether an increased rate of disturbance from vessel traffic from proposed offshore developments was biologically significant. The study statistically modelled an increase in vessel traffic from 70 to 470 vessels per year and found that an increase in commercial vessel traffic alone will not result in a biologically significant increase in disturbance, because dolphins have the ability to compensate for their immediate behavioural response. Therefore, their health and vital rates were predicted to be unaffected (New et al., 2013).

6.4.18.46 Bottlenose dolphins have also been observed tolerating vessel disturbance, particularly in areas where vessel traffic has always been high (Pirotta et al. 2013). Similarly, the presence of bottlenose dolphin was positively correlated with overall vessel number during the construction works of an oil pipeline in Broadhaven Bay, northwest Ireland (Anderwald et al., 2013). However, it was unclear whether the bottlenose dolphins were attracted to the vessels themselves or to particularly high prey concentrations within the study area at the time (Anderwald et al., 2013).

6.4.18.47 A study of Indo-Pacific bottlenose dolphin habitat occupancy along the coast of Western Australia found dolphin density to be negatively affected by vessels at one site, but no significant impact at the other (Marley et al., 2017a). It is hypothesised that the quality of the habitat impacts the behavioural response to disturbance as the latter habitat is a known foraging area. Other studies along the coast of Western Australia have found that increased vessel presence was associated with significantly increased swim speeds for individuals when resting or socialising (Marley et al., 2017b). Animals exposed to high levels of shipping traffic were also found to spend more time travelling and less time resting or socialising. The study also found that the whistle characteristics changed with increased broadband exposure, with the greatest variation occurring in the presence of low frequency noise (Marley et al., 2017b). Other studies have reported similar findings, for example, common bottlenose dolphins in Galveston Ship Channel, USA, found that the presence of vessels was associated with significantly less foraging and socialising activity (Piwetz, 2019). For this population, a significant increase in swimming speeds was observed during the presence of recreational and tourism vessels, and shrimp trawlers (Piwetz, 2019).

6.4.18.48 Bottlenose dolphins have also been known to exhibit different behavioural responses to different vessel types. A study conducted in New Zealand showed that bottlenose dolphin resting behaviour decreased as the number of dolphin-watching tour boats increased (Constantine et al., 2004). In a study conducted in Italy, dolphins exhibited an avoidance response to motorboats, but changed their acoustic behaviour in response to trawler vessels, presumably to compensate for masking (La Manna et al., 2013). This study also found that bottlenose dolphins would tolerate vessel presence within certain levels and were more likely to leave an area if disturbance was persistent (La Manna et al., 2013). Therefore, the degree to which an individual is disturbed is likely linked to their baseline level of tolerance (Bejder et al., 2009).

6.4.18.49 With consideration of the studies, it is concluded that bottlenose dolphin have a low sensitivity to impacts from vessel movements, with reasonable adaptability, tolerance and high recoverability from the potential disturbance. **Therefore, there is no AEoI on the Lleyn Peninsula and the**

Sarnau/ Pen Llyn a'r Sarnau SAC, as defined by the COs of the site, as a result of injury or disturbance from vessel movement.

CONSTRUCTION AND DECOMMISSIONING

6.4.18.50 During the construction phase, a maximum of 66 installation vessels will be present within the Proposed Development at any one time, resulting in a maximum of 4,150 vessel return trips over the five-year construction period, and a maximum of 1,797 vessel return trips per year. A similar number of vessels are anticipated for the decommissioning phase.

6.4.18.51 The majority of vessels used during the construction phase are likely to be large vessels that will either be travelling considerably slower than 7 m/s (the key risk is when this speed is exceeded with large vessels) or will be stationary for significant periods of time. Therefore, the actual increase in vessel traffic moving within the Proposed Development and to/from port will occur over short periods of the offshore construction activity. Smaller vessels involved in construction activities (i.e. tug/anchor handlers, guard vessels, survey vessels, and crew transfer vessels) are able to move to avoid marine mammals (when detected), even when an animal is close and the vessel is going at high speed, due to better manoeuvrability compared to larger vessels (Schoeman et al., 2020). In contrast, large vessels, such as jack-up vessels, have low manoeuvrability and may require larger distances to avoid an animal, but travel at slower speeds. In addition, the factored-in measures (see Table 6.7) which includes an Environmental VMP (EVMP), will ensure that vessel traffic will move along predictable routes, which is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al., 2001; Lusseau 2003; 2006) and most importantly with regards to collision risk, at reduced speeds. The EVMP also sets out a Code of Conduct to minimise interactions with marine mammals and to define how vessels should behave in the presence of them.

6.4.18.52 It is also anticipated that noise produced by the vessels will be detectable by the bottlenose dolphin and therefore enable avoidance.

6.4.18.53 **It is concluded that there is no potential for AEoI upon the integrity of Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC as defined by the COs of the site, as a result of injury from vessel collision impacting bottlenose dolphin from Project Design Option 1.**

6.4.18.54 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.18.55 With consideration of disturbance and displacement, the coastal areas and immediate surrounding waters of the Proposed Development are already subject to high levels of vessel traffic. With consideration of this, it is concluded that it is unlikely there will be a significant change in the level of disturbance bottlenose dolphin naturally present are subject to.

6.4.18.56 The EVMP will serve to ensure that vessels follow predictable routes in addition to setting out how the vessels should behave in the presence of the species. It is concluded that any disturbance above current baseline levels of activity will only result in a short-term and temporary impact on behaviour. The proposed implementation of a EVMP will reduce the risk of vessel disturbance by controlling the speed and movement of vessels, resulting in slower moving vessels travelling more predictable routes which are less likely to cause disturbance. This is supported by vessel simulation modelling by Findlay et al. (2023) which predicted that, when animals were exposed to vessels at a given distance with both a 20% and a 50% reduction in speed, all potential noise impacts were reduced. At a 20% reduction in speed, the vessel noise swath halved, reducing the average number of animals exposed by 50% and therefore reducing the number of animals that are likely to be disturbed (Findlay et al., 2023). In addition, the study demonstrated that moderate slowdowns strongly reduce vessel source levels, with a 20% reduction in speed decreasing mean source levels by 6 dB and a 50% speed reduction by 18 dB (Findlay et al., 2023).

6.4.18.57 With consideration of our conclusions above that bottlenose dolphins have low sensitivity and when considering the EVMP and baseline levels of disturbance, **it is concluded there will be no AEoI upon the integrity of Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC, as defined by the COs of the site, as a result of disturbance from vessel movement impacting bottlenose dolphin from Project Design Option 1.**

6.4.18.58 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE

6.4.18.59 During the operational and maintenance phase, a maximum of 22 vessels will be present within the Array Area at any one time, resulting in a maximum of 1,294 vessel return trips per year. With consideration that this is a significant reduction in the number of vessels present in comparison to the construction and decommissioning phase it is concluded that based on the assessment for that phase, there is no potential for a significant effect.

6.4.18.60 **Therefore, it is concluded that there are no AEoI upon the integrity of Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC, as defined by the COs of the site, as a result of disturbance or collision risk from vessel movement impacting bottlenose dolphin from Project Design Option 1 in this phase.**

6.4.18.61 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

EMF

6.4.18.62 The conduction of electricity through subsea power cables has the potential for emit localised EMF, which has the potential to affect the sensory mechanisms of bottlenose dolphins (CMACS, 2003; Copping, 2018; Normandeau et al., 2011), though the effects are not well understood. This impact may only occur during the Operational and Maintenance phase of the Proposed Development when there is power generation occurring.

6.4.18.63 Anthropogenic sources of EMF are primarily subsea cables used for power generation and telecommunications or submarine communications (Normandeau et al., 2011). Therefore, the presence and operation of between 110 and 122 km of 66 kV inter-array cables, between 35 and 40 km of 220 kV offshore export cables, and between 25 and 28 km of 220 kV OSP interconnector cables during the lifetime of the Proposed Development may lead to localised EMF effects on marine mammals.

6.4.18.64 Submarine cables can cause three different types of EMFs: electrical (E) fields, magnetic (B) fields, and induced electric (iE) fields. E-fields are measured in volts per metre (V/m) and are generated by the voltage of the cable. B-fields are measured in microtesla (μT) or milligauss (mG) where 1 μT = 10 mG and are generated by the current of the power through the cable. They attenuate both horizontally and vertically away from the cable, with field strength directly related to the power of the current passing through the cable, rather than being specifically related to the voltage. iE-fields are measured in V/m and are generated by the fluctuation of the B-fields (in AC transmission) or by the motion of the seawater (or an organism) through the B-field. Therefore, they are dependent on the strength of the B-field, thus the strength of the iE-field is directly related to the B-field, which is strongest closest to the cable, attenuating horizontally and vertically away from it.

6.4.18.65 EMFs also occur naturally in the marine environment from a variety of sources including background levels from the Earth's magnetic field, and very small fields generated by electrical currents moving through organisms (Tricas and Gill, 2011). The Earth's static B-field is present in both terrestrial and aquatic environments and lies in the range 25 to 65 μT (Hutchison et al., 2018). The B-field strength of the Irish Sea is approximately 49 μT (National Oceanic and Atmospheric Administration (NOAA), 2020).

6.4.18.66 Measurements of EMF for subsea cables associated with offshore windfarms vary, with the strength of the B-field generated generally related to the wind speed captured by the turbines. A variety of design and installation factors affect EMF levels in the vicinity of the cables such as current flow, distance between cables, cable insulation, number of conductors, configuration of cable and burial depth. For example, EMFs produced by inter-array cables are smaller than those of export and OSP interconnector cables as they are lower powered in comparison. Furthermore, the B-fields generated by High Voltage Alternating Current (HVAC) and High Voltage Direct Current (HVDC) cables are significantly different, with HVDC cables typically generating much larger EMFs than HVAC cables (Tricas and Gill, 2011). The transmission system used for the Proposed Development will only comprise HVAC.

6.4.18.67 CMACS (2003) reported that for a 132 kV three-phase AC cable with perfect shielding, the predicted B-field in close proximity to the cable was 1.6 μT and the respective iE-field was 91.25 μV/m above the cable if buried to 1 m depth, which reduced to 10 μV m-1 8 m from the cable. Gill et al. (2009) measured iE-fields of 30 μV/m and 110 μV/m at two different offshore windfarm cables (both three-phase AC, 36 kV, 100 A) close to the cables and B-fields of 0.23 μT and 6.5 μT, respectively. Continental Shelf Associates (CSA, 2019) compared offshore windfarm subsea cables and found EMF levels directly over live AC undersea power cables associated with offshore wind energy projects ranged between 5 to 15 mG (0.5 to 1.5 μT) for inter-array cables and 10 to 40 mG (1 to 4 μT) for export cables, at heights of 1 m above the seabed. At lateral distances of between 3 m and 7.5 m from the cable, B-fields greatly reduced to <0.1 to 7 mG (<0.01 to 0.7 μT) for inter-array cables, and <0.1 to 12 mG (<0.01 to 1.2 μT) for export cables, at heights of 1 m above the seabed. Measurements of the iE-fields directly over live AC undersea power cables in the same study ranged between 0.1 to 1.2 mV/m for the inter-array cables and 0.2 to 2.0 mV/m for export cables, at heights of 1 m above the seabed (CSA, 2019). At lateral distances of between 3 m and 7.5 m, iE-fields reduced to between 0.01 to 0.9 m V/m for inter-array cables and 0.02 to 1.1 mV/m for export cables at heights of 1 m above the seabed.

6.4.18.68 The strength of the B-field (and consequently, iE-fields) decreases rapidly horizontally and vertically with distance from source (Normandeau et al., 2011). Burial of cables, in particular, can therefore reduce the strength of the B- and iE-fields. However, it is unlikely that cables can be buried to sufficient depths that will reduce the magnitude of the B-field, and hence the sediment-seawater interface iE-field, to the extent that these fields could not be detected by certain marine organisms on or close to the seabed (Gill et al., 2005). A study conducted by CSA (2019) found that inter-array and export cables buried between depths of 1 m to 2 m reduces the magnetic field at the seabed surface four-fold. For cables that are unburied and instead protected by thick concrete mattresses or rock berms, the field levels were found to be similar to buried cables.

6.4.18.69 Overall, based on the above assessment it is concluded that any potential impact will be highly localised, with strength dissipating rapidly with distance from the buried cables.

6.4.18.70 There is evidence to suggest that some species of cetacean may be able to detect variations in magnetic fields, therefore it is plausible that they are magneto-sensitive (Normandeau et al., 2011). Kirschvink et al. (1986) suggested that species that were sensitive to changes in the Earth's magnetic field and that are likely to be present within the Proposed Development include bottlenose dolphin. However, the majority of these have had a theoretical evidence base, coming to differing conclusions regarding species' sensitivity to changes in electric and magnetic fields (Normandeau et al., 2011). The only evidence of electro-sensitivity in marine mammals to date is reported in Guiana dolphin (Sotalia guianensis) as they have been shown to possess an electroreceptive system which is used to detect electrical stimuli (Czech-Damal et al., 2013).

6.4.18.71 Potential responses of cetaceans from EMF could include avoidance behaviour, disruption in orientation, and effects on feeding or social interaction (Normandeau et al., 2011), although it is important to note that these responses are all currently hypothetical. Whilst subsea cables could create a very localised change in the geomagnetic field (Taormina et al., 2018), modelling studies of EMF from cables suggests that the likelihood of such a change affecting a large enough area to elicit a significant course alteration would be low (Normandeau et al., 2011).

6.4.18.72 With consideration that the evidence of impact is only theoretical, and the highly localised nature of potential impacts, and the impacts are recoverable, it is concluded that any EMF effects, if there are any at all, are entirely negligible of impacting this QI.

6.4.18.73 **Therefore, it is concluded that there would be no AEoI upon the integrity of Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC, as defined by the COs of the site, from EMF impacting bottlenose dolphin from Project Design Option 1 in this phase.**

6.4.18.74 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

CHANGES IN PREY

6.4.18.75 Bottlenose dolphin are primarily dependent on poor cod, salmonids, sandeel, dragonet, whiting, bib, blue whiting, haddock, pollock, saithe, herring, rockling, Norway pout, mackerel, hake, eels, wrasse, perch, sole, halibut, dab, flatfish species, squid species and octopus species for food (Gosch et al., 2014; Wilson and Hammond, 2019). This demonstrates a very highly varied diet and ability to adapt to changes in availability of prey types where needed and so we view bottlenose dolphin as generalist feeders.

6.4.18.76 Impacts to prey resources will be largely restricted to the boundaries of the Proposed Development and, therefore, bottlenose dolphin occurring within this area also have the potential to be impacted. Prey species for bottlenose dolphin are subject to the same impacts as the prey species as the other Annex 2 marine mammal species considered within this assessment (grey seal, harbour porpoise and harbour seal). A full assessment on the impacts of the Proposed Development on prey species has been considered within the Blackwater Bank SAC, which is located 19.76 km from the Proposed Development, significantly closer than Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC (73.32 km).

6.4.18.77 **Therefore, it is concluded that there is no AEoI upon the integrity of Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC, as defined by the COs of the site, from changes in prey impacting bottlenose dolphin from Project Design Option 1 in this phase.**

6.4.18.78 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

ACCIDENTAL POLLUTION

6.4.18.79 There is the potential for an accidental release of pollutants to occur from vessels and equipment associated with the construction, operational and maintenance and decommissioning phases of the Proposed Development, which may result in adverse effects on marine mammals. Pollutants may include diesel fuel, bentonite (from drilling activities), lubricants, grease and oils, anti-fouling biocides, and grout.

6.4.18.80 In the event of an accidental spill, given the density and distribution of marine mammals in the Marine Mammal Study Area, it is possible that individuals could come into contact with contaminants.

6.4.18.81 Direct impacts include ingestion, inhalation, and absorption. All of which may result in physiological responses with health and long-term survival and/or reproduction consequences, the most serious of which could be damage to the respiratory system (Helm *et al.*, 2015).

6.4.18.82 Indirect impacts include short- and long-term reductions in food availability, disruption to social bonds, reduced reproduction, and/or cumulative effects on individuals, populations, and the ecosystem (Helm *et al.*, 2015).

6.4.18.83 Bottlenose dolphin are at risk from oil pollution in the marine environment because they lack the ability to leave the water to avoid oil. They are however highly mobile and wide ranging, therefore any contact with a spill would be expected to be brief. They are also capable of detecting surface slicks, for example, experiments with captive bottlenose dolphins have shown that they can visually discriminate between oil and uncontaminated water and avoid oil on the surface of the water (Geraci and St. Aubin, 1984). Dolphins appear to rely on tactile clues to detect and avoid oil and it is unlikely that they would be unknowingly subjected to prolonged or repeated exposure to oil in the wild (Helm *et al.*, 2015).

6.4.18.84 However, bottlenose dolphin must surface periodically to breathe, potentially bringing them into contact with floating oil and volatile toxic components. The more extensive the slick, the more likely that an animal will surface within it (Geraci and St. Aubin, 1980). While oil does not readily penetrate cetacean skin, exposure could affect mucus membranes, eyes, and other external soft tissue areas, potentially resulting in mortality (Helm *et al.*, 2015).

6.4.18.85 Overall, accidental pollution has the potential to cause LSE on bottlenose dolphin features.

CONSTRUCTION AND DECOMMISSIONING PHASE

6.4.18.86 The installation of the offshore infrastructure for the Proposed Development may lead to the accidental release of pollutants through spills and leaks from vessels and equipment. The project design parameters for Project Design Option 1 during the construction phase are outlined in Table 6.8 and include the installation of 56 WTGs, two OSPs, between 110 and 122 km of inter-array cables, between 25 and 28 km of interconnector cables, and between 35 and 40 km offshore export cables. There will also be up to 4,150 vessel round trips and 294 helicopter round trips during the construction phase (including activities at the landfall site).

6.4.18.87 The potential impact to marine mammals from accidental pollution during the decommissioning phase is expected to be the same or less than the construction phase.

6.4.18.88 The magnitude of the impact of accidental pollution will be dependent on the quantities of potential pollutants carried by construction vessels and within equipment. The release of a large inventory of fuel oil from a construction vessel is, however, considered to represent the greatest potential accidental pollution event from installation activities. In the event of an accidental spill from vessels, equipment or from construction activities, the spill would be subject to immediate dilution and rapid dispersal (Marappan *et al.,* 2022).

6.4.18.89 Considering avoidance through design and management (see Table 6.7), the likelihood of accidental release is considered extremely low. The measures in the EMP include storage of chemicals in secure designated areas on vessels in line with appropriate regulations and guidelines, and double skinning of any tanks and pipes containing hazardous substances. All chemicals used will be subject to a chemical risk assessment to ensure risks are understood and minimised. The EMP also includes a MPCP which will contain key emergency contact details and response procedures in the event of a spill of any magnitude to ensure minimal impact. Complying with these procedures will also reduce the magnitude of any spill. Adherence to the avoidance design and management measures outlined in Table 6.7, including the EMP and MPCP will significantly reduce the likelihood of an accidental pollution incident occurring, and the magnitude of its impact.

6.4.18.90 **Given the inherent low likelihood of accidental pollution from vessel activity and other activities, as well as the proposed avoidance/ impacts reduction measures (as set out in Table 6.7), there is no potential for AEoI from accidental pollution on Lleyn Peninsula and**

the Sarnau/ Pen Llyn a'r Sarnau SAC, as defined by the COs of the site, impacting bottlenose dolphin from Project Design Option 1.

6.4.18.91 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL AND MAINTENANCE PHASE

6.4.18.92 There is the potential for the accidental release of pollutants during this phase of the Proposed Development as a result of the presence of offshore infrastructure, associated equipment, and vessel movements. The project design parameters for Project Design Option 1 during the operational and maintenance phase are outlined in Table 6.8. This includes synthetic compound, for example from antifouling biocides, heavy metal, and hydrocarbon contamination as a result of the presence of 56 WTGs and two OSPs as well as from maintenance activities. There will also be up to 1,294 vessel round trips and 485 helicopter round trips per year during this phase of the proposed development.

6.4.18.93 The assessment for this phase is the same as for the construction phase, with the same avoidance by design and management measures being implemented to reduce the risk to negligible levels (see Table 6.7 and Section 6.4.18.89). **It is therefore concluded that the potential for AEoI upon the integrity of Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC, as defined by the COs of the site, from accidental pollution impacting bottlenose dolphin from Project Design Option 1 is entirely negligible.**

6.4.18.94 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Grey Seal

6.4.18.95 The conservation objectives for grey seal at this designated site is to achieve favourable conservation status (FCS) of the feature, how this is defined is presented in Table 5.1.

6.4.18.96 There are four key potential impacts on grey seal associated with the construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey and Accidental pollution.

6.4.18.97 With consideration that the impact severity is based on distance from the site of works, Lambay Island SAC (62.87 km) is designated for the same QIs as Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC (73.32 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.3, it has been concluded that none of the potential effects on grey seal would result in an AEoI of the QIs.

6.4.18.98 **Therefore, there is no AEoI for Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC as defined by the COs of the site as a result of any of the impacts considered above affecting grey seal from Project Design Option 1.**

6.4.18.99 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.19 Cardigan Bay/ Bae Ceredigion SAC

Bottlenose Dolphin

6.4.19.0 The conservation objectives for bottlenose dolphin at this designated site is to achieve FCS of the feature, how this is defined is presented in Table 5.1.

6.4.19.1 There are five key potential impacts on bottlenose dolphin associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental pollution.

6.4.19.2 With consideration that the impact severity is based on distance from the site of works, Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC (73.32 km) is designated for the same QIs as Cardigan Bay/ Bae Ceredigion SAC (82.73 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.18 it has been concluded that none of the potential effects on bottlenose dolphin would result in an AEoI of the QIs.

6.4.19.3 **Therefore, there is no AEoI for Cardigan Bay/ Bae Ceredigion SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting bottlenose dolphin from Project Design Option 1 in this phase.**

6.4.19.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Grey Seal

6.4.19.5 The conservation objectives for grey seal at this designated site is to achieve FCS of the feature, how this is defined is presented in Table 5.1.

6.4.19.6 There are four key potential impacts on grey seal associated with the construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey and Accidental pollution.

6.4.19.7 With consideration that the impact severity is based on distance from the site of works, Lambay Island SAC (62.87 km) is designated for the same QIs as Cardigan Bay/ Bae Ceredigion SAC (82.73 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.3 it has been concluded that none of the potential effects on grey seal would result in an AEoI of the QIs.

6.4.19.8 **Therefore, there is no AEoI for Cardigan Bay/ Bea Ceredigion SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting grey seal from Project Design Option 1 in this phase.**

6.4.19.9 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.20 North Anglesey Marine/ Gogledd Môn Forol SAC

Harbour porpoise

6.4.20.0 The conservation objectives for harbour porpoise at this designated site is to ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining FCS for harbour porpoise in UK waters, how this is defined is presented in Table 5.1.

6.4.20.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, and Changes in EMF and Accidental pollution.

6.4.20.2 With consideration that the impact severity is based on distance from the site of works Blackwater Bank SAC (19.76 km) is designated for the same QIs as North Anglesey Marine/ Gogledd Môn Forol SAC (114.17 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.5, it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.20.3 **Therefore, there is no AEoI for North Anglesey Marine/ Gogledd Môn Forol SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.20.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.21 North Channel SAC

Harbour porpoise

6.4.21.0 The conservation objectives for harbour porpoise at this designated site is to ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining FCS for harbour porpoise in UK waters, how this is defined is presented in Table 5.1.

6.4.21.1 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental pollution.

6.4.21.2 With consideration that the impact severity is based on distance from the site of works Blackwater Bank SAC (19.76 km) is designated for the same QIs as North Channel SAC (194.53 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.5, it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.21.3 **Therefore, there is no AEoI for North Channel SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.21.4 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.22 Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC

Harbour porpoise

6.4.22.1 The conservation objectives for harbour porpoise at this designated site is to ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining FCS for harbour Porpoise in UK waters, how this is defined is presented in Table 5.1.

6.4.22.2 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental pollution.

6.4.22.3 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC (214.68 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.4.5, it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.22.4 **Therefore, there is no AEoI for Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.22.5 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.23 Transboundary sites within Mainland Europe

Harbour Porpoise

6.4.23.1 These comprise of the following sites:

- Nord Bretagne DH (FR);
- Récifs et Lands de la Hague (FR) SAC;
- Anse de Vauville (FR) SAC;
- Mers Celtiques - Talus du golfe de Gascogne (FR) SAC;
- Tregor Goëlo (FR) SAC;
- Banc et récifs de Surtainville (FR) SAC;
- Baie de Morlaix (FR) SAC;
- Ouessant-Molène (FR) SAC;
- Cap d’Erquy-Cap Fréhel (FR) SAC;
- Chausey (FR) SAC;
- Côte de Granit rose-Sept-Iles (FR) SAC;
- Abers - Côtes des legends (FR) SAC;
- Côtes de Crozon (FR) SAC;
- Baie de Saint-Brieuc – Est (FR) SAC;
- Chaussée de Sein (FR) SAC;
- Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard (FR) SAC;
- Baie du Mont Saint-Michel (FR) SAC; and
- Estuaire de le Rance (FR) SAC.

6.4.23.2 There are no conservation objectives available for harbour porpoise at these designated sites as outlined in Table 5.1, however it is assumed that the objectives will be to ensure that the integrity of the site is maintained and ensure that the site contributes to achieving the FCS of its QIs.

6.4.23.3 There are five key potential impacts on harbour porpoise associated with the construction, operational, and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.8 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, Injury and/ or disturbance caused by vessel movements, Changes in prey, Changes in EMF and Accidental pollution.

6.4.23.4 With consideration that the impact severity is based on distance from the site of works, Blackwater Bank SAC (19.76 km) is designated for the same QIs as Transboundary sites within Mainland Europe (the closest being 486.66 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for these sites. In Section 6.4.5 it has been concluded that none of the potential effects on harbour porpoise would result in an AEoI of the QIs.

6.4.23.5 **Therefore, there is no AEoI for Transboundary sites within Mainland Europe, as defined by the COs of the site, as a result of any of the impacts considered above affecting harbour porpoise from Project Design Option 1 in this phase.**

6.4.23.6 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.4.24 Summary of Stage 2 Appraisal for Sites Screened in for Annex II Marine Mammal Species QIs

6.4.24.1 Five potential impacts were assessed for impacts on Marine Mammals resulting from construction, operational and maintenance cand decommissioning of the Proposed Development, the results of this assessment can be seen in Table 6.20.

Table 6.20: Conclusion for the assessment of potential impacts on Sites screened in for Annex II Marine Mammal Species QIs

Potential impact	Differences between Project Design Option 1 and 2	Conclusion
Injury and/ or disturbance by Underwater noise from piling and other construction activities	Project Design Option 1 comprises of 9 more WTGs than Project Design Option 2, installation of these is the primary source of underwater noise produced by the Proposed Development. Other activities producing underwater noise will be the same for both Project Design Option 1 and 2, with no difference.	As both Options produce underwater noise from construction activities they have both been considered. With consideration of the overall temporary nature of the works and low sensitivity to the impact it is concluded no AEoI for either Project Design Option from Underwater noise.
Injury and/or disturbance from Vessel movements	There is no difference between Project Design Option 1 and 2, as the same number of vehicles and movements is anticipated to be carried out.	As both Project Design Option 1 and Project Design Option 2 comprise of the same vessel movements, and based on the conclusions above, it is concluded no AEoI from vessel movements.

Potential impact	Differences between Project Design Option 1 and 2	Conclusion
Accidental Pollution	Within the construction phase Project Design Option 1 consists of a larger number of foundations to be installed – – 58 monopile foundations in total (56 for WTGs and 2 for OSPs), whilst Project Design Option 2 comprises of 49 foundations in total (47 for WTGs and 2 for OSPs).. Therefore, Project Design Option 1 will have a greater potential for accidental pollution. Within the Decommissioning Phase Project Design Option 1 will result in the deconstruction and removal of all 56 WTG topsides and 2 OSP topsides , with both to be cut at seabed level, whilst Project Design Option 2 consists of the deconstruction and removal of all 47 WTG topsides and 2 OSP topsides , with both to be cut at seabed level . Therefore, Project Design Option 1 will have a greater potential for accidental pollution. Therefore, overall Project Design Option 1 has a higher potential for impact than Project Design Option 2.	As both options have a risk of accidental pollution they have both been considered. With consideration of the avoidance by design and management features we have concluded no AEoI for either Project Design Option from accidental pollution.
EMF	There is no difference between Project Design Option 1 and 2, as the same amount of cabling is anticipated to be installed.	As both Project Design Option 1 and Project Design Option 2 comprise of the same cabling, based on the above assessment it is concluded no AEoI from EMF.
Changes in prey	Project Design Option 1 comprises of 9 more WTGs that Project Design Option 2, installation of these is the primary source of underwater noise, suspended sediment deposition (SSD), and other potential impacts produced by the Proposed Development. Overall, Project Design Option 1 has the higher potential impact.	As both Project Design Option 1 and Project Design Option 2 have the potential to cause changes in prey, based on the above assessment it is concluded no potential for AEoI for either Project Design Option from changes in prey.

6.5 Baseline information to inform Stage 2 AA for Migratory Fish Species QIs

6.5.1.1 As outlined in Section 5.1, the following designated sites in Ireland have continued through the Stage 1 Screening Assessment to be assessed in Stage 2 as a likely significant effect could not be ruled out. These are presented in Figure 6.7.

- Slaney River Valley SAC – freshwater pearl mussels, twaite shad, Atlantic salmon, sea lamprey and river lamprey;
- River Barrow and River Nore SAC – freshwater pearl mussels, twaite shad, Atlantic salmon, sea lamprey and river lamprey;
- Lower River Suir SAC - freshwater pearl mussels, twaite shad, Atlantic salmon, sea lamprey and river lamprey; and
- River Boyne and River Blackwater SAC – Atlantic salmon

6.5.1.2 The Array Area and Cable Corridor and Working Area do not overlap any of these designated sites, with the closest site being Slaney River Valley SAC at 44.54 km from the Proposed Development. All migratory fish species are highly mobile and so despite distance the above sites have been screened in due to potential LSE on the qualifying features caused by the Proposed Development. The Stage 1 SISAA (Volume I) concluded that there is potential for LSE via underwater noise, EMF and changes in prey availability for freshwater pearl mussels, twaite shad, Atlantic salmon, sea lamprey and river lamprey.

6.5.1.3 Underwater noise will be produced by the Proposed Development primarily through piling activities, with vessel movements also partly contributing to the LSE potential from underwater noise. Underwater noise from piling and other activities can result in individuals suffering physical injury, hearing damage and disturbance or displacement.

6.5.1.4 EMF induced effects (e.g. effects on navigation and other life-history dependant functions) may occur may arise during the operational and maintenance phase of the Proposed Development if individuals are located within close proximity to the cabling.

6.5.1.5 Changes in prey can include a change in species distribution and abundance and may be caused by accidental pollution and/ or an ensonified underwater noise environment and/ or as a result of increased collision risk with vessels and/ or prey species may be impacted by EMF induced effects.

6.5.1.6 Overall, the following effects are therefore considered below, with consideration of the conservation objectives of the qualifying interests of these SACs:

- Underwater noise from piling activities;
- Underwater noise from other activities; and
- EMF.

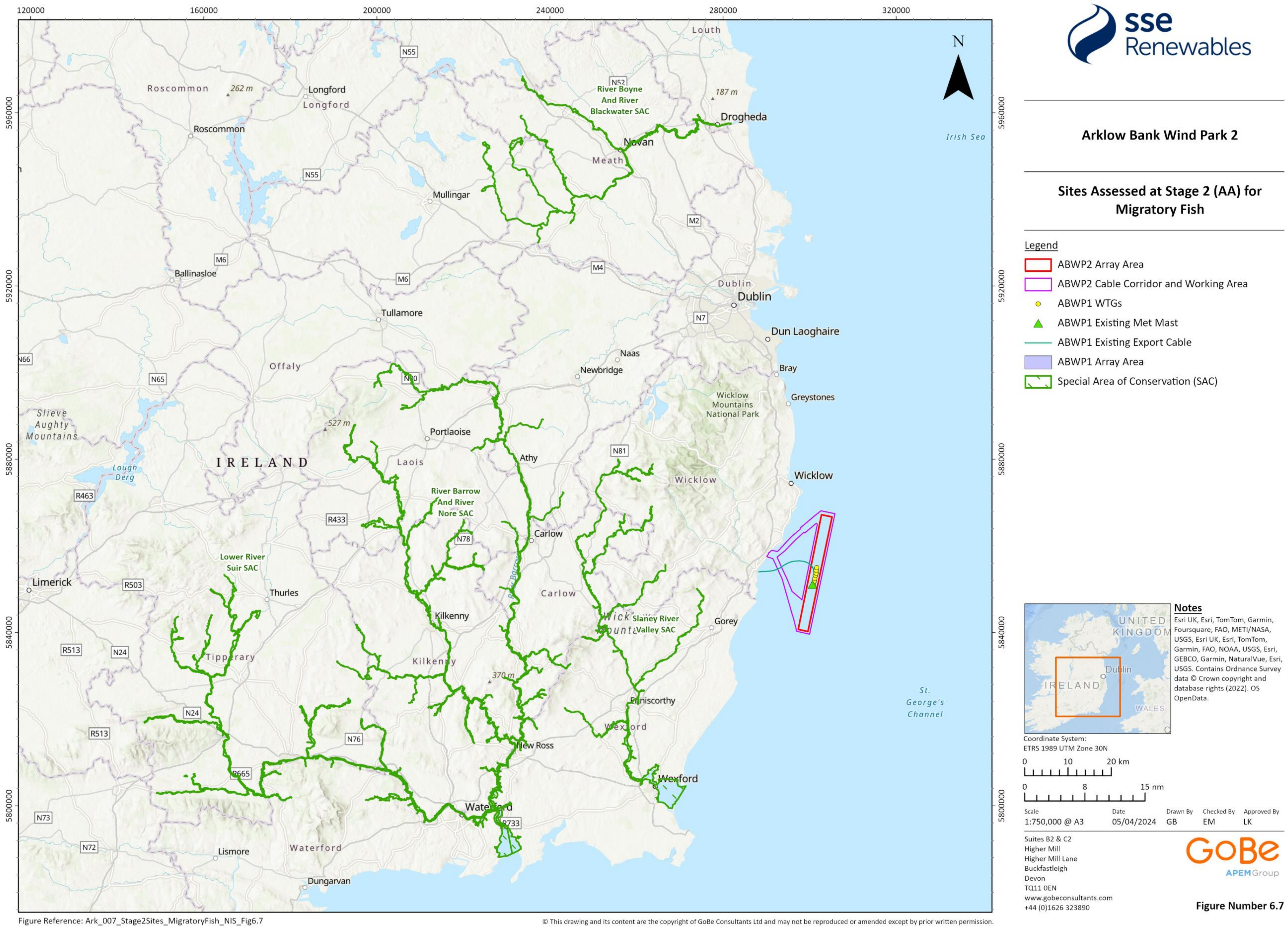

Figure 6.7: Sites assessed at AA for Migratory Fish

6.5.2 Baseline Environment

6.5.2.1 The Irish Sea is characterised by a deep channel (the Western Channel) running north to south in the western Irish Sea, and extending north into the North Channel, between Northern Ireland and Scotland and south into St George's Channel, between Ireland and Wales (Mellet *et al.*, 2015). The Western Channel is considered to be an important feature in shaping the fish and shellfish assemblages (Parker-Humphreys, 2004). At its deepest point the channel is 230 m deep with an extensive area of relatively flat, shallow (< 60 m depth) seabed (the Eastern Platform) and a narrow shelf of shallow water to the west (the Western Trough) (Mellet *et al.*, 2015).

6.5.2.2 Fish assemblages within the ZoI are typical of the sandy and gravelly seabeds of the wider Western Irish Sea. Species noted during site specific surveys included plaice, dab, poor cod, sand eel *Ammodytes tobianus*, common dragonet *Callionymus lyra* and sand goby *Pomatoschistus minutus*, with sand eel and sand goby being particularly abundant in some years. Other commercial species noted included whiting, lemon sole *Microstomus kitt*, sole, John dory *Zeus faber* and turbot *Psetta maxima*.

6.5.2.3 The western Irish Sea is home to a number of diadromous fish species that migrate between the sea and freshwater at different stages of their lifecycle. Atlantic salmon *Salmo salar* and sea trout *Salmo trutta* are two commercially important species in the region. The rivers Slaney, Boyne, Dargle and Avoca on the east coast of Ireland are key rivers for migratory fish species (Celtic Sea Trout Project, 2016; Inland Fisheries Ireland, 2022). Sea lamprey *Petromyzon marinus*, river lamprey *Lampetra. fluviatilis*, and twaite shad *Allosa fallax* are known to occur in inshore waters off the coast of co. Wicklow (Inland Fisheries Ireland, 2018).

Site-specific survey summary

6.5.2.4 A summary of site-specific surveys undertaken to inform the Stage 2 appraisal on migratory fish is provided in Table 6.21.

Table 6.21: Summary of site-specific survey data for migratory fish species

Data Source	Method	Date
Digital aerial marine mammal and bird surveys (ABWP2)	Aerial	March 2018 to April 2020
GE Wind Energy. Post-construction surveys (ABWP1)	Anchor dredge Beam trawl	June 2010 to September 2021
Arklow Energy Ltd (2010). Post-construction survey (ABWP1)	Anchor dredge Beam trawl	June 2009
HydroServ Projects Ltd. Post-construction surveys (ABWP1)	Anchor dredge Beam trawl	June 2004 to May 2008
EcoServe (2001). Baseline/pre-construction survey (ABWP1).	Anchor dredge Agassiz trawl	April 2001
EcoServe (2001). Baseline/pre-construction survey (ABWP1).	Anchor dredge Otter trawl	September 2000

Data Source	Method	Date
EcoServe (2001). Baseline/pre-construction survey (ABWP1).	Anchor dredge	June 2000

6.5.3 Avoidance through Design and Standard Project Environmental Protection Measures of the Proposed Development

6.5.3.1 The design of the Proposed Development is such that some potential impact can be avoided as seen by applying the design features and management measures relevant to migratory fish receptors which are presented in Table 6.22.

Table 6.22: Project design and environmental protection measures relevant for migratory fish receptors

Measure	Justification
Scour protection	In the absence of scour protection, there is potential for scour pits to develop around foundations. This may result in the release of sediment into the water column and a change to seabed habitat in the vicinity of the foundation which may result in disturbance to migratory fish. Scour protection will be installed which will reduce the potential for suspended sediment.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339)	The Developer was granted a Foreshore Licence (FS007339) for Site Investigations (associated with the Proposed Development) from the Minister for Housing, Local Government and Heritage in May 2022. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339) being carried out. As such there is no temporal overlap between the activities consented in this Foreshore Licence and the Proposed Development and there will be no potential for cumulative effects.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried	The Developer submitted a Foreshore Licence Application for Site Surveys to the Minister for Housing, Local Government and Heritage in April 2023 (FS007555) and this application is pending determination. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried out. As such there is no temporal overlap between the activities proposed in the Foreshore Licence Application and the Proposed Development.
Impact avoidance/ reduction through implementation of a Construction and Operational and Maintenance activities are detailed in Volume I, Supporting Information for Screening for Appropriate Assessment Report.	The construction activities including cable plans, techniques and burial depths are detailed in Volume II, Chapter 4. Operational and maintenance activities are also set out in Volume II, Chapter 4. These methods are set out using best practice guidelines to reduce the potential for impacts on marine habitats and megafauna including migratory fish.

Measure	Justification
Impact avoidance/ reduction through development of and adherence to a Rehabilitation Schedule (Volume III, Appendix 4.1).	The Rehabilitation Schedule describes measures for the decommissioning of the Proposed Development. Measures which will be implemented that will mitigate against effects on fish, shellfish and sea turtle include leaving scour protection in-situ.
Impact avoidance/ reduction through implementation of an Environmental Vessel Management Plan (EVMP) (Volume III, Appendix 25.10)	The implementation of an Environmental VMP which includes best practice guidance measures to minimise the potential for collision risk, potential injury to, and disturbance of marine megafauna from vessel activities.
Impact avoidance/ reduction through development of and implementation of an Environmental Management Plan (EMP) (Volume III, Appendix 25.1).	This will include mitigation/monitoring measures and commitments made within the EIAR, including but not limited to chemical usage, invasive and non-native species, pollution prevention and waste management. These measures are set out using best practice guidelines to reduce the potential for impacts on marine habitats and megafauna including migratory fish.
Impact avoidance/ reduction through implementation of a Marine Pollution Contingency Plan will be included in the EMP (Volume III, Appendix 25.1, Annex 2).	Ensures plans are in place to manage any marine pollution spills including key emergency contact details. These measures are set out using best practice guidelines to reduce the potential for impacts on marine habitats and megafauna including migratory fish.
Impact avoidance/ reduction through implementation of an Invasive Non-Indigenous Species Management Plan will be implemented and will be included in the EMP (Volume III, Appendix 25.1, Annex 4)	The plan outlines measures to ensure vessels comply with the International Maritime Organisation (IMO) ballast water management guidelines, it will consider the origin of vessels and contain standard housekeeping measures for such vessels as well as measures to be adopted in the event that a high alert species is recorded. These measures are set out to reduce the potential for impacts on marine habitats and megafauna including migratory fish.
Impact avoidance/ reduction through development of and adherence to Marine Mammal Mitigation Plan (MMMP) (Volume III, Appendix 25.2)	This will identify appropriate mitigation measures during offshore activities that are likely to produce underwater noise and vibration levels capable of potentially causing injury or disturbance to marine mammals. Factored-in measures adopted to reduce the risk of impact to marine mammal receptors will also be employed to reduce the risks to other marine megafauna that can be visually detected on the surface of the sea such as migratory fish.
Impact avoidance/ reduction through implementation of an Environmental Monitoring Measures are set out in the SISAA, Section:4 Tables 4.27 to 4.33.	Volume II, Chapter 25: Summary of Factored in Measures, Mitigation and Monitoring sets out commitments to environmental monitoring in pre-, during and post-construction phases.
Impact avoidance/ reduction through cables being buried where possible and protected where not possible.	Reduces the effect of Electromagnetic Fields (EMF). As EMF can have an adverse effect on migratory fish, burying cables will reduce the potential effects on migratory fish.

6.5.4 Impacts and Parameters Assessed

6.5.4.1 Both Project Design Options identified in Table 6.23 have the same potential to result in the effects on migratory fish species.

Table 6.23: Project Design Options 1 and 2 considered for the assessment of potential impacts on migratory fish receptors

Potential impact	Phase C	Phase O	Phase D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
Injury and/or disturbance from UWN and vibration during pile driving and cable installation	✓	✓	X	Project Design Option 1: **Construction phase:** Foundation installation: WTGs installed on monopile foundations: • Installation of 56 WTGs with a pile diametre between 7 m and 11 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24-hour period); • Maximum hammer energy 6,600 kJ, average hammer energy 4,400 kJ and a strike rate of 30 strikes per minute; • Soft start at 825 kJ; • Anticipated maximum duration of piling at 5 hours and 10 minutes per day with an average duration of 4 hours per pile and; • Total of 75 days when piling may occur over construction period, which may last up to 5 years. Offshore Substations Platforms (OSP) installed on monopile foundations: • Installation of two OSPs with a pile diametre between 7 and 14 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy 6,600kJ and an average hammer energy 6,000 kJ; • Soft start at 825 kJ; • Average duration of 4 hours per pile and; • Total of 4 days when piling may occur over construction period.	Within the construction phase Project Design Option 1 consists of a larger number of foundations to be installed – 58 monopile foundations in total (56 for WTGs and 2 for OSPs), whilst Project Design Option 2 comprises of 47 foundations in total (47 for WTGs and 2 for OSPs). Therefore, Project Design Option 1 will have a greater potential for UWN from piling activities.

Potential impact	Phase C	O	D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
				Detonation of UXO's. **Operational and maintenance phase** • 56 operational WTGs • Cable repair once every 3 years and cable re-burial once every 3 years for inter-array and interconnector cables. • For export cables, cable repair once every 5 years and cable re-burial once every 5 years. • Operational dredging once every 5 years. • Geophysical surveys every 6 months for first two years and annually thereafter.	
				Project Design Option 2 **Construction Phase:** Foundation installation: WTGs and OSPs installed on monopile foundations: • Installation of 47 WTGs with a pile diametre between 7 m and 11 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy up to 6,600 kJ, average hammer energy up to 4,400 kJ and a strike rate of 30 strikes per minute; • Soft start energy of 825 kJ; • Anticipated maximum duration of piling at 5 hours and 10 minutes per day with an average duration of 4 hours per pile; and • Total of 63 days when piling may occur over construction period, which may last up to 5 years. OSPs installed on monopile foundations:	

Potential impact	Phase C	O	D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
				• Installation of 2 OSPs with a pile diametre between 7 m and 14 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy up to 6,600 kJ and an average hammer energy up to 6,000 kJ; • Soft start of 825 kJ; • Average duration of 4 hours per pile; and • Total of 4 days when piling may occur over construction period. Detonation of UXO's. **Operational and maintenance phase**: • 47 operational WTGs • Cable repair once every 3 years and cable re-burial once every 3 years for inter-array and interconnector cables. • For export cables, cable repair once every 5 years and cable re-burial once every 5 years. • Operational dredging once every 5 years. • Geophysical surveys every 6 months for first two years and annually thereafter.	
UWN from other activities	✓	✓	✓	Project Design Option 1 **Construction Phase:** • Installation of between 110 and 122 km inter-array cables and between 35 and 40 km offshore export cables; and • Up to 4,150 vessel round trips and up to 294 helicopter round trips during the construction phase. **Operational and Maintenance phase:**	Within the Construction phase, both Project Design Option 1 and 2 have the same level of potential impact from UWN from Other Activities. Within the Operational and Maintenance Phase, both Project Design Option 1 and 2 have the same level of potential impact.

Potential impact	Phase C	O	D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
				• Up to 1,359 vessel round trips per year and 485 helicopter round trips per year. • 56 operational WTGs • Cable repair once every 3 years and cable re-burial once every 3 years for inter-array and interconnector cables. • For export cables, cable repair once every 5 years and cable re-burial once every 5 years. • Operational dredging once every 5 years. • Geophysical surveys every 6 months for first two years and annually thereafter. **Decommissioning Phase:** • Decommissioning of up to 56 WTGs and up to 2 OSP.	Within the Decommissioning Phase, both Project Design Option 1 and 2 have the same level of potential impact from UWN from Other Activities.
				<u>Project Design Option 2</u> **Construction Phase:** • Installation between 110 and 122 km inter-array cables and between 35 and 40 km offshore export cables; and Up to 4,150 vessel round trips and up to 294 helicopter round trips during the construction phase. **Operational and Maintenance phase:** • Up to 1,294 vessel round trips per year and 485 helicopter round trips per year. • 47 operational WTGs • Cable repair once every 3 years and cable re-burial once every 3 years for inter-array and interconnector cables. • For export cables, cable repair once every 5 years and cable re-burial once every 5 years. • Operational dredging once every 5 years. • Geophysical surveys every 6 months for first two years and annually thereafter.	

Potential impact	Phase C	Phase O	Phase D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
				Decommissioning Phase: • Decommissioning of up to 47 WTGs and up to 2 OSP.	
EMF	X	✓	X	Project Design Option 1 **Operational and Maintenance phase:** Presence of inter-array, OSP interconnector, and offshore export cables: • 66 kV inter-array cables between 110 – 122 km in length. • 220 kV OSP interconnector cables between 25 – 28 km in length. • 220 kV offshore export cables between 35 – 40 km in length. • Burial depth between 0-1.5 m for inter-array cables and 0-2.5 m for OSP interconnector and offshore export cables. • 15% of inter-array cable routes, 50% of OSP interconnector cable routes, and 20% of export cable routes requiring protection. • Third party export cable crossings. • Operational phase of 36.5 years. • Cable protection system (up to 1.5 m in diameter) comprising concrete, polyurethane, steel, cast iron shells, high density polyethylene and/or plastic ducts. Project Design Option 2: **Operational and Maintenance phase:** Presence of inter-array, OSP interconnector, and offshore export cables: • 66 kV inter-array cables between 110 – 122 km in length. • 220 kV OSP interconnector cables between 25 – 28 km in length. • 220 kV offshore export cables between 35 – 40 km in length. • Burial depth between 0-1.5 m for inter-array cables and 0-2.5 m for OSP interconnector and offshore export cables.	No differences in parameters for EMF for Project Design Option 1 and Project Design Option 2.

Potential impact	Phase C	O	D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
				• 15% of inter-array cable routes, 50% of OSP interconnector cable routes, and 20% of export cable routes requiring protection. • Third party export cable crossings. • Operational phase of 36.5 years. • Cable protection system (up to 1.5 m in diametre) comprising concrete, polyurethane, steel, cast iron shells, high density polyethylene and/or plastic ducts.	

6.6 Assessment of Proposed Development alone for Migratory Fish QIs

6.6.1 Slaney River Valley SAC

Twaite Shad

6.6.1.1 The conservation objectives for twaite shad at this designated site is to restore the favourable conservation condition of the feature, this is defined and presented in Table 5.1.

6.6.1.2 There are three key potential impacts on twaite shad associated with construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.23 and are assessed below for each phase of the Proposed Development.

INJURY AND/ OR DISTURBANCE FROM UNDERWATER NOISE – PILING AND OTHER ACTIVITIES

6.6.1.3 Underwater noise and vibration within the Array Area and Cable Corridor and Working Area will occur during the construction, operational and maintenance, and decommissioning phases as a result of a range of activities including impact piling, cable laying, dredging, drilling, rock placement, vessel movements, operational WTG noise, and unexploded ordnance (UXO) clearance. This can cause injury and/or disturbance to fish and shellfish.

6.6.1.4 The assessment has been informed by the Underwater Noise Assessment by Subacoustech (Volume III, Appendix 11.1) which includes the results of numerical modelling using the INSPIRE underwater noise model.

6.6.1.5 Underwater noise and vibration may cause the following effects on fish:

- Behavioural effects (e.g. reduced detection of predators/prey, inhibited communication between conspecifics, alteration in swimming behaviour);
- Masking effects (i.e. the reduced detectability of a given sound owing to the simultaneous occurrence of another sound);
- Temporary threshold shift (TTS) in hearing (short or long-term changes in hearing sensitivity that may or may not reduce fitness);
- Recoverable tissue injury (not resulting in mortality e.g. hair cell damage, minor internal or external hematoma etc.); and
- Mortality or potential mortal injury (immediate or delayed death).

6.6.1.6 There can also be vibration effects within the immediate vicinity of piling or other sources of noise that can cause slight movement of sediment that in turn may have an effect on the behaviour of benthic fish species or could potentially affect the viability of fish eggs near the source (Popper & Hawkins 2018). Vibration can also refer to the effects of particle motion (separate from sound pressure) in the water column. However, very little research has been conducted on the effects of vibration on fish. Noise and vibration are produced at the same time and are interconnected and so for the purposes of this assessment we have referred to them together as appropriate.

6.6.1.7 Hearing abilities of fish are related to the morphological adaptations of the acoustico-lateralis apparatus, in particular the distance of the swim bladder to the inner ear (Hastings & Popper, 2005; Mason, 2013). Species with no swim bladder (e.g. Sea and river lamprey) have a lower hearing ability than many other fish species and rely on the detection of particle motion (the oscillatory displacement of fluid particles in a sound field) (Popper *et al.*, 2014). They are considered to have a low sensitivity to underwater noise and vibration effects.

6.6.1.8 Fish species with a swim bladder but with no connection to the inner ear (e.g. salmon) have better hearing but can also only detect particle motion. They are considered to have a medium sensitivity to underwater noise and vibration effects.

6.6.1.9 Species that have an extension of the swim bladder that terminates in the inner ear (e.g. Twaite shad) can hear sounds over a far greater range than other species (Popper *et al.*, 2014; Gill *et al.*, 2012) and can detect both particle motion and sound pressure (a form of stress measured in terms of force/unit area). They are considered to have a high sensitivity to underwater noise and vibration effects.

6.6.1.10 Popper *et al.* (2014) provides criteria that can be applied to assess the potential effects of noise and vibration on fish from different marine activities such as piling, dredging and vessel movements (Table 6.24). The approach assesses the potential effects of underwater noise and vibration on fish based on grouping species according to their hearing apparatus, specifically whether they have no swim bladder, they have a swim bladder but it is not involved in hearing, or they have a swim bladder which is involved in hearing (Popper *et al.* 2014).

6.6.1.11 The noise levels are based on consideration of peak noise (SPL_{peak}, the maximum absolute value of the instantaneous sound pressure during a specified time interval), and cumulative Sound Exposure Level (SEL_{cum}) which is the linear summation of the individual sound events over the time period of interest (Appendix 11.1: Subsea Noise Technical Report for further details).

6.6.1.12 Insufficient data exists to make a recommendation for guidelines in relation to masking effects or behavioural effects and therefore a qualitative approach has been adopted in which relative risk of an effect is placed in order of rank at three distances from the source – near (N) (tens of metres from the source), intermediate (I) (hundreds of metres from the source) and far (F) (thousands of metres from the source) (refer to Table 6.24).

Table 6.24: Mortality, potential injury, temporary threshold shift, masking and behaviour criteria for fish and shellfish in relation to pile driving noise (Popper et al. 2014)

Fish grouping	Impairment				
	Mortality and potential mortal injury	Recoverable injury	Temporary Threshold Shift (TTS)	Masking	Behaviour
No swim bladder (particle motion detection)	>219 dB SEL_{cum} or >213 dB SPL_{peak}	>216 dB SEL_{cum} or >213 dB SPL_{peak}	>186 dB SEL_{cum}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Swim bladder is not involved in hearing (particle motion detection)	>210 dB SEL_{cum} or >207 dB SPL_{peak}	>203 dB SEL_{cum} or >207 dB SPL_{peak}	>186 dB SEL_{cum}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Swim bladder is involved in hearing (primarily pressure detection)	>207 dB SEL_{cum} or >207 dB SPL_{peak}	>203 dB SEL_{cum} or >207 dB SPL_{peak}	>186 dB SEL_{cum}	(N) High (I) High (F) Moderate	(N) High (I) High (F) Moderate

6.6.1.13 For continuous noise sources such as vibropiling, dredging and vessel noise, quantitative criteria for assessment are only available for recoverable injury and TTS for fish with a swim bladder involved in hearing. For other potential effects (i.e. masking and behaviour changes) the qualitative approach described in Table 6.25 is applicable.

Table 6.25: Mortality, potential injury, temporary threshold shift, masking and behaviour criteria for fish and shellfish in relation to vessel noise and other continuous sounds (Popper et al, 2014)

Fish grouping	Impairment				
	Mortality and potential mortal injury	Recoverable injury	Temporary Threshold Shift	Masking	Behaviour
No swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Swim bladder is not involved in hearing (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Swim bladder is involved in hearing (primarily pressure detection)	(N) Low (I) Low (F) Low	170 dB SPL_{rms} for 48 hrs	158 dB SPL_{rms} for 12 hours	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low

6.6.1.14 The results of noise modelling for the piling of 11 m monopiles within the Array Area and ECC for Group 1, 2 and 3 fleeing receptors can be seen in Figure 6.8, Figure 6.9 and Figure 6.10 respectively.

6.6.1.15 The results of noise modelling for the piling of 14 m monopiles within the Array Area and ECC for Group 1, 2 and 3 fleeing receptors can be seen in Figure 6.11, Figure 6.12 and Figure 6.13.

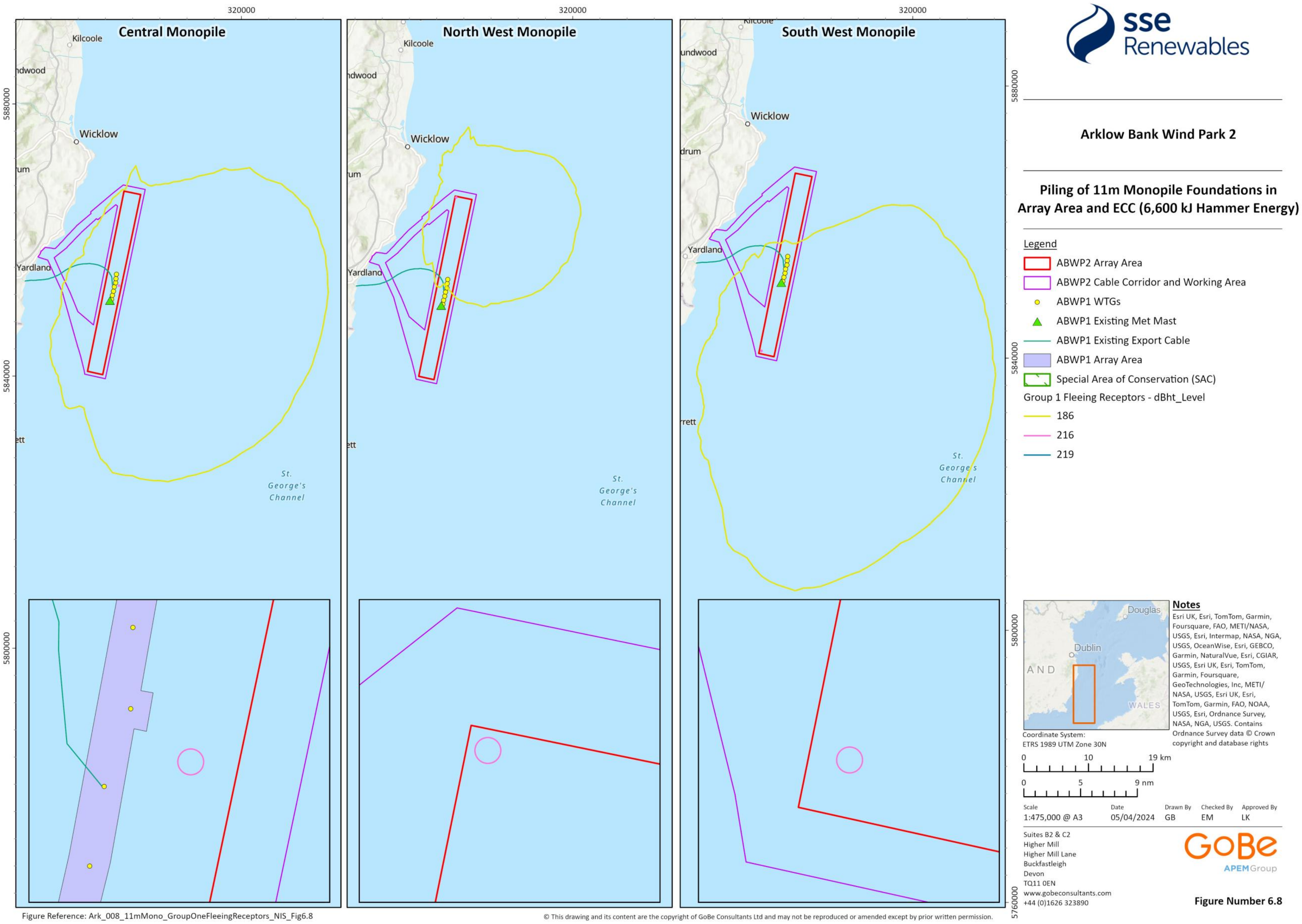

Figure 6.8: Piling of 11 m monopile foundations within the Array Area for Group 1 fleeing receptors

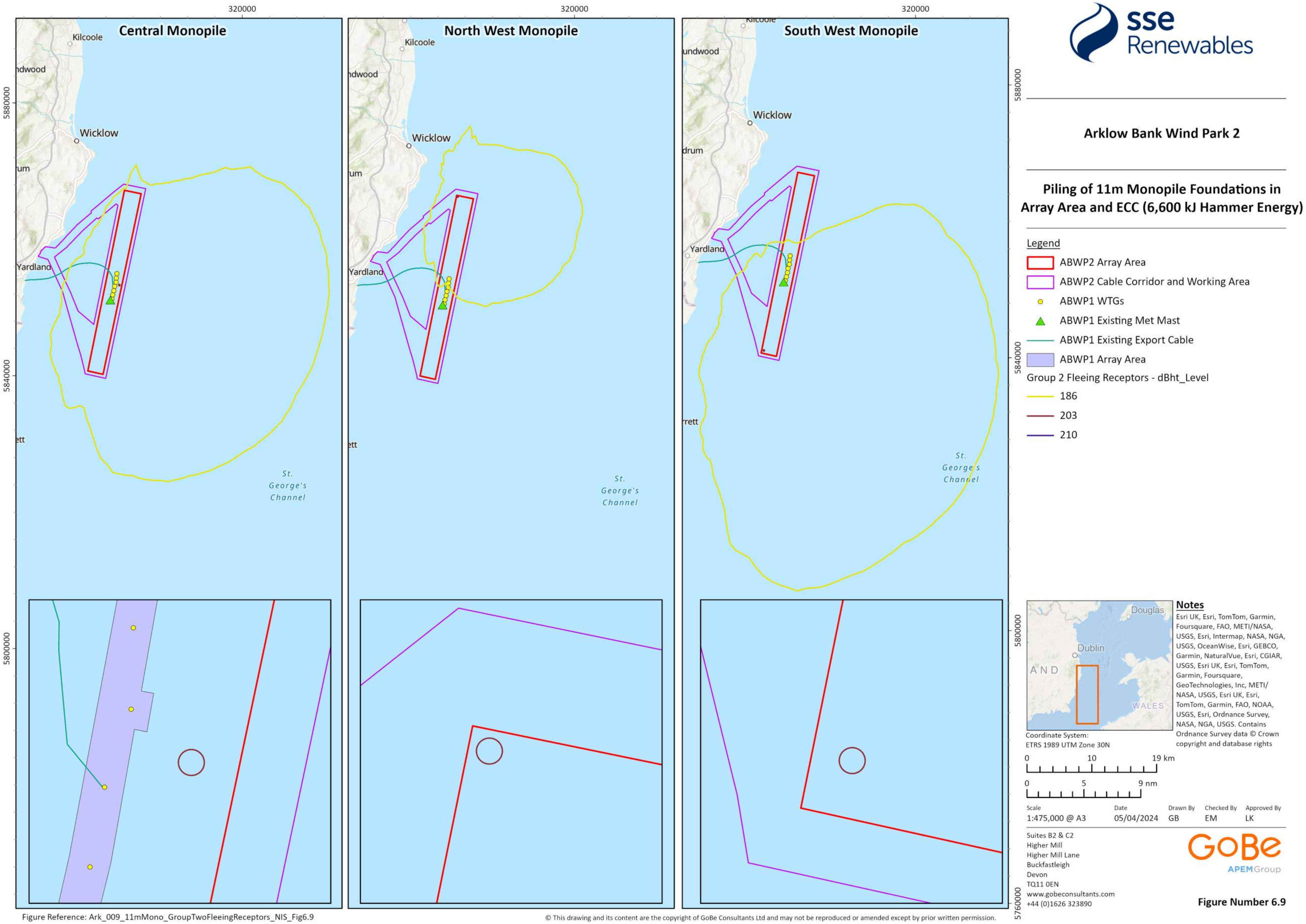

Figure 6.9: Piling of 11 m monopile foundations within the Array Area for Group 2 fleeing receptors

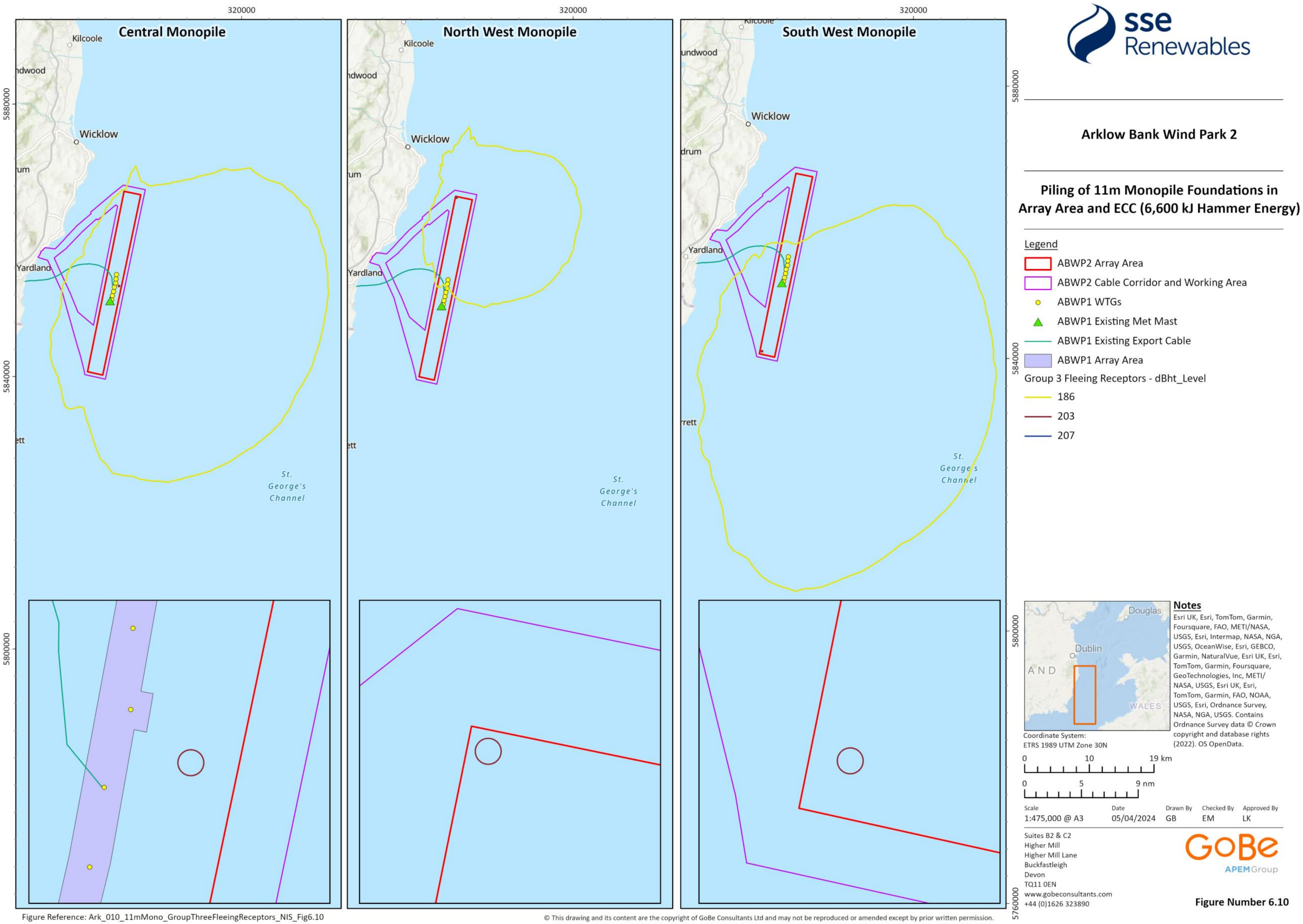

Figure 6.10: Piling of 11 m monopile foundations within the Array Area for Group 3 fleeing receptors

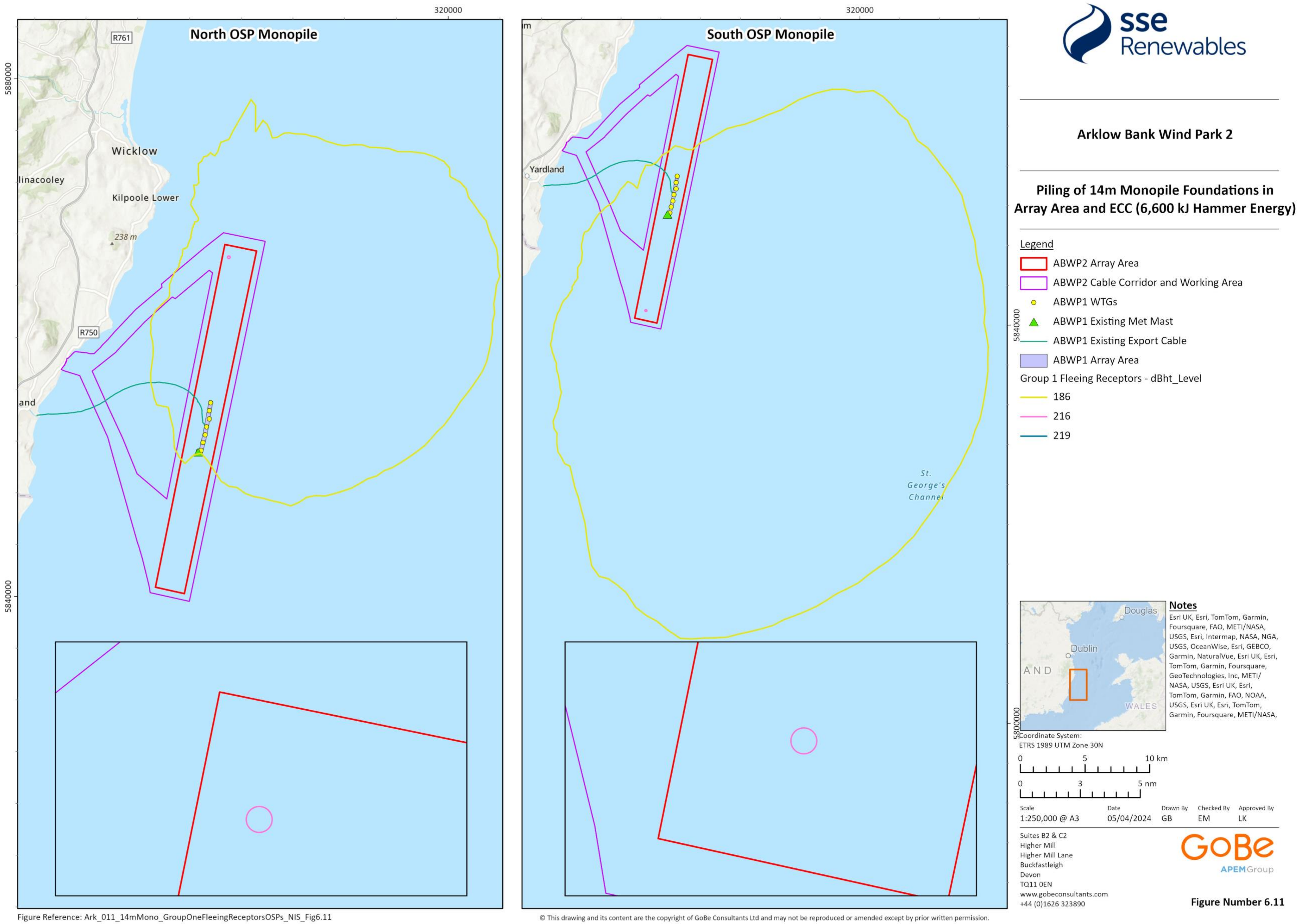

Figure 6.11: Piling of 14 m monopile foundations within the Array Area for Group 1 fleeing receptors

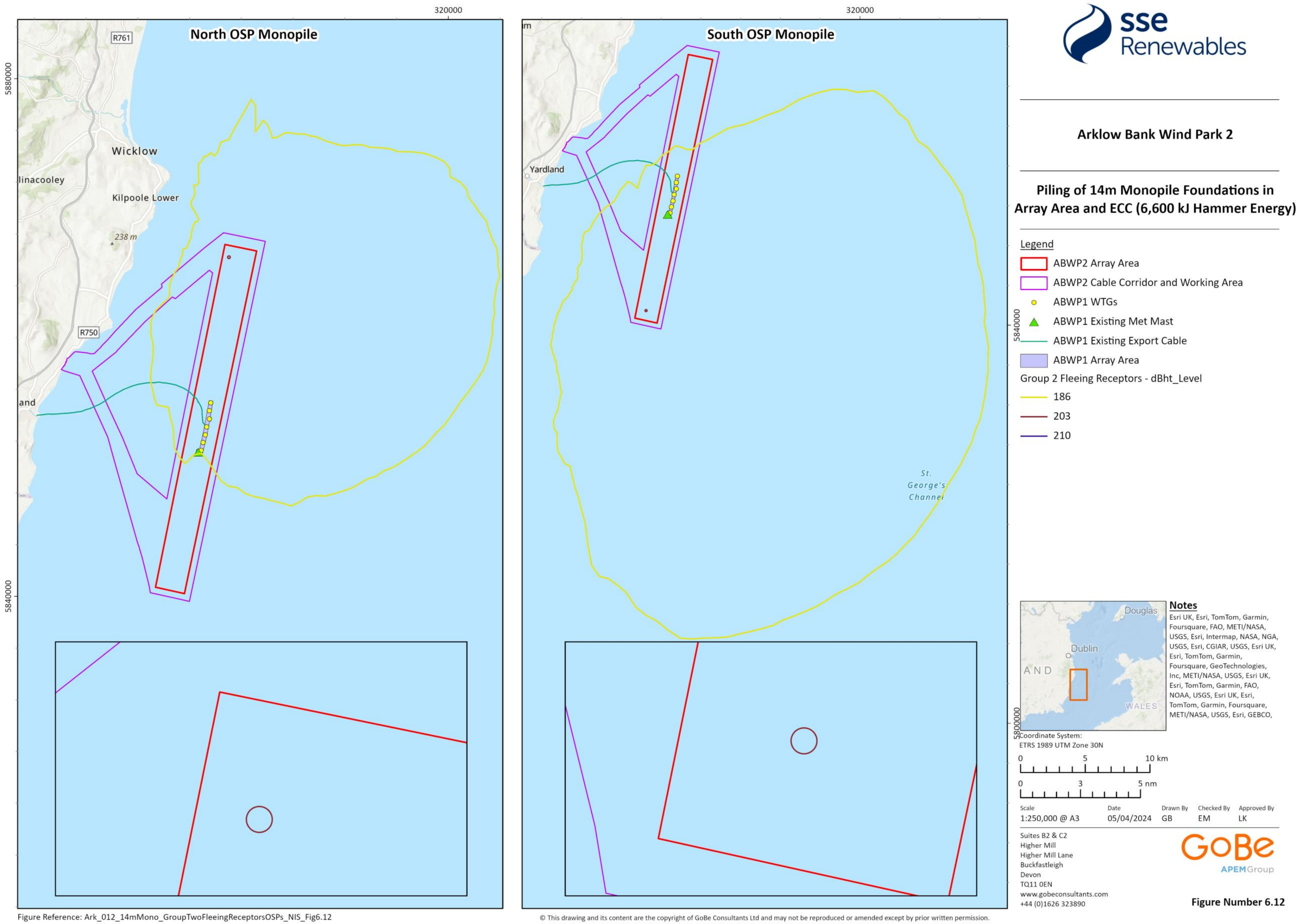

Figure 6.12: Piling of 14 m monopile foundations within the Array Area for Group 2 fleeing receptors

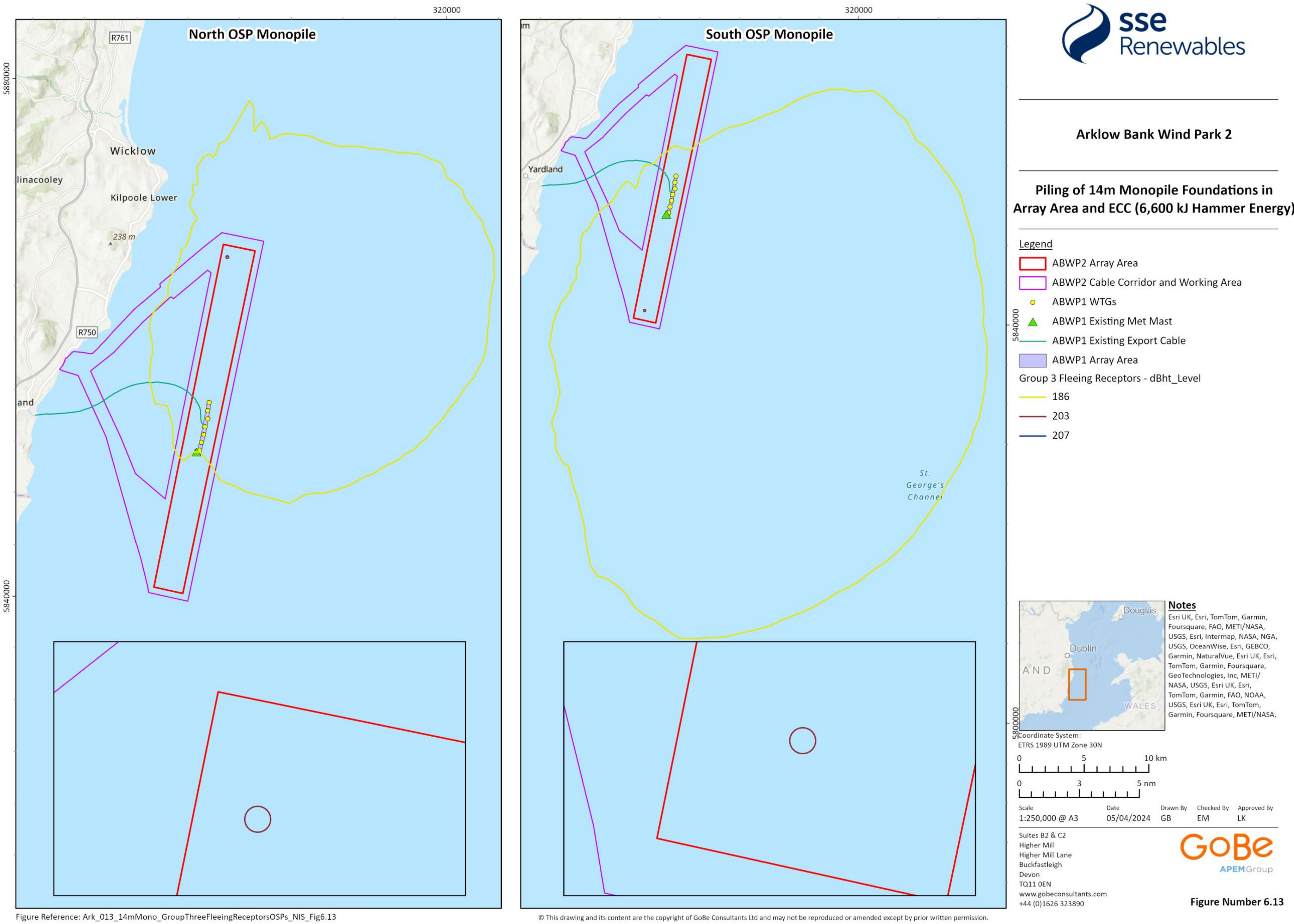

Figure 6.13: Piling of 14 m monopile foundations within the Array Area for Group 3 fleeing receptors

INJURY AND/ OR DISTURBANCE FROM UNDERWATER NOISE – PILING ACTIVITIES (CONSTRUCTION)

6.6.1.16 As twaite shad fall into the category of fish with a swim bladder which is involved in hearing they are the most susceptible to underwater noise impacts. For the >207 dB SPL_{peak} thresholds for mortality and recoverable injury indicated in Table 6.24, modelling for the 11 m diametre monopiles indicates this threshold may be exceeded up to 340 m away from the sound source at the SW site, covering an area of up to 0.33 km^2. At the other WTG foundation sites modelled, the maximum distance was 310 m (0.3 km^2). For the two OSP foundation sites modelled for the 14 m diametre monopiles, the maximum distance was 310 m (0.29 km^2). This is the distance at which underwater noise and vibration may cause mortality or a recoverable injury to fish that have a swim bladder that is involved in hearing. It should be noted that the >207 dB SPL_{peak} threshold range is larger than the >207 dB SEL_{cum} threshold range, therefore the larger range of impact was used for this assessment.

6.6.1.17 The >186 dB SEL_{cum} threshold for TTS was modelled to be exceeded up to 36 km from the noise source (maximum range) at the SW WTG site, covering an area of up to 1,900 km^2 for fleeing animals. At the NW WTG site the model predicts that the TTS threshold could be exceeded up to 19 km from the noise source, covering an area of 440 km^2 for fleeing animals. At the S OSP site, the TTS threshold was exceeded up to 37 km from the noise source, covering an area of up to 1,800 km^2.

6.6.1.18 The Popper *et al.* (2014) criteria for fish with a swim bladder that is involved in hearing indicates that piling in likely to have a high effect on both masking and behaviour on fish within tens and hundreds of metres from the noise source and a Moderate effect beyond this.

6.6.1.19 As the Slaney River Valley SAC is located 44.54 km from the proposed development, the site is not within the threshold for mortality, recoverable injury or TTS (Figure 6.8 through Figure 6.13). However, individuals migrating past the Proposed Development may come into contact with these thresholds. As highly mobile fish species, twaite shad are expected to be able to avoid the noise sources before potential mortal injuries could occur and therefore effects are likely to be restricted to temporary TTS effects and temporary disruption/avoidance during migration.

6.6.1.20 **It is concluded that there will be no AEoI on the twaite shad feature of Slaney River Valley SAC as defined by the COs of the site as a result of underwater noise from piling activities as described above, from Project Design Option 1.**

6.6.1.21 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

INJURY AND/ OR DISTURBANCE FROM UNDERWATER NOISE – OTHER ACTIVITES (CONSTRUCTION, OPERATIONAL AND MAINTENANCE AND DECOMMISSIONING)

6.6.1.22 The Popper *et al.* (2014) criteria for fish with a swim bladder that is not involved in hearing indicates for vessels and other continuous noise sources, mortality is likely to be Low at all distances as seen in Table 6.25.

6.6.1.23 Moderate TTS effects may be observed within tens of metres and Low TTS effects beyond this distance. High effects on masking are likely within tens and hundreds of metres from the noise source with Moderate effects within thousands of metres. Moderate behavioural effects are likely within tens and hundreds of metres and Low behavioural effects are likely at thousands of metres.

6.6.1.24 Recoverable injury has a numerical criterion of >170 dB SPL_{rms} for 48 hrs for continuous noise sources. Of the continuous noise sources for the Proposed Development, four have source noise levels below this criterion. There are four noise activities with a source noise level of more than >170 dB SPL_{rms}: cable laying; suction dredging; rock placement; and trenching. For these activities the modelling indicates the criterion may be exceeded up to 50 m away from the noise source if continuous for 48 hours or more.

6.6.1.25 The TTS criterion for continuous noise sources is >158 dB SPL_{rms} for 12 hours. Modelling indicates the criterion may be exceeded up to 50 m away from the noise source if continuous for 12 hours or more.

6.6.1.26 For continuous noise sources, it is likely there will be a High masking effect at all distances. For behavioural effects, Popper *et al.* (2014) suggests the effects are likely to be of High significance within tens of metres, Moderate within hundreds of metres and Low within thousands of metres.

6.6.1.27 As the Slaney River Valley SAC is located 44.54 km from the proposed development, the site is not within the threshold for mortality or recoverable injury or the threshold for TTS, and the magnitude of individuals at sea is considered to be low, it can be assumed that mortality and recoverable injury will not adversely affect the site.

6.6.1.28 **It is concluded that there will be no AEoI on the twaite shad feature of Slaney River Valley SAC as defined by the COs of the site as a result of underwater noise from other activities, as seen in Table 5.1 from Project Design Option 1.**

6.6.1.29 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

CHANGES IN EMF (OPERATIONAL AND MAINTENANCE)

6.6.1.30 The conduction of electricity through subsea power cables has the potential to emit a localised EMF which could potentially affect the sensory mechanisms of some species of fish and shellfish, particularly electrosensitive species including migratory fish species.

6.6.1.31 The presence and operation of inter-array, interconnector and offshore export cables within the Array Area and Cable Corridor and Working Area may lead to a localised EMF affecting fish and shellfish receptors. EMF comprises both the electrical I fields, measured in volts per metre (V/m), and the magnetic (B) fields, measured in microtesla (μT) or milligauss (mG) (1 μT = 10 mG). Direct E-field are typically blocked using conductive sheathing, meaning that the EMFs that are emitted into the marine environment are the B-field and the resultant induced electrical field (iE).

6.6.1.32 The range over which these species can detect electric fields from offshore windfarm subsea cables is very localised and likely to be limited to metres, from the cable (CSA, 2019). EMFs may alter animal behaviour (e.g. via avoidance of EMF, increases in foraging behaviour, reductions in swimming speeds) but there is little evidence to suggest a reduction in survival. Pelagic species are considered unlikely to be exposed to EMF as they generally swim well above the seafloor and consequently would rarely be exposed even at low levels from subsea power cables (CSA, 2019). All QIs are therefore deemed to be of high tolerance and adaptability, high recoverability and of local to international importance. The sensitivity of all relevant fish species to temporary changes in electromagnetic fields is therefore, considered to be Low.

6.6.1.33 While there is some change to EMFs in the vicinity of inter-array and offshore export cables, studies indicate that these are limited in extent, with the strength of EMF dissipating quickly with distance (within metres) from the buried cables. The impact therefore is predicted to be of near-field extent (i.e. restricted to within the Array Area and Cable Corridor and Working Area), long term duration (i.e. the lifetime of the Proposed Development), continuous and of low consequence.

6.6.1.34 **As the Slaney River Valley SAC is 44.54 km from the Proposed Development and the EMF dissipates quickly within metres of the buried cables and the sensitivity of twaite shad is low to EMF, it is concluded that there is no AEoI on the twaite shad feature of Slaney River Valley SAC as defined by the COs of the site as a result of EMF from Project Design Option 1.**

6.6.1.35 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Atlantic salmon

6.6.1.36 The conservation objectives for Atlantic salmon at this designated site is to restore the favourable conservation condition of the feature, this is defined and presented in Table 5.1.

6.6.1.37 There are three key potential impacts on Atlantic salmon associated with construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.23 and are assessed below for each phase of the Proposed Development.

INJURY AND/ OR DISTURBANCE FROM UNDERWATER NOISE – PILING ACTIVITIES (CONSTRUCTION)

6.6.1.38 Atlantic salmon fall into the category of fish that have a swim bladder, but it is not involved in hearing. For the >207 dB SPL_{peak} thresholds indicated in Table 6.24, modelling for the 11 m diametre monopiles indicates this threshold may be exceeded up to 340 m away from the sound source at the SW site, covering an area of up to 0.33 km^2. At the other WTG foundation sites modelled, the maximum distance was 310 m (0.3 km^2). For the two OSP foundation sites modelled, the maximum distance was 310 m (0.3 km^2) for the 7 m and 14 m diametre foundations. This is the distance at which underwater noise and vibration may cause mortality or a recoverable injury to fish that have a swim bladder that is not involved in hearing.

6.6.1.39 The >210 dB SEL_{cum} threshold for mortality criteria was modelled to be exceeded less than 100 m from the noise source for all WTG foundation and OSP foundation locations for fleeing animals.

6.6.1.40 The >203 dB SEL_{cum} threshold for recoverable injury criteria was modelled to be exceeded less than 100 m from the noise source for all WTG foundation and OSP foundation locations for fleeing animals.

6.6.1.41 The >186 dB SEL_{cum} threshold for TTS was modelled to be exceeded up to 36 km from the noise source (maximum range) at the SW WTG site, covering an area of up to 1,900 km^2 for fleeing animals. At the NW WTG site the model predicts that the TTS threshold could be exceeded up to 19 km from the noise source, covering an area of 440 km^2 for fleeing animals. At the S OSP site the model predicts that the TTS threshold could be exceeded up to 35 km from the noise source, covering an area of 1,800 km^2 for fleeing animals.

6.6.1.42 The Popper *et al.* (2014) criteria for fish with a swim bladder that is not involved in hearing indicates that piling in likely to have a Moderate effect on masking for fish within tens of metres from the noise source and a Low effect beyond this. Behavioural effects are likely to be High within tens of metres, Moderate within hundreds of metres and Low at greater distances.

6.6.1.43 As the Slaney River Valley SAC is located 44.54 km from the proposed development, the site is not within the threshold for mortality, recoverable injury or TTS. Migration patterns of Atlantic salmon out of this SAC are not fully understood. However, they are assumed to migrate northerly past the Proposed Development, similar to the migration patterns observed for Atlantic salmon along other East Ireland rivers (Barry *et al.*, 2020). As highly mobile fish species, Atlantic salmon are expected to be able to avoid the noise sources before potential mortal injuries could occur and therefore effects are likely to be restricted to temporary TTS effects and temporary disruption/avoidance during migration.

6.6.1.44 **It is concluded that there will be no AEoI on the Atlantic salmon feature of Slaney River Valley SAC as defined by the COs of the site as a result of underwater noise from piling activities, as seen in Table 5.1 from Project Design Option 1.**

6.6.1.45 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

INJURY AND/ OR DISTURBANCE FROM UNDERWATER NOISE – OTHER ACTIVITES (CONSTRUCTION, OPERATIONAL AND MAINTENANCE AND DECOMMISSIONING)

6.6.1.46 The Popper *et al.* (2014) criteria for fish with a swim bladder that is not involved in hearing indicates for vessels and other continuous noise sources, mortality is likely to be Low at all distances as seen in Table 6.25.

6.6.1.47 The Popper *et al.* (2014) criteria for fish with a swim bladder that is not involved in hearing indicates for vessels and other continuous noise sources, mortality and recoverable injuries are likely to be Low at all distances. Moderate TTS effects may be observed within tens of metres and Low beyond this distance. High effects on masking are likely within tens and hundreds of metres from the noise source with Moderate effects within thousands of metres. Moderate behavioural effects are likely within tens and hundreds of metres and Low behavioural effects are likely at thousands of metres.

6.6.1.48 The results of modelling of UXO clearance indicates that if the maximum charge (800 kg + donor) was detonated it could result in mortality or mortal injury in 560-930 m from the explosion. If Low-order deflagration (charge weight of 0.5 kg) is used to initiate a burnout of the explosive any fish within 80 m of the explosion would be at risk of mortality or mortal injury. Low-order deflagration is not always possible and if the original charge is not fully detonated then a High-order detonation would be required to remove the remaining charge. If High-order detonation is required of an 800 kg UXO it has the potential to kill Type 1 fish occurring in the area. Recoverable injury, TTS and behavioural effects are also likely within tens of metres of the noise source and may be observed within hundreds of metres.

6.6.1.49 As the Slaney River Valley SAC is located 44.54 km from the proposed development, the site is not within the threshold for mortality or recoverable injury or the threshold for TTS, and the magnitude of individuals at sea is considered to be low, it can be assumed that mortality and recoverable injury will not have an adversely effect on the site.

6.6.1.50 **It is concluded that there will be no AEoI on the Atlantic salmon feature of Slaney River Valley SAC as defined by the COs of the site as a result of underwater noise from other activities, as seen in Table 5.1 from Project Design Option 1.**

6.6.1.51 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

CHANGES IN EMF (OPERATIONAL AND MAINTENANCE)

6.6.1.52 The conduction of electricity through subsea power cables has the potential to emit a localised EMF which could potentially affect the sensory mechanisms of some species of fish and shellfish, particularly electrosensitive species including migratory fish species.

6.6.1.53 The presence and operation of inter-array, interconnector and offshore export cables within the Array Area and Cable Corridor and Working Area may lead to a localised EMF affecting fish and shellfish receptors. EMF comprises both the electrical (E) fields, measured in volts per metre (V/m), and the magnetic (B) fields, measured in microtesla (μT) or milligauss (mG) (1 μT = 10 mG). Direct E-field are typically blocked using conductive sheathing, meaning that the EMFs that are emitted into the marine environment are the B-field and the resultant induced electrical field (iE).

6.6.1.54 The range over which these species can detect electric fields from offshore windfarm subsea cables is very localised and likely to be limited to metres, from the cable (CSA, 2019). EMFs may alter animal behaviour (e.g. via avoidance of EMF, increases in foraging behaviour, reductions in swimming speeds) but there is little evidence to suggest a reduction in survival. Pelagic species are considered unlikely to be exposed to EMF as they generally swim well above the seafloor and consequently would rarely be exposed even at low levels from subsea power cables (CSA, 2019). All IEFs are therefore deemed to be of high tolerance and adaptability, high recoverability and of local to international importance. The sensitivity of all relevant fish species to temporary changes in electromagnetic fields is therefore, considered to be Low.

6.6.1.55 While there is some change to EMFs in the vicinity of inter-array and offshore export cables, studies indicate that these are limited in extent, with the strength of EMF dissipating quickly with distance (within metres) from the buried cables.

6.6.1.56 **As the Slaney River Valley SAC is 44.54 km from the Proposed Development and the EMF dissipates quickly within metres of the buried cables and the sensitivity of Atlantic salmon is low to EMF, it is concluded that there is no AEoI on the Atlantic salmon feature of Slaney River Valley SAC as defined by the COs of the site as a result of EMF from Project Design Option 1.**

6.6.1.57 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Sea lamprey and River lamprey

6.6.1.58 The conservation objectives for sea lamprey and river lamprey at this designated site is to restore the favourable conservation condition of the feature, this is defined and presented in Table 5.1.

6.6.1.59 There are three key potential impacts on sea lamprey and river lamprey associated with construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.23 and are assessed below for each phase of the Proposed Development.

INJURY AND/ OR DISTURBANCE FROM UNDERWATER NOISE – PILING ACTIVITIES (CONSTRUCTION)

6.6.1.60 Sea lamprey and River lamprey fall into the category of fish with no swim bladder. For fish with no swim bladder, the 213 dB SPL_{peak} thresholds for mortality and recoverable injury criteria as indicated in Table 6.24, the modelling for the 11 m diametre monopiles indicates this threshold may be exceeded up to 130 m away from the sound source at the SW site, covering an area of up to 0.05 km^2. At the other WTG foundation sites modelled, the maximum distance range was 90-120 m (0.03-0.04 km^2). For the two OSP foundation sites modelled, the maximum distance range was 110-120 m (0.03-0.04 km^2) for both the 7 m and 14 m monopiles. This is the distance at which underwater noise and vibration may cause mortality or a recoverable injury to fish with no swim bladder.

6.6.1.61 The >219 dB SEL_{cum} threshold for mortality and recoverable injury criteria was modelled to be exceeded less than 100 m from the noise source for all WTG foundation and OSP foundation locations for fleeing animals.

6.6.1.62 The >186 dB SEL_{cum} threshold for TTS was modelled to be exceeded up to 36 km from the noise source (maximum range) at the SW WTG site, covering an area of up to 1,900 km^2 for fleeing animals. At the NW WTG site the model predicts that the TTS threshold could be exceeded up to 19 km from the noise source, covering an area of 440 km^2 for fleeing animals. At the S OSP site the model predicted the TTS threshold could be exceeded up to 35 km from the noise source, covering an area of up to 1,800 km^2 for both the 7 m and 14 m diametre foundations.

6.6.1.63 The Popper *et al.* (2014) criteria for fish with no swim bladder indicates that piling in likely to have a Moderate effect on masking for fish within tens of metres from the noise source and a Low effect beyond this. Behavioural effects are likely to be High within tens of metres, Moderate within hundreds of metres and Low at greater distances.

6.6.1.64 As the Slaney River Valley SAC is located 44.54 km from the proposed development, the site is not within the threshold for mortality or recoverable injury or the threshold for TTS (Figure 6.8 through Figure 6.13), and the magnitude of individuals at sea is considered to be low, it can be assumed that mortality and recoverable injury will not have an adverse effect on the site.

6.6.1.65 **It is concluded that there will be no AEoI on the sea lamprey and river lamprey feature of Slaney River Valley SAC as defined by the COs of the site as a result of underwater noise from other activities, as seen in Table 5.1 from Project Design Option 1.**

6.6.1.66 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

INJURY AND/ OR DISTURBANCE FROM UNDERWATER NOISE – OTHER ACTIVITES (CONSTRUCTION, OPERATIONAL AND MAINTENANCE AND DECOMMISSIONING)

6.6.1.67 The Popper *et al.* (2014) criteria for fish with no swim bladder indicates for vessels and other continuous noise sources, mortality and recoverable injuries are likely to be Low at all distances. Moderate TTS effects may be observed within tens of metres and Low beyond this distance. High effects on masking are likely within tens and hundreds of metres from the noise source with Moderate effects within thousands of metres. Moderate behavioural effects are likely within tens and hundreds of metres and Low behavioural effects are likely at thousands of metres as seen in Table 6.25.

6.6.1.68 As the Slaney River Valley SAC is located 44.54 km from the proposed development, the site is not within the threshold for mortality or recoverable injury or the threshold for TTS, and the magnitude of individuals at sea is considered to be low, it can be assumed that mortality and recoverable injury will not have an adverse effect on the site.

6.6.1.69 **It is concluded that there will be no AEoI on the sea lamprey and river lamprey feature of Slaney River Valley SAC as defined by the COs of the site as a result of underwater noise from other activities, as seen in Table 5.1 from Project Design Option 1.**

6.6.1.70 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

CHANGES IN EMF (OPERATIONAL AND MAINTENANCE)

6.6.1.71 The conduction of electricity through subsea power cables has the potential to emit a localised EMF which could potentially affect the sensory mechanisms of some species of fish and shellfish, particularly electrosensitive species including migratory fish species.

6.6.1.72 The presence and operation of inter-array, interconnector and offshore export cables within the Array Area and Cable Corridor and Working Area may lead to a localised EMF affecting fish and shellfish receptors. EMF comprises both the electrical (E) fields, measured in volts per metre (V/m), and the magnetic (B) fields, measured in microtesla (μT) or milligauss (mG) (1 μT = 10 mG). Direct E-field are typically blocked using conductive sheathing, meaning that the EMFs that are emitted into the marine environment are the B-field and the resultant induced electrical field (iE).

6.6.1.73 The range over which these species can detect electric fields from offshore windfarm subsea cables is very localised and likely to be limited to metres, from the cable (CSA, 2019). EMFs may alter animal behaviour (e.g. via avoidance of EMF, increases in foraging behaviour, reductions in swimming speeds) but there is little evidence to suggest a reduction in survival. Pelagic species are considered unlikely to be exposed to EMF as they generally swim well above the seafloor and consequently would rarely be exposed even at low levels from subsea power cables (CSA, 2019). All IEFs are therefore deemed to be of high tolerance and adaptability, high recoverability and of local to international importance. The sensitivity of all relevant fish species to temporary changes in electromagnetic fields is therefore, considered to be Low.

6.6.1.74 While there is some change to EMFs in the vicinity of inter-array and offshore export cables, studies indicate that these are limited in extent, with the strength of EMF dissipating quickly with distance (within metres) from the buried cables.

6.6.1.75 **As the Slaney River Valley SAC is 44.54 km from the Proposed Development and the EMF dissipates quickly within metres of the buried cables and the sensitivity of sea lamprey and river lamprey is low to EMF, it is concluded that there is no AEoI on the sea lamprey and river lamprey feature of Slaney River Valley SAC as defined by the COs of the site as a result of EMF from Project Design Option 1.**

6.6.1.76 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Freshwater pearl mussels

6.6.1.77 The conservation objectives for freshwater pearl mussels at this designated site is to restore the favourable conservation condition of the feature, this is defined and presented in Table 5.1.

6.6.1.78 There are three key potential impacts on freshwater pearl mussels associated with construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.23 and are assessed below.

6.6.1.79 Freshwater pearl mussels is of consideration at this site as within the first year of their life cycle, they live on the gills of either young Atlantic salmon or Brown trout (Moorkens, 1999). As the viability of the mussel population is inherently linked to the viability of the salmon population, it is considered that the maximum potential effect from the Proposed Development on freshwater pearl mussel will be the same as that considered for Atlantic salmon, and the conclusions made to the salmon population will mirror those for freshwater pearl mussel.

6.6.1.80 **As it was concluded that there would be no AEoI for Atlantic salmon from all potential impacts, the same is concluded for freshwater pearl mussels and therefore there is no AEoI on the freshwater pearl mussel feature of Slaney River Valley SAC as defined by the COs of the site as a result of all potential impacts from Project Design Option 1.**

6.6.1.81 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.6.2 River Barrow and River Nore SAC

Twaite Shad

6.6.2.1 The conservation objectives for twaite shad at this designated site is to restore the favourable conservation condition of the feature, this is defined and presented in Table 5.1.

6.6.2.2 There are two key potential impacts on twaite shad associated with construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.23 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, and changes in EMF.

6.6.2.3 With consideration that the impact severity is based on distance from the site of works, Slaney River Valley SAC (44.54 km) is designated for the same QIs as River Barrow and River Nore SAC (109.6 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.6.1 it has been concluded that none of the potential effects on twaite shad would result in an AEoI of the QIs.

6.6.2.4 **Therefore, there is no AEoI on the twaite shad feature of River Barrow and River Nore SAC as defined by the COs of the site as a result of any of the impacts considered above from Project Design Option 1.**

6.6.2.5 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Atlantic salmon

6.6.2.6 The conservation objectives for Atlantic salmon at this designated site is to restore the favourable conservation condition of the feature, this is defined and presented in Table 5.1.

6.6.2.7 There are two key potential impacts on Atlantic salmon associated with construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.23 and are assessed below for each phase of the Proposed Development. These comprise Injury and/ or disturbance from underwater noise caused by piling and construction activities, and changes in EMF.

6.6.2.8 With consideration that the impact severity is based on distance from the site of works, Slaney River Valley SAC (44.54 km) is designated for the same QIs as River Barrow and River Nore SAC (109.6 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.6.1, it has been concluded that none of the potential effects on Atlantic salmon would result in an AEoI of the QIs.

6.6.2.9 **Therefore, there is no AEoI on the Atlantic salmon feature of River Barrow and River Nore SAC, as defined by the COs of the site, as a result of any of the impacts considered above from Project Design Option 1.**

6.6.2.10 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Sea lamprey and River lamprey

6.6.2.11 The conservation objectives for sea lamprey and river lamprey at this designated site is to restore the favourable conservation condition of the feature, this is defined and presented in Table 5.1.

6.6.2.12 There are two key potential impacts on sea lamprey and river lamprey associated with construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.23 and are assessed below for each phase of the Proposed Development. These comprise Injury and/ or disturbance from underwater noise caused by piling and construction activities, and changes in EMF.

6.6.2.13 With consideration that the impact severity is based on distance from the site of works, Slaney River Valley SAC (44.54 km) is designated for the same QIs as River Barrow and River Nore SAC (109.6 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.6.1 it has been concluded that none of the potential effects on sea lamprey and river lamprey would result in an AEoI of the QIs.

6.6.2.14 **Therefore, there is no AEoI on the sea lamprey and river lamprey feature of River Barrow and River Nore SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting from Project Design Option 1.**

6.6.2.15 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Freshwater pearl mussels

6.6.2.16 The conservation objectives for freshwater pearl mussels at this designated site is to restore the favourable conservation condition of the feature, this is defined and presented in Table 5.1.

6.6.2.17 There are two key potential impacts on freshwater pearl mussels associated with construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.23 and are assessed below for each phase of the Proposed Development. These comprise of Injury and/ or disturbance from underwater noise caused by piling and construction activities, and changes in EMF.

6.6.2.18 With consideration that the impact severity is based on distance from the site of works, Slaney River Valley SAC (44.54 km) is designated for the same QIs as River Barrow and River Nore SAC (109.6km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.6.1.80 it has been concluded that none of the potential effects on freshwater pearl mussels would result in an AEoI of the QIs.

6.6.2.19 **Therefore, there is no AEoI on the freshwater pearl mussel feature of River Barrow and River Nore SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting from Project Design Option 1.**

6.6.2.20 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.6.3 Lower River Suir SAC

Twaite Shad

6.6.3.1 The conservation objectives for twaite shad at this designated site is to restore the favourable conservation condition of the feature, this is defined and presented in Table 5.1.

6.6.3.2 There are two key potential impacts on twaite shad associated with construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.23 and are assessed below for each phase of the Proposed Development. These comprise Injury and/ or disturbance from underwater noise caused by piling and construction activities, and changes in EMF.

6.6.3.3 With consideration that the impact severity is based on distance from the site of works, Slaney River Valley SAC (44.54 km) is designated for the same QIs as Lower River Suir SAC (126.51 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.6.1 it has been concluded that none of the potential effects on twaite shad would result in an AEoI of the QIs.

6.6.3.4 **Therefore, there is no AEoI on the twaite shad feature of Lower River Suir SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting from Project Design Option 1.**

6.6.3.5 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Atlantic salmon

6.6.3.6 The conservation objectives for Atlantic salmon at this designated site is to restore the favourable conservation condition of the feature, this is defined and presented in Table 5.1.

6.6.3.7 There are two key potential impacts on Atlantic salmon associated with construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.23 and are assessed below for each phase of the Proposed Development. These comprise Injury and/ or disturbance from underwater noise caused by piling and construction activities, and changes in EMF.

6.6.3.8 With consideration that the impact severity is based on distance from the site of works, Slaney River Valley SAC (44.54 km) is designated for the same QIs as Lower River Suir SAC (126.51 km) and is located nearer to the Proposed Development, it was concluded that the potential for

AEoI is the same or reduced for this site. In Section 6.6.1 it has been concluded that none of the potential effects on Atlantic salmon would result in an AEoI of the QIs.

6.6.3.9 **Therefore, there is no AEoI on the Atlantic salmon feature of Lower River Suir SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting from Project Design Option 1.**

6.6.3.10 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Sea lamprey and River lamprey

6.6.3.11 The conservation objectives for sea lamprey at this designated site is to restore the favourable conservation condition of the feature, this is defined and presented in Table 5.1.

6.6.3.12 There are two key potential impacts on sea lamprey associated with construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.23 and are assessed below for each phase of the Proposed Development. These comprise Injury and/ or disturbance from underwater noise caused by piling and construction activities, and changes in EMF.

6.6.3.13 With consideration that the impact severity is based on distance from the site of works, Slaney River Valley SAC (44.54 km) is designated for the same QIs as Lower River Suir SAC (126.51 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.6.1 it has been concluded that none of the potential effects on sea lamprey would result in an AEoI of the QIs.

6.6.3.14 **Therefore, there is no AEoI on the sea lamprey and river lamprey feature of Lower River Suir SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting from Project Design Option 1.**

6.6.3.15 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Freshwater pearl mussels

6.6.3.16 The conservation objectives for freshwater pearl mussels at this designated site is to restore the favourable conservation condition of the feature, this is defined and presented in Table 5.1.

6.6.3.17 There are two key potential impacts on freshwater pearl mussels associated with construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.23 and are assessed below for each phase of the Proposed Development. These comprise injury and/ or disturbance from underwater noise caused by piling and construction activities, and changes in EMF.

6.6.3.18 With consideration that the impact severity is based on distance from the site of works, Slaney River Valley SAC (44.54 km) is designated for the same QIs as Lower River Suir SAC (126.51 km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.6.1 it has been concluded that none of the potential effects on freshwater pearl mussels would result in an AEoI of the QIs.

6.6.3.19 **Therefore, there is no AEoI on the freshwater pearl mussel feature of Lower River Suir SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting from Project Design Option 1.**

6.6.3.20 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.6.4 River Boyne and River Blackwater SAC

Atlantic salmon

6.6.4.1 The conservation objectives for Atlantic salmon at this designated site is to restore the favourable conservation condition of the feature, this is defined and presented in Table 5.1.

6.6.4.2 There are two key potential impacts on Atlantic salmon associated with construction, operational and maintenance, and decommissioning of the Proposed Development, which are presented in Table 6.23 and are assessed below for each phase of the Proposed Development. These comprise Injury and/ or disturbance from underwater noise caused by piling and construction activities, and changes in EMF.

6.6.4.3 With consideration that the impact severity is based on distance from the site of works, Slaney River Valley SAC (44.54 km) is designated for the same QIs as River Boyne and River Blackwater SAC (99.86km) and is located nearer to the Proposed Development, it was concluded that the potential for AEoI is the same or reduced for this site. In Section 6.6.1 it has been concluded that none of the potential effects on Atlantic salmon would result in an AEoI of the QIs.

6.6.4.4 **Therefore, there is no AEoI on the Atlantic salmon feature of River Boyne and River Blackwater SAC, as defined by the COs of the site, as a result of any of the impacts considered above affecting from Project Design Option 1.**

6.6.4.5 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.6.5 Conclusion of Stage 2 Appraisal for Sites Screened in for Migratory Fish Species QIs

6.6.5.1 Three potential impacts were assessed for migratory fish resulting from construction, operational and maintenance and decommissioning of the Proposed Development, the results of this assessment can be seen in Table 6.26.

Table 6.26: Conclusion for the assessment of potential impacts on sites screened in for migratory fish QIs

Potential impact	Differences between Project Design Option 1 and 2	Conclusion
Injury and/or disturbance from UWN and vibration during pile driving and cable installation	Project Design Option 1 presents a larger risk of underwater noise as a higher number of monopile foundations require installation, therefore, piling will take place over a longer period of time. Underwater noise produced by piling will therefore take place over a longer period of time.	No AEoI for Slaney River Valley SAC, River Barrow and River Nore SAC, Lower River Suir SAC or River Boyne and River Blackwater SAC for any migratory fish receptors
Underwater noise resulting from other activities	No difference between Project Design Option 1 and 2	No AEoI for Slaney River Valley SAC, River Barrow and River Nore SAC, Lower River Suir SAC or River Boyne and River Blackwater SAC for any migratory fish receptors
EMF	No difference between Project Design Option 1 and 2	No AEoI for Slaney River Valley SAC, River Barrow and River Nore SAC, Lower River Suir SAC or River Boyne and River Blackwater

Potential impact	Differences between Project Design Option 1 and 2	Conclusion
		SAC for any migratory fish receptors

6.7 Baseline information to inform Stage 2 AA for Intertidal and Offshore Ornithology QIs

6.7.1.1 As outlined in Section 5.2 above, the following designated sites have continued through the Stage 1 Screening Assessment to be assessed in Stage 2 as a likely significant effect could not be ruled out. These are presented in Figure 6.14.

- Howth Head Coast SPA - Kittiwake
- Ireland's Eye SPA – Guillemot, Herring gull, Kittiwake, Razorbill
- Lambay Island SPA – Guillemot, Herring gull, Kittiwake, Lesser black-backed gull, Razorbill
- Saltee Islands SPA – Gannet, Guillemot, Herring gull, Kittiwake, Lesser black-backed gull, Razorbill
- Skerries Island SPA – Herring gull
- Wicklow Head SPA – Kittiwake

6.7.1.2 Following completion of the screening exercise, the boundary of the Murrough SPA was extended offshore such that the minimum distance between the SPA and the Proposed Development reduced from 10.1 km to 8 km. It is considered that wintering red-throated diver may be displaced within distances of up to 10 km from offshore windfarms (SNCBs 2022). While this would indicate there is potential for the Proposed Development to displace red-throated divers from the area of the SPA within 10 km, given that the designated red-throated diver population is 32 individuals and the site area has been increased from 940 ha to 9,767 ha, of which only a small amount would be within 10 km of the Proposed Development and this would be at the seaward edge in areas expected to be of lower density for this species (which favours areas inshore with shallower depths). It is therefore reasonable to conclude that any resulting change in density of this species within the remainder of the SPA would have an undetectable affect. Therefore, this boundary update does not change the original determination to screen the SPA out for assessment.

6.7.1.3 The Proposed Development does not overlap any of these designated sites. The closest site is Wicklow Head SPA which is a minimum of 5.27 km from the Proposed Development. However, seabirds are highly mobile with large breeding season foraging ranges and so the above sites have been screened in due to potential LSE on the qualifying features caused by the Proposed Development. The Stage 1 screening concluded that there was potential for LSE via displacement risk during construction and operational phase, and collision risk during operational phase.

6.7.1.4 In reaching determinations about which species and SPAs should be screened in, ecological and behavioural aspects were considered in relation to the risks posed by offshore windfarm development to seabirds, specifically collision risk and displacement (within the latter, barrier effects were also considered).

6.7.1.5 Collision risk varies between seabird species in relation to flight characteristics and in particular flight height. For those species which breed at SPAs within their species-specific foraging ranges, the species sensitivity reviews of Garthe and Hüppop (2004); Furness and Wade (2012) and Wade *et al.*, (2016) were used as a coarse filter (i.e. to screen out those species at very low or negligible risk of collisions irrespective of abundance in the Array Area), in combination with the results of surveys of the Array Area (i.e. to further screen out species with non-negligible theoretical collision risks but present in such low numbers that no population level effect would occur). This enabled identification of species and SPA combinations for which a Likely Significant Effect for collision risk could not be ruled out.

6.7.1.6 Displacement risk similarly varies among species, and in general those species at risk of displacement impacts are those not considered at risk of collisions and vice versa. The species sensitivity reviews (Garthe and Hüppop, 2004; Furness and Wade, 2012 and Wade *et al.*, 2016) were used as a coarse filter (i.e. to screen out those species at very low or negligible risk of displacement irrespective of abundance in the Array Area), in combination with the results of surveys of the Array Area (i.e. to further screen out species with non-negligible theoretical displacement risks but present in such low numbers that no population level effect would occur). This enabled identification of species and SPA combinations for which a Likely Significant Effect for displacement risk could not be ruled out.

6.7.1.7 A summary of the site-specific surveys undertaken to inform the Stage 2 appraisal on seabirds is provided in Table 6.27.

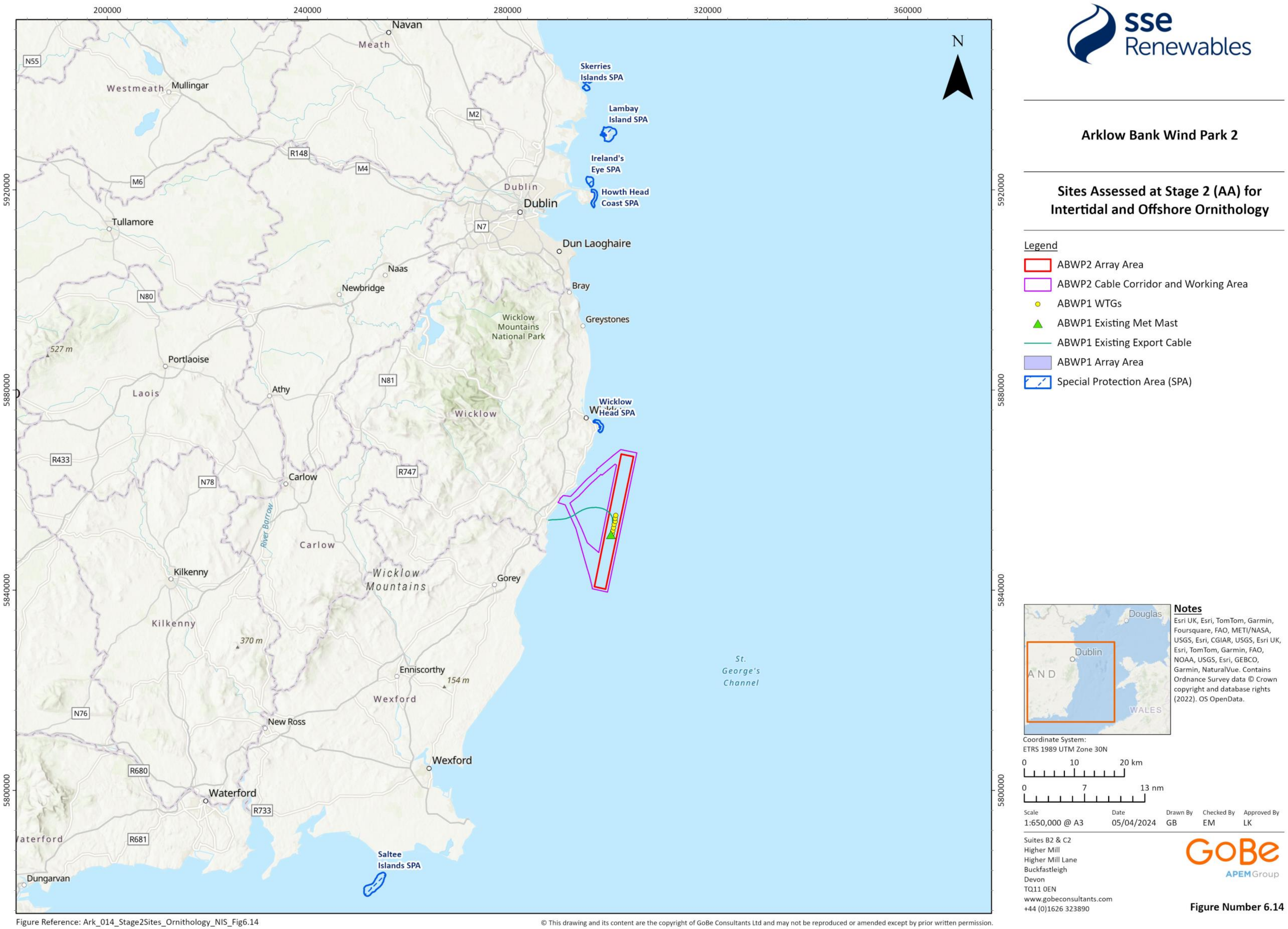

Figure 6.14: Sites assessed at AA for Intertidal and Offshore Ornithology

6.7.2 Baseline Environment

6.7.2.1 A summary of the site-specific surveys undertaken to inform the Stage 2 appraisal on seabirds is provided in Table 6.27.

Table 6.27: Summary of site-specific survey data for seabirds

Data source	Overview of survey	Survey contractor	Date	Reference to further information
Baseline digital aerial survey (DAS)	DAS	HiDef Aerial Surveying Limited	March 2018 to February 2020 (excluding April 2019 plus April 2020)	Volume III, Appendix 12.1 Offshore Ornithology Technical Report - Overview
Intertidal survey of landfall location	Visual and walkover surveys	Dixon Brosnan	November 2019 to March 2020	Volume III, Appendix 12.11 Offshore Ornithology - Onshore Cable Route and Landfall – Baseline Bird Survey.

Digital Aerial Survey (DAS)

6.7.2.2 These surveys were carried out to inform the baseline for the Proposed Development. Aerial digital methods are widely accepted as an appropriate methodology for collecting baseline data for offshore wind development, both in the UK and Ireland (see for example, DCCAE, 2018). Aerial surveys of seabirds (and marine mammals) commenced in March 2018 and continued monthly until February 2020 with an additional month (April 2020) added to cover a missed survey in April 2019 (due to adverse weather). The surveys were conducted by HiDef from an aircraft equipped with four HiDef Gen II cameras with sensors to set resolution of 2 cm ground sample distance (GSD). The transects were completed at a height of ~550 m above sea level (ASL) and a target flight speed of 220 km per hour.

6.7.2.3 The survey comprised 20 transects spaced 2 km apart, extending perpendicularly from the coast to more than 4 km beyond the Proposed Development's seaward boundary (actual distance beyond the seaward boundary varied across the survey, between 5-6 km). The total transect length was approximately 340 km, and viewed imagery gave 10% coverage of the study area (i.e. a strip width of 200 m). Details are provided in Volume III, Appendix 12.1 Offshore Ornithology Technical Report - Overview.

Intertidal Ornithology Survey

6.7.2.4 Six observer-based surveys across the Intertidal Ornithology Study Area were conducted between November 2019 and March 2020 to investigate wintering bird presence and one breeding survey was conducted in July 2020 (Appendix 12.11 Offshore Ornithology Technical report - Onshore Cable Route and Landfall - Baseline Bird Survey). For each wintering bird survey, three counts were made of the coastal waters from vantage points at Arklow town (vantage point A), Johnstown North (Vantage point B) and at Johnstown South (Vantage Point C). At each vantage point (VP), a 180° scan using a 20x telescope and 8x binoculars was made of the inshore waters and adjacent intertidal land and all species of wildfowl, waders and gulls observed were recorded. The breeding seabird survey looked for suitable habitat and signs of seabird breeding (e.g. guano splash on cliff faces etc.)

6.7.2.5 The data collected during these surveys have been used to identify the species present in the intertidal area.

Historical survey data

6.7.2.6 Historical data were reviewed to supplement the recent site-specific surveys. This included data from boat surveys conducted monthly across a portion of the Array Area between July 2000 and June 2010; and aerial surveys of the western Irish Sea conducted in 2016 for the ObSERVE project (Jessopp *et al.*, 2018).

ECOLOGY OF SPECIES SCREENED FOR ASSESSMENT

KITTIWAKE

6.7.2.7 The kittiwake is a small cliff-nesting gull. It breeds in a large number of colonies around the coast of Britain and Ireland. Kittiwake numbers increased dramatically throughout the British Isles between 1900 and 1985, however started to decline during the 1980s in the North of their range, particularly in Shetland, when the local sandeel stock suffered recruitment failure (Mitchell *et al.*, 2004). Numbers have declined considerably since the 1980s, although this decline has been most marked in the north and east (e.g. Shetland) and less severe to the south and west (e.g. England and the west coast of Scotland; Mitchell *et al.*, 2004). The population trend in Ireland between the 1970s and 2000 was largely stable, although a survey conducted in 2015 found a decline of around a third in many colonies and more recent surveys indicate this decline has been maintained (Cummins *et al.*, 2019). Within UK regions, declines have been greatest in SPA populations (of which there are many) (Furness, 2015) because they are the largest colonies and furthermore, food shortage affects breeding success and recruitment at large colonies more than at small ones (Coulson, 2011).

6.7.2.8 Kittiwakes feed on marine invertebrates, small fish (especially sandeels), and fishing vessel waste (mostly fragments of offal and fish as they are unable to swallow large fish). Sandeels are a key prey during the breeding season (Furness and Tasker, 2000; Coulson, 2011) whereas fishery waste is taken mostly during winter (Garthe *et al.*, 1996).

6.7.2.9 Breeding success of kittiwakes colonies can be closely linked with sandeel stock abundance in areas near colonies, especially in the North Sea (Frederiksen *et al.*, 2004, 2005; Cook *et al.*, 2014). Irish Sea kittiwakes may take a more diverse range of fish prey, including sprat, but very little detailed study of diet in this area has been published (Chivers *et al.*, 2012, 2013). Breeding kittiwakes mostly feed close to their colony, although as more tracking studies have been conducted the estimated foraging ranges have increased; the mean foraging range is 55 km, the mean maximum foraging range is 156 km, and the longest foraging range recorded up to 2019 was 770 km (Woodward *et al.*, 2019). Several tracking studies provide evidence on foraging ranges of breeding kittiwakes and winter movements from different populations. Tracking studies by RSPB show that chick-rearing kittiwakes from Flamborough and Filey Coast SPA mainly feed within 50 km of that colony, but sometimes may travel as far as the Dogger Bank to forage (Carroll *et al.*, 2017; Wischnewski *et al.*, 2018).

6.7.2.10 Kittiwakes disperse from colonies in late summer and may migrate from British and Irish colonies as far as Canada, the central North Atlantic, the Bay of Biscay and the Barents Sea. In the nonbreeding season, British and Irish waters hold a mixture of birds from many breeding areas, including Norway and Russia (Frederiksen *et al.*, 2012).

GANNET

6.7.2.11 Gannets are the largest breeding seabird in the British Isles and are able to swallow fish up to at least the size of adult herring and mackerel (Nelson, 1978). As a result, they can feed on a wide range of fish, from sandeels to mackerel and discards from fishing vessels (Nelson 1978; Garthe *et al.*, 1996). They are also aggressive at sea, displacing smaller seabirds from food and so can access discards from fishing vessels more efficiently than other scavenging seabirds (Garthe *et* *al.*, 1996). Gannets dive for fish, often from considerable height, and so can be at risk of collision with wind turbine blades while foraging. Foraging activity is by sight and hence birds do not forage during the dark but spend the night either in the colony or sitting on the sea surface (Nelson, 1978; Hamer *et al.*, 2000; Hamer *et al.*, 2007; Garthe *et al.*, 2012).

6.7.2.12 Gannets breed in a relatively small number of colonies, many of which are very large, and all of which are in locations relatively remote from human disturbance and from predatory mammals.

6.7.2.13 Breeding adults have efficient commuting flight and can travel long distances while searching for food. Numerous tracking studies show foraging ranges of breeding adults and overwinter migrations from many different colonies. Breeding adults tend to remain within a foraging area that is discrete to the individual colony (i.e. birds rarely overlap in foraging distribution with birds from neighbouring colonies; Wakefield *et al.*, 2013). Gannet numbers have increased continuously from 1900 to the present, although the rate of population increase has been slowing in the last few years (Murray *et al.*, 2015). Gannets migrate, with birds from Britain mainly wintering off west Africa and southern Europe, and many of the birds wintering around the British Isles are adults from colonies in Norway or Iceland (Fort *et al.*, 2012; Garthe *et al.*, 2016).

HERRING GULL

6.7.2.14 The herring gull is widespread throughout Britain and Ireland, especially around coasts but also in urban environments. The population in Ireland has more than doubled over the last two decades at natural sites, and indications are that even greater increases have occurred at urban sites (Burnell *et al.* 2023). Most herring gull are either resident year-round or undertake local migration of no more than a few hundred kilometres at most (O'Hanlon *et al.*, 2022). A wide range of habitats are utilised, including marine, intertidal, arable and urban locations, with a shift towards terrestrial and urban sites in the nonbreeding season (O'Hanlon *et al.*, 2022). Herring gulls often fly at turbine rotor height and therefore may be vulnerable to collisions (Johnston *et al.*, 2014).

LESSER BLACK-BACKED GULL

6.7.2.15 The lesser black-backed gull breeds in moderate numbers in Ireland and the population has more than doubled over the last two decades, mostly in coastal areas but also in urban sites and some inland sites such as moorland (Burnell *et al.*, 2023). It is primarily a summer visitor, with most birds migrating to southern Europe or north Africa for the winter (Wernham *et al.*, 2002). Breeding numbers increased considerably during the 20th century, probably in part due to provision of fishery discards (Camphuysen 2013). Male lesser black-backed gulls forage mostly at sea, whereas females forage more in terrestrial habitats (Camphuysen *et al.*, 2015). Habitat use is also seasonal, with greater use of inland foraging early and late in the breeding season, and peak marine foraging activity during chick-rearing (Thaxter *et al.*, 2015). Lesser black-backed gulls sometimes fly at heights that make them vulnerable to collision with turbine blades, especially during the day (Ross-Smith *et al.*, 2016). Although they do not show macro-avoidance (i.e. complete avoidance of entire offshore windfarm areas) of offshore windfarms, tracking data suggest a high level of meso-avoidance of turbines (i.e. birds do not approach close to the rotor blades; Thaxter *et al.* 2018, Johnston *et al.*, 2022).

GUILLEMOT

6.7.2.16 The guillemot is a large auk which breeds throughout the northern temperate and colder parts of the Atlantic, Pacific and adjacent Arctic waters. Two sub-species breed around the British Isles, the dark-mantled nominate race aalge occurs in most of Europe including Scotland and possibly northern England; the smaller, much browner mantled albionis occurs in England, Wales, Ireland, Helgoland, France and Iberia. Guillemots breed widely around the coasts using suitable cliff habitat. They form large colonies typically grouping together along suitable ledges, where they lay a single large egg which is incubated directly on the bare rock.

6.7.2.17 Guillemots catch fish by flying underwater, and in order to do so have relatively small wings to reduce drag in the viscous liquid medium. This results in high wing loading that constrains their ability to fly in the air, and as a consequence they tend to avoid flying due to the relatively high energy costs. When they fly, they tend to fly low over the sea surface, at high speed in a straight line. Therefore, their risk of colliding with offshore wind turbines is low. However, they show displacement from offshore windfarms (Dierschke *et al.*, 2016) and are sensitive to disturbance and displacement by ship traffic (Fliessbach *et al.*, 2019). When breeding, they have to fly out from the colony to forage, and foraging distances from large colonies can be tens of kilometres. However, guillemot chicks fledge when only partly grown, and travel out to sea by swimming, led to foraging areas away from the colony by their male parent. Adults moult rapidly after the breeding season, becoming flightless for a period. It is likely that they select areas with reliable food fish availability for moulting but details of the moult locations used are not yet clear. After the moult, birds move to wintering areas. In general, many guillemots spend the winter not far from their breeding area but dispersed over the sea (Buckingham *et al.*, 2022). There is evidence from maps of guillemot densities at sea that they tend to aggregate to an extent over some shallow sandbanks. The ObSERVE study reported particularly dense areas of guillemots (and razorbills, as the two species were difficult to distinguish) in autumn in the northernmost region of the Irish part of the Irish Sea, with more dispersed observations in summer and winter.

RAZORBILL

6.7.2.18 The razorbill is a large auk which breeds around the North Atlantic. There are two subspecies; nominate A. t. torda breeds in eastern North America, Greenland, Bear Island, White Sea, Norway, Denmark, and Baltic Sea. Subspecies islandica breeds in Iceland, Faroe, British Isles, Germany, and France. Razorbills breed in colonies on cliff ledges, on sea stacks, or under boulders below cliffs. Nest sites differ from those of common guillemots, with razorbill nests more often among boulders and more often scattered rather than in high-density groups. They lay a single egg onto bare rock but will replace lost eggs around 14 days later. While breeding, razorbills forage by diving to catch fish by underwater pursuit, feeding chicks especially on sandeels and sprats, and generally taking smaller fish than caught by common guillemots.

6.7.2.19 British and Irish razorbills generally move south after breeding, wintering from British waters to Iberia including the western Mediterranean (Wernham *et al.*, 2002). However, many British razorbills, especially adults, remain in British waters all year round (Buckingham *et al.* 2022). Rather few foreign-ringed razorbills have been recovered in Britain, but these together with biometrics of tideline corpses indicate that some birds from Scandinavia (from the subspecies torda) winter in British waters and some birds from Iceland do too (Wernham *et al.*, 2002).

6.7.2.20 Razorbills catch fish by flying underwater, and in order to do so have relatively small wings to reduce drag in the viscous liquid medium. This results in high wing loading that constrains their ability to fly in the air, and as a consequence they tend to avoid flying due to the relatively high energy costs. When they fly, they tend to fly low over the sea surface, at high speed in a straight line. Therefore, their risk of colliding with offshore wind turbines is low. However, they show displacement from offshore windfarms (Dierschke *et al.*, 2016) and are sensitive to disturbance and displacement by ship traffic (Fliessbach *et al.*, 2019). When breeding, they have to fly out from the colony to forage, and foraging distances from large colonies can be tens of kilometres. However, razorbill chicks fledge when only partly grown, and travel out to sea by swimming, led to foraging areas away from the colony by their male parent. Adults moult rapidly after the breeding season, becoming flightless for a period. After the moult, birds move predominantly southwards to wintering areas. There is evidence from maps of razorbill densities at sea that they tend to aggregate to an extent over some shallow sandbanks. The ObSERVE study reported particularly dense areas of razorbills (and guillemots, as the two species were difficult to distinguish) in autumn in the northernmost region of the Irish part of the Irish Sea,, with more dispersed observations in summer and winter.

6.7.3 Avoidance through Design and Standard Project Environmental Protection Measures of the Proposed Development

6.7.3.1 The design of the Proposed Development is such that some potential impact can be avoided as seen by applying the design features relevant to intertidal and offshore ornithology receptors which are presented in Table 6.28.

Table 6.28: Project design and environmental protection measures relevant for intertidal and offshore ornithology receptors

Measure	Justification
Impact avoidance/ reduction through an Environmental Management Plan (EMP) which has been prepared and will be implemented during the construction, operational and maintenance and decommissioning phases of the Proposed Development. The RWMP include mitigation/monitoring measures and commitments made within the EIAR and a Marine Pollution Contingency Plan (MPCP) which will include key emergency contact details (e.g. EPA). An EMP is included in Volume III, Appendix 25.1: Environmental Management Plan.	Measures will be implemented to ensure that the potential for release of pollutants from construction, operational and maintenance, and decommissioning plant is minimised. These include: Storage of chemicals in secure designated area in line with appropriate regulations and guidelines; Double skinning of pipes and tanks containing hazardous substances; Storage of these substances in impenetrable bunds; Working vessels will handle all wastes in accordance with International Maritime Organisation (IMO) requirements and in accordance with the requirements of national legislation (i.e. Sea Pollution Acts 1991 to 1999; Sea Pollution (Miscellaneous Provisions) Act 2006) as applicable; All waste and/or litter, including potential pollutants produced during construction and/or operation of the windfarm will be stored and returned to shore for authorised disposal at suitable facilities; and Vessel refuelling will take place in port or under permit from the Irish Coast Guard. In this manner, accidental release of contaminants from vessels will be strictly controlled, thus providing protection for marine life across all phases of the Proposed Development. Any accidental pollution of the marine environment will be immediately reported to the Irish Coastguard and to any other local authorities who are likely to be affected by such pollution.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339)	The Developer was granted a Foreshore Licence (FS007339) for Site Investigations (associated with the Proposed Development) from the Minister for Housing, Local Government and Heritage in May 2022. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the

Measure	Justification
	Foreshore Licence for Site Investigations (FS007339) being carried out. As such there is no temporal overlap between the activities consented in this Foreshore Licence and the Proposed Development and there will be no potential for cumulative effects.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried	The Developer submitted a Foreshore Licence Application for Site Surveys to the Minister for Housing, Local Government and Heritage in April 2023 (FS007555) and this application is pending determination. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried out. As such there is no temporal overlap between the activities proposed in the Foreshore Licence Application and the Proposed Development.
Maximum number of wind turbines of 56.	The number of wind turbines has been refined to minimise the potential collision risk impacts (see Chapter 4: Consideration of Alternatives).
Minimum lower blade tip height of 37 m above LAT	Minimises potential seabird collision risks since the abundance of birds decreases with increasing height above the sea surface.

6.7.4 Impacts and Parameters Assessed

6.7.4.1 Both Project Design Options identified in Table 6.29 have the potential to result in AEoI on intertidal and offshore ornithology receptors.

6.7.4.2 Note that Project Design Option 1 has two variants (identified as WTG Model 1a and 1b) which differ only in the blade chord width and the average rotation speed. As these parameters can result in different predicted collision risks both WTG Model 1a and 1b have been assessed, as well as for WTG Model 2.

Table 6.29: Project Design Options 1 and 2 considered for the assessment of potential impacts on intertidal and offshore ornithology receptors

Potential impact	Phase C	Phase O	Phase D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
Disturbance and displacement	✓	✓	✓	Project Design Option 1 **Construction Phase:** Disturbance and displacement from construction activity, including increased vessel and helicopter activity: • Installation of 56 Wind Turbine Generators (WTGs) and 2 OSPs within the Array Area; • Maximum of 1 foundation installed at any one time (within any 24 hour period); • Maximum of 69 installation vessels in the Array Area at any one time (including 12 installation vessels along the offshore Cable Corridor and Working Area at any one time, and maximum of 7 installation vessels in the vicinity of the landfall at any one time); • Maximum of 3 helicopters in the Array Area at any one time; and • Maximum construction schedule of 24 hours a day, 7 days a week for a maximum construction period of 5 years. Within this period, offshore export cable installation may take place over a period of 12 months. **Operational and maintenance phase:** Disturbance and displacement from operational and maintenance activity, including increased vessel and helicopter activity: • Presence of 58 (i.e. 56 x WTG + 2 x OSP) monopile foundations with base diametre between 7 – 11 m for WTGs and 7-14 m for OSPs and associated scour protection; • Presence of associated cable protection for between 110 – 122 km inter-array cables and between 35 – 40 km offshore export cables. Assumes a maximum of 15% of inter-array cable route, 50% of interconnector and 20% of offshore export cable route may require cable protection; • Minimum spacing of 500 m between turbine blade tips; • A maximum of 1,359 vessel return trips per annum for supporting windfarm operations comprised of crew transfer vessels, jack-up vessels, cable repair vessels and other vessels;	Within the construction phase Project Design Option 1 consists of a larger number of foundations to be installed – 58 monopile foundations in total, whilst Project Design Option 2 comprises of 49 foundations. Therefore, Project Design Option 1 will have a greater potential for Disturbance and Displacement. Within the Operational and Maintenance phase Project Design Option 1 comprises of 56 operational turbines, whilst Project Design Option 2 comprises of 47 operational turbines. Therefore, Project Design Option 1 will have a greater potential for Disturbance and Displacement. Within the Decommissioning Phase Project Design Option 1 will result in the deconstruction and removal of all 56 WTGs, 2 OSPs and associated infrastructure, whilst Project Design Option 2 consists of the deconstruction and complete removal of all 47 WTGs and associated infrastructure. Therefore, Project Design Option 1 will have a greater potential for disturbance and displacement.

Potential impact	Phase C	O	D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
				• A maximum of 485 helicopter movements making return trips per annum for supporting windfarm operations; and Operational phase of 36.5 years. **Decommissioning Phase:** Disturbance is anticipated to be similar in nature but of lower magnitude than during construction.	Therefore, overall Project Design Option 1 has a higher potential for impact than Project Design Option 2.
	✓	✓	✓	Project Design Option 2 **Construction Phase:** Disturbance and displacement from construction activity, including increased vessel and helicopter activity and confirmatory surveys (see Volume I, Supporting Information for Screening for Appropriate Assessment Report) • Installation of 47 WTGs and 2 x OSPs within the Array Area; A maximum of 1 foundation installed at any one time (within any 24 hour period); • A maximum of 69 installation vessels in the Array Area at any one time (including 12 installation vessels along the Cable Corridor and Working Area at any one time, and 7 installation vessels in the vicinity of the landfall at any one time); • A maximum of 3 helicopters in the Array Area at any one time; and • Maximum construction schedule of 24 hours a day, 7 days a week for a maximum construction period of 5 years. Within this period, offshore export cable installation may take place over a period of 12 months. **Operational and Maintenance Phase:** Disturbance and displacement from operational and maintenance activity, including increased vessel and helicopter activity: • Presence of 49 (i.e. 47 x WTG + 2 x OSP) monopile foundations with base diametre between 7 – 11 m for WTGs and 7-14 m for OSPs and associated scour protection; • Presence of associated cable protection for between 110 – 122 km inter-array cables and between 35 – 40 km offshore export cables. Assumes a	

Potential impact	Phase C	Phase O	Phase D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
				maximum of 15% of inter-array cable route, 50% of interconnector and 20% of offshore export cable route may require cable protection; • Minimum spacing of 500 m between turbines; • A maximum of 1,359 vessel return trips per annum for supporting windfarm operations comprised of crew transfer vessels, jack-up vessels, cable repair vessels and other vessels; • A maximum of 485 helicopter movements making return trips per annum for supporting windfarm operations; and • Operational phase of 36.5 years. **Decommissioning Phase:** Disturbance is anticipated to be similar in nature but of lower magnitude than during construction.	
Collision Risk	X	✓	X	Project Design Option 1 **Operational Phase:** • Presence of 56 wind turbines within the Array Area: • Hub height of 155 m above Lowest Astronomical Tide (LAT); • Lower blade tip height of 37 m above LAT; • Upper blade tip height of 273 m above LAT; and • Rotor diametre of 236 m. • Average rotation speed (RPM): 1a = 6.34; 1b = 5.73 Further details are provided in Volume III, Appendix 12.4: Offshore Ornithology: Collision Risk Input Parameters	Collision risk is a function of all the turbine parameters so it is necessary to undertake collision risk modelling to identify impacts for any given design. All options have been assessed.

Potential impact	Phase C	Phase O	Phase D	Project Design Option Assessed (1 and 2)	Parameter Differences Between Project Design Option 1 and 2 (if any)
	X	✓	X	Project Design Option 2 **Operational Phase:** • Presence of 47 wind turbines within the Array Area; • Hub height of 162 m above Lowest Astronomical Tide (LAT); • Lower blade tip height of 37 m above LAT; • Upper blade tip height of 287 m above LAT; and • Rotor diametre of 250 m.	Collision risk is a function of all the turbine parameters so it is necessary to undertake collision risk modelling to identify impacts for any given design. All options have been assessed.

6.8 Assessment of Proposed Development alone for Intertidal and Offshore Ornithology Receptors

6.8.1 Howth Head Coast SPA

COLLISION RISK

Kittiwake

6.8.1.1 The conservation objectives for kittiwake in Howth Head Coast SPA can be found in Table 5.2.

6.8.1.2 See section 6.7.2.7 for a summary of relevant kittiwake ecology.

6.8.1.3 The only potential impacts are present within the Operational and Maintenance phase and so therefore the other phases of development are not considered within this qualifying features assessment.

6.8.1.4 The Howth Head Coast SPA population of kittiwakes at designation was 2,269 AON (apparently occupied nests) which equates to a breeding adult population of 4,538. More recent surveys have reported 1,773 AON (Cummins *et al.*, 2019).

6.8.1.5 The main concern with respect to windfarm impacts for kittiwakes is the risk of collision mortality. Kittiwakes were recorded in the Array Area in all months. Collision mortality predictions were estimated using the stochastic implementation (Caneco et al., 2022) of the Band (2012) Collision Risk Model (CRM). The CRM uses a combination of site specific and generic parameters for seabird flight behaviour, together with turbine parameters, to predict the number of collisions per month (Appendix 12.4). The values advised by statutory conservation agencies for some of the generic seabird parameters have been investigated in recent studies (e.g. Skov et al., 2018; Bowgen and Cook, 2018; Furness et al., 2018) and the results have indicated that the current values are highly likely to be over-estimates and result in overly precautionary results. With respect to kittiwake, there is evidence that the currently recommended flight speed (13.1 m/s) is conservative and therefore an alternative evidence-based value (8.7 m/s) was considered to be more appropriate for use in the current CRM (Skov et al. 2018).

6.8.1.6 Using the evidence-based rates, the total kittiwake breeding season collision estimate for Project Design Option 1a was estimated to be 16.7, for Project Design Option 1b was 18.8 and for Project Design Option 2 was 16.8 (Appendix 12.5 Offshore Ornithology Technical Report – Collision Risk Modelling Results). The total kittiwake nonbreeding season collision estimate for Project Design Option 1a was 170.1, for Project Design Option 1b was 190.3 and for Project Design Option 2 was 172.0 (Appendix 12.5 Offshore Ornithology Technical Report – Collision Risk Modelling Results).

6.8.1.7 The breeding season collision estimates will potentially affect individuals from colonies within range of the Proposed Development, therefore it is necessary to estimate the relative degree of connectivity between the Proposed Development and the SPAs screened into the Stage 2 appraisal. This was undertaken using the apportioning method developed for NatureScot1. This method uses distance, colony size and the area of sea within the foraging range to estimate the relative contribution from each colony under consideration to the at sea abundance recorded at a given location. This calculation also included non-SPA colonies (and SPAs where kittiwakes breed but are not listed as features) to ensure that impacts were apportioned appropriately. This

[1] https://www.nature.scot/doc/interim-guidance-apportioning-impacts-marine-renewable-developments-breeding-seabird-populations#Future+Approaches+to+Apportioning

apportioning used the most recent colony counts where available (e.g. Burnell et al. 2023) in Table 6.30 provides the calculations and outputs from the apportioning tool.

Table 6.30: Estimated proportions of kittiwake from colonies with potential connectivity to the Proposed Development. SPA colonies assessed are highlighted in bold

Colony	Distance to Proposed Development (SPA edge to Proposed Development midpoint, km)	Colony size (AON)	Estimated sea proportion	Calculated colony weight	Apportioned Colony percentage
Lambay SPA	77	3,320	0.55	0.57	13.8
Irelands eye SPA	68	455	0.55	0.10	2.4
Rockabill	89	165	0.7	0.02	0.4
Howth Head SPA	64	1,773	0.55	0.44	10.7
Bray Head	44	873	0.5	0.51	12.2
Wicklow Head SPA	19	773	0.5	2.41	58.1
Saltee Islands SPA	93	1,038	0.7	0.10	2.3

6.8.1.8 The percentage of kittiwakes recorded within the Proposed Development predicted to originate from the Howth Head Coast SPA in the breeding season was 10.7%. Application of this rate to the total breeding season collision predictions indicates that 1.8 (Project Design Option 1a), 2.0 (Project Design Option 1b) and 1.8 (Project Design Option 2) collisions would be apportioned to the SPA.

6.8.1.9 As these collision predictions are derived from at sea survey data, they include all age classes. Kittiwake populations consist of an estimated 53% adults, with the remaining 47% distributed among sub-adult age classes (Furness, 2015). Thus, applying these age class proportions, the Howth Head Coast SPA adult collisions in the breeding season would be between 0.9 and 1.0.

6.8.1.10 The nonbreeding season total kittiwake collision estimates, summing the autumn and spring BDMPS periods, were 170.1 (Project Design Option 1a), 190.3 (Project Design Option 1b) and 172.0 (Project Design Option 2). During the nonbreeding season, kittiwakes disperse from their colonies and migrate to overwintering areas on both sides of the North Atlantic. Thus, a considerable number of birds from colonies around the Irish Sea and from further north (e.g. Scotland, Norway and Russia) will pass through or be resident in the Irish Sea (Frederiksen *et al.*, 2012). Frederiksen *et al.* (2012) analysed tracking data from a wide range of colonies and estimated their non-breeding season movements. The Proposed Development is within the region Frederiksen *et al.* (2012) identified as the Celtic Seas and Biscay. This comprised birds from British and Irish colonies (55%) and North Sea, Norwegian and Russian colonies (45%). Thus, to estimate the wintering population and thereby estimate the proportion originating from any given breeding colony, the breeding numbers at colonies within this region were summed (using counts from Burnell *et al.*, 2023 to ensure contemporary values were used). This yielded a total British and Irish population (all age classes) with connectivity to the Celtic Seas and Biscay region of 230,008. Allowing for Norwegian and Russian birds (at 45%) this total was estimated to be 418,196 (Table 6.31). Alternatively, the biologically defined minimum population scale

(BDMPS) estimated by Furness (2015) for the UK Western Waters (which includes the Irish Sea) was 801,556 (autumn and spring average). Adjusting this figure to incorporate colonies along the Irish coast of the Irish Sea a revised figure of 818,181 was obtained. Thus, the nonbreeding kittiwake population was estimated to lie within a range from 418,196 and 818,181.

Table 6.31: British and Irish kittiwake colonies associated with the Celtic Seas and Biscay nonbreeding region (as defined by Frederiksen et al., 2012) and estimated total nonbreeding population

County	Region	AON (Burnell *et al.* 2023)	Adults (AON x 2)	Immatures (@ 47%)	Total
Ireland	Antrim	16,202	32,404	28,736	61,140
Ireland	Down	656	1,312	1,163	2,475
Ireland	Dublin	5,713	11,426	10,132	21,558
Ireland	Wicklow	1,646	3,292	2,919	6,211
Ireland	Wexford	1,038	2,076	1,841	3,917
Ireland	Waterford	883	1,766	1,566	3,332
Ireland	Cork	1,579	3,158	2,800	5,958
Wales	West Glamorgan	101	202	179	381
Wales	Dyfed	2,155	4,310	3,822	8,132
Wales	Gwynedd	2,526	5,052	4,480	9,532
England	Lancashire	220	440	390	830
England	Cumbria	809	1,618	1,435	3,053
Isle of Man	-	685	1,370	1,215	2,585
England	Dorset	17	34	30	64
England	Cornwall	736	1,472	1,305	2,777
England	Devon	707	1,414	1,254	2,668
Scotland	Wigtown	444	888	787	1,675
Scotland	Ailsa Craig	490	980	869	1,849
Scotland	Sutherland	9,819	19,638	17,415	37,053
Scotland	Argyll and Bute	4,767	9,534	8,455	17,989
Scotland	Lochaber	2,145	4,290	3,804	8,094
Scotland	Skye and Lochalsh	1,327	2,654	2,354	5,008
Scotland	Western Isles	6,287	12,574	11,151	23,725
Total associated with Irish Sea colonies		60,952	121,904	108,104	230,008

County	Region	AON (Burnell *et al.* 2023)	Adults (AON x 2)	Immatures (@ 47%)	Total
Inc. Russia/Norway/North Sea (@45%)					418,196

6.8.1.11 Of the total nonbreeding season collisions, the proportion originating from the Howth Head Coast SPA population was estimated to be between 0.43% and 0.85% (3,546 adults divided into 818,181 and 418,196). Thus, maximums of 1.4 (Project Design Option 1a), 1.6 (Project Design Option 1b) and 1.5 (Project Design Option 2) of the nonbreeding collisions would be apportioned to the Howth Head Coast SPA.

6.8.1.12 Thus, summing the breeding season (0.9, 1.0 and 0.9) and nonbreeding season (1.4, 1.6 and 1.5) collision estimates, the maximum annual mortality for Howth Head Coast SPA would be 2.3 (Project Design Option 1a), 2.6 (Project Design Option 1b) and 2.4 (Project Design Option 2) adults.

6.8.1.13 The background adult mortality rate for kittiwake is 0.146 per annum (Horswill and Robinson 2015), which indicates that the natural mortality for the SPA population using the most recent count (1,773 AON, Cummins *et al.*, 2019) would be 518. Addition of 2.2, 2.6 or 2.4 adults to these would increase the background rate of the designated population by 0.44 to 0.50%. The threshold below which increases in background mortality are considered to be undetectable against natural variations is 1% (Parker *et al.*, 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold (in this case around 0.44 to 0.50% rather than 1%), even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.1.14 **Therefore, on this basis there will be no AEoI on the kittiwake feature of Howth Head Coast SPA, as defined by the Cos of the site, as a result of collision effects considered above, from Project Design Option 1.**

6.8.1.15 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.8.2 Ireland's Eye SPA

Kittiwake

6.8.2.1 The conservation objective for kittiwake in Ireland's Eye SPA can be found in Table 5.2.

6.8.2.2 See section 6.7.2.7 for a summary of relevant kittiwake ecology.

6.8.2.3 The only potential impacts are present within the Operational and Maintenance phase and so therefore the other phases of development are not considered within this qualifying features assessment.

6.8.2.4 The Ireland's Eye SPA population of kittiwake at designation was 941 AON which equates to a breeding adult population of 1,882. More recent surveys have reported 455 AON (Burnell *et al.*, 2023).

6.8.2.5 Using the evidence-based rates, the total kittiwake breeding season collision estimates for Project Design Option 1a was 16.7, for Project Design Option 1b was 18.8 and for Project Design Option 2 was 16.8. The total kittiwake nonbreeding season collision estimates for Project Design Option 1a was 170.1, for Project Design Option 1b was 190.3 and for Project Design Option 2 was 172.0.

6.8.2.6 The percentage of kittiwake on the Proposed Development predicted to originate from Ireland's Eye SPA in the breeding season was 2.4% (Table 6.30). Application of this rate to the total breeding season collision predictions indicated that 0.4 (Project Design Option 1a, Project Design Option 1b and Project Design Option 2) collisions would be apportioned to the SPA.

6.8.2.7 As these collision predictions are derived from at sea survey data, they include all age classes. Kittiwake populations consist of an estimated 53% adults, with the remaining 47% distributed among sub-adult age classes (Furness, 2015). Thus, using these age class proportions the Ireland's Eye SPA adult collisions in the breeding season would be 0.2.

6.8.2.8 The nonbreeding season total kittiwake collision estimates, summing the autumn and spring BDMPS periods, were 170.1 (Project Design Option 1a), 190.3 (Project Design Option 1b) and 172.0 (Project Design Option 2). The proportion originating from the Ireland's Eye SPA population was estimated to be between 0.11% and 0.22% (910 adults divided into 818,181 and 418,196; Table 6.31). Thus, a maximum of 0.4 (Project Design Option 1a, Project Design Option 1b and Project Design Option 2) of the nonbreeding collisions would be apportioned to the Ireland's Eye SPA.

6.8.2.9 Thus, summing the breeding season (0.2) and nonbreeding season (0.4) collision estimates, the annual mortality for Ireland's Eye SPA would be 0.6 adults (for all Options).

6.8.2.10 The background adult mortality rate for kittiwake is 0.146 per annum (Horswill and Robinson 2015), which indicates that the natural mortality for the SPA population using the most recent count (455 AON, Cummins *et al.*, 2019) would be 133. Addition of 0.6 adults to these would increase the background mortality rate of the designated population by 0.42 to 0.46%. The threshold below which increases in background mortality are considered to be undetectable against natural variations is 1% (Parker *et al.*, 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.2.11 **Therefore, on this basis there will be no AEoI on the kittiwake feature of Ireland's Eye SPA, as defined by the Cos of the site, as a result of collision effects considered above, from Project Design Option 1.**

6.8.2.12 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Herring gull

6.8.2.13 The conservation objective for herring gull in Ireland's Eye SPA can be found in Table 5.2.

6.8.2.14 See section 6.7.2.14 for a summary of relevant herring gull ecology.

6.8.2.15 The only potential impacts are present within the Operational and Maintenance phase and so therefore the other phases of development are not considered within this qualifying features assessment.

6.8.2.16 The Ireland's Eye SPA population of herring gull at designation was 250 pairs which equates to a breeding adult population of 500. More recent surveys have reported 318 AON (Burnell et al., 2023).

6.8.2.17 Herring gull collisions were only predicted to occur in two months, February and November, with none in the breeding season, therefore there is no breeding season connectivity of relevance between the Ireland's Eye SPA and the Proposed Development.

6.8.2.18 The total nonbreeding season collisions (i.e. not apportioned among SPA colonies) was 1.3 (Project Design Option 1a), 1.5 (Project Design Option 1b) and 1.3 (Project Design Option 2). The most recent estimate of the herring gull population from Northern Irish and Irish colonies with connectivity to the Irish Sea (from Antrim to Waterford) is 8,635 AON (Burnell et al. 2023). Birds from Ireland's Eye SPA would make up 3.7% of this population, therefore 3.7% of the total collisions would equate to 0.05 individuals. The adult mortality rate for herring gull is 0.166 (Horswill and Robinson 2015). The background mortality of herring gull from Ireland's Eye SPA would therefore be 105 individuals. Addition of the apportioned mortality to this would increase the rate by 0.05% which would be undetectable against background variations (Parker et al. 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.2.19 **Therefore, on this basis there will be no AEoI on the herring gull feature of Ireland's Eye SPA, as defined by the COs of the site, as a result of collision effects considered above, from Project Design Option 1.**

6.8.2.20 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Guillemot

6.8.2.21 The conservation objective for guillemot in Ireland's Eye SPA can be found in Table 5.2.

6.8.2.22 See section 6.7.2.16 for a summary of relevant guillemot ecology.

6.8.2.23 The Ireland's Eye SPA population of guillemots at designation was 2,191 individuals. More recent surveys have reported 4,410 (Burnell et al., 2023).

6.8.2.24 Guillemots fly close to the sea surface and are therefore at very low risk of collisions. However, there is evidence that guillemots have lower densities within windfarms than outside, and therefore some displacement appears to occur (Dierschke et al., 2016). It is not clear to what extent this may affect individuals or populations, since this depends on the importance of the site (e.g. habitat quality) and the extent of alternative suitable habitat. The approach to estimating displacement impacts for UK offshore windfarms is based on a matrix formulation, with estimates of the percentage of birds predicted to be displaced on one axis and the percentage which may suffer consequent mortality on the other. Natural England and NatureScot differ in the predicted rates of displacement and mortality recommended for assessing potential impacts on auks. Natural England assume there would be 100% displacement of auks within the 2 km buffer surrounding the cable laying vessel combined with consequent mortalities for displaced birds between 1% and 10%. In contrast, NatureScot, with respect to displacement from Array Areas, recommend an auk displacement rate of 60% and consequent mortality (for displaced individuals) of 1-3% in the nonbreeding season and 3-5% in the breeding season. MacArthur Green (2019) undertook a review of available evidence for auk displacement which concluded that precautionary rates of displacement and mortality from operational windfarms would be 50% and 1% respectively. These figures are also considered suitably precautionary for the potential displacement around construction vessels. Therefore, the assessment presents estimates using a 60% displacement rate and a 1% mortality rate in order to ensure the assessment conclusions are conservative in this regard. The guillemot breeding season was defined as April to August, with all other months treated as nonbreeding.

6.8.2.25 There are three SPAs within the mean maximum foraging range of the Proposed Development; Ireland's Eye, Lambay Island and Saltee Islands, and small numbers of guillemots breed at some non-SPA colonies. The relative contribution from each main colony to the breeding season population on the Proposed Development was estimated using the NatureScot apportioning method1 (Table 6.32). It should be noted that although the Wicklow Head population has been included in this table, this population is not a designated feature and therefore is not assessed in this NIS. However, it has been included in order that impacts on the SPA populations are not over-estimated. This apportioning could potentially include other non-SPA populations of guillemot therefore the current estimates are considered precautionary as they may over-estimate the contributions from SPA populations.

Table 6.32: Estimated proportions of guillemot from colonies with potential connectivity to the Proposed Development. SPA colonies assessed are highlighted in bold

Colony	Distance to Proposed Development (SPA edge to Proposed Development midpoint, km)	Colony size (Individuals)	Estimated sea proportion	Calculated colony weight	Apportioned Colony percentage
Lambay SPA	77	59,983	0.55	0.55	64.6
Ireland's eye SPA	68	4,410	0.55	0.05	6.1
Wicklow Head SPA	19	737	0.5	0.12	14.3
Saltee Islands SPA	93	25,851	0.7	0.13	15.0

6.8.2.26 On the basis of the apportioning, 6.1% of the adult guillemots recorded on the Proposed Development in the breeding season would be predicted to originate from Ireland's Eye SPA.

CONSTRUCTION

6.8.2.27 In order to calculate the number of guillemots that potentially would be at risk of displacement from the Cable Corridor and Working Area during the cable laying process, the density of this species in the Cable Corridor and Working Area (corridor 1 and corridor 2) was estimated from the site-specific surveys carried out for the Proposed Development (Volume III, Appendix 12.1: Offshore Ornithology Technical Rep–rt - Overview).

6.8.2.28 During the breeding season (March to July), the seasonal peak density in corridor 1 was 2.9 birds/ km^2 and in corridor 2 was 3.3 birds/ km^2. Within a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), 22 individuals (2.9 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 25 (3.3 x 12.56 x 60%) along corridor 2, 47 in total. This means that, across all populations, 0.47 individuals (1%) would be at risk of mortality due to cable installation, of which 6.1% (0.03 individuals) would be at risk from Ireland's Eye SPA.

6.8.2.29 During the nonbreeding season (August to February), the seasonal peak density in corridor 1 was 27.3 birds/ km^2 and in corridor 2 was 12.6 birds/ km^2. Within a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), 206 individuals (27.3 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 95 (12.6 x 12.56 x 60%) along corridor 2, 301 in total. This means that, across all populations, 3 individuals (1%) would be at risk of mortality due to cable installation.

6.8.2.30 During the nonbreeding season, guillemots disperse from their colonies to overwintering areas. Thus, a considerable number of birds from colonies around the Irish Sea will pass through, or be present in, the Irish Sea. Using just the colony estimates from the last comprehensive survey (Burnell et al. 2023), the total population with high connectivity to the Irish Sea was estimated as 563,371 (Table 6.33). Alternatively, the biologically defined minimum population scale (BDMPS) estimated by Furness (2015) for the UK Western Waters (which includes the Irish Sea) was 1,139,220. Adjusting this figure to incorporate colonies along the Irish coast of the Irish Sea a revised figure of 1,567,463 was obtained. Thus, the nonbreeding guillemot population was estimated to lie within a range from 563,371 and 1,567,463.

Table 6.33: British and Irish guillemot colonies associated with the Irish Sea nonbreeding region and estimated total nonbreeding population

County	Region	Adults	Immatures (@ 43%)	Total
Ireland	Antrim	155,890	67,033	222,923
Ireland	Dublin	65,264	28,064	93,328
Ireland	Wicklow	2,150	925	3,075
Ireland	Wexford	25,851	11,116	36,967
Ireland	Waterford	1,595	686	2,281
Ireland	Cork	6,413	2,758	9,171
Wales	West Glamorgan	169	73	242
Wales	Dyfed	68,574	29,487	98,061
Wales	Gwynedd	35,994	15,477	51,471
England	Cumbria	17,501	7,525	25,026
Isle of Man	-	5,219	2,244	7,463
Scotland	Wigtown	2,206	949	3,155
Scotland	Ailsa Craig	7,140	3,070	10,210
Total associated with Irish Sea colonies		393,966	169,405	563,371

6.8.2.31 Of the total nonbreeding season mortalities, the proportion originating from the Ireland's Eye SPA population was estimated to be between 0.28% and 0.78% (4,410 adults divided into 1,567,463 and 563,371). Thus, a maximum of 0.02 of the nonbreeding construction displacement mortalities would be apportioned to the Ireland's Eye SPA.

6.8.2.32 Thus, summing the breeding season (0.03) and nonbreeding season (0.02) construction displacement mortalities, the potential annual mortality on the Ireland's Eye SPA guillemot population would be 0.05 adults.

6.8.2.33 The background adult mortality rate for guillemot is 0.061 (Horswill and Robinson, 2015), which indicates that the natural mortality for this SPA population would be 269 individuals (4,410 x 0.061). Addition of a maximum of 0.05 individuals to this would increase the background rate by 0.02%. This is a very small increase and would be undetectable against natural variations. The threshold below which increases in background mortality are considered to be undetectable against natural variations is 1% (Parker et al. 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.2.34 **Therefore, on this basis there will be no AEoI on the guillemot feature of Ireland's Eye SPA, as defined by the COs of the site, as a result of construction displacement effects considered above, from Project Design Option 1.**

6.8.2.35 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL

6.8.2.36 The assumption for guillemots is that displacement from windfarms occurs at a constant level to a distance of 2 km in line with guidance (SNCBs 2022) and that within this area, 30% to 70% of birds will be displaced and mortality of displaced birds will be between 1% and 10%.

6.8.2.37 Empirical evidence indicates that auk (guillemots and razorbills) displacement from windfarms is likely to be lower than 70%, although pre- and post-construction monitoring data have yielded variable results. Auks may be displaced to some extent by some windfarms, although displacement is partial and apparently negligible in some sites (Dierschke et al., 2016). Several studies have reported displacement: guillemots were displaced at Blighbank (Vanermen et al., 2012) and German offshore windfarms (Peschko et al. 2020, 2024), were displaced only in a minority of surveys at two Dutch windfarms (OWEZ and Princess Amalia Windpark (PAWP); Leopold et al., 2011; Krijgsveld et al., 2011), and were not significantly displaced at Horns Rev (although the data suggest that slight displacement was probably occurring; Petersen et al., 2007) or Thornton Bank (Vanermen et al., 2012). However, while at least some of these studies have recorded changes in abundance and reported these as displacement, these results should be treated with caution due to limits on their power to distinguish natural inter-annual variation from windfarm effects, as noted in recent re-evaluation of some of these studies (Zuur 2018).

6.8.2.38 The 10% mortality rate for auks is unconfirmed and this magnitude of impact is not supported in the literature. Given that this exceeds the existing natural adult annual mortality for guillemot from all other sources of mortality (baseline mortality is 6.1%; Horswill and Robinson 2015), it is highly improbable that such an effect would occur. Mortality due to displacement might arise if displacement increased competition for resources in the remaining areas of auk habitat outside the windfarm. However, it should be recognised that the mortality rate due to displacement may well be 0% since the increase in density of auks outside the windfarm area will be negligible (because the rest of the available habitat is vast) and is very unlikely to be as high as 10%.

6.8.2.39 MacArthur Green (2019) undertook a review of available evidence for auk displacement and concluded that precautionary rates of displacement and mortality from operational windfarms would be 50% and 1% respectively. Thus, this assessment presents displacement in the range from 30% displaced and 1% mortality to 70% displaced and 10% mortality, with a focus on the evidence-based rates of 50% displaced and 1% mortality.

6.8.2.40 During the breeding season (March to July), the seasonal peak abundance in the Array Area and 2 km buffer was 3,033 birds. Thus, in total, between 9 (30% displaced and 1% mortality) and 212 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence-based prediction of 15 (50% displaced and 1% mortality). Of these, 6.1% (Table 6.32) which equate to 0.55, 0.91 and 13 individuals at the respective rates, would be at risk from Ireland's Eye SPA.

6.8.2.41 During the nonbreeding season (August to February), the seasonal peak abundance in the Array Area and 2 km buffer was 5,079 birds. Thus, in total, between 15 (30% displaced and 1% mortality) and 356 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence-based prediction of 25 (50% displaced and 1% mortality). Of these, 0.028% to 0.78% (Table 6.33) which equate to maximums of 0.1, 0.2 and 2.8 individuals at the respective rates, would be at risk from Ireland's Eye SPA.

6.8.2.42 Thus, summing the breeding season (0.55, 0.91, 13) and nonbreeding season (0.1, 0.2, 2.8) operational displacement mortalities, the potential annual mortality on the Ireland's Eye SPA guillemot population would be 0.65, 1.1 and 15.8 adults, respectively.

6.8.2.43 The background adult mortality rate for guillemot is 0.061 (Horswill and Robinson, 2015), which indicates that the natural mortality for this SPA population would be 269 individuals (4,410 x 0.061). Addition of individuals subject to displacement mortality would increase the background rate by 0.2%, 0.4% and 5.8%. While the most precautionary displacement rates result in an increase in background mortality above the 1% threshold of detectability (Parker et al. 2022), this is not the case at the evidence-based rates (50% displaced and 1% mortality). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.2.44 **Therefore, on this basis there will be no AEoI on the guillemot feature of Ireland's Eye SPA, as defined by the COs of the site, as a result of operational displacement effects considered above, from Project Design Option 1.**

6.8.2.45 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Razorbill

6.8.2.46 The conservation objective for razorbill in Ireland's Eye SPA can be found in Table 5.2.

6.8.2.47 See section 6.7.2.18 for a summary of relevant razorbill ecology.

6.8.2.48 The Ireland's Eye SPA population of razorbill at designation was 522 individuals. More recent surveys have reported 1,600 (Burnell et al., 2023).

6.8.2.49 Razorbills fly close to the sea surface and are therefore at very low risk of collisions. However, there is evidence that razorbills have lower densities within windfarms than outside, and therefore some displacement appears to occur (Dierschke et al., 2016). It is not clear to what extent this may affect individuals or populations, since this depends on the importance of the site (e.g. habitat quality) and the extent of alternative suitable habitat. The approach to estimating displacement impacts for UK offshore windfarms is based on a matrix formulation, with estimates of the percentage of birds predicted to be displaced on one axis and the percentage which may suffer consequent mortality on the other. Natural England and NatureScot differ in the predicted rates of displacement and mortality recommended for assessing potential impacts on auks. Natural England assume there would be 100% displacement of auks within the 2 km buffer surrounding the cable laying vessel combined with consequent mortalities for displaced birds between 1% and 10%. In contrast, NatureScot, with respect to displacement from Array Areas, recommend an auk displacement rate of 60% and consequent mortality (for displaced individuals) of 1-3% in the nonbreeding season and 3-5% in the breeding season. MacArthur Green (2019) undertook a review of available evidence for auk displacement which concluded that precautionary rates of displacement and mortality from operational windfarms would be 50% and 1% respectively. These figures are also considered suitably precautionary for the potential displacement around construction vessels. Therefore, the assessment presents estimates using a 60% displacement rate and a 1% mortality rate in order to ensure the assessment conclusions are conservative in this regard. The razorbill breeding season was defined as April to July, autumn migration is defined as August to October, winter as November and December and spring migration as January to March.

6.8.2.50 There are three SPAs within the mean maximum foraging range of the Proposed Development; Ireland's Eye, Lambay Island and Saltee Islands, and small numbers of razorbills breeding at some non-SPA colonies. The relative contribution from each main colony to the breeding season population on the Proposed Development was estimated using the NatureScot apportioning method1 (Table 6.34). It should be noted that although the Wicklow Head population has been included in this table, this population is not a designated feature and therefore is not assessed in this NIS. However, it has been included in order that impacts on the SPA populations are not over-estimated. This apportioning could potentially include other non-SPA populations of razorbill therefore the current estimates are considered precautionary as they may over-estimate the contributions from SPA populations.

Table 6.34: Estimated proportions of razorbill from colonies with potential connectivity to the Proposed Development. SPA colonies assessed are highlighted in bold

Colony	Distance to Proposed Development (SPA edge to Proposed Development midpoint, km)	Colony size (Individuals)	Estimated sea proportion	Calculated colony weight	Apportioned Colony percentage
Lambay SPA	77	7,353	0.55	0.71	45.3
Ireland’s Eye SPA	68	1,600	0.55	0.20	12.6
Wicklow Head SPA	19	184	0.5	0.32	20.5
Saltee Islands SPA	93	6,519	0.7	0.34	21.6

6.8.2.51 On the basis of the apportioning, 12.6% of the adult razorbills recorded on the Proposed Development in the breeding season would be predicted to originate from Ireland’s Eye SPA.

6.8.2.52 During the nonbreeding seasons, razorbills disperse from their colonies to overwintering areas. Thus, a considerable number of birds from colonies around the Irish Sea will pass through, or be present in, the Irish Sea. Using the colony estimates from the last comprehensive survey (Burnell et al. 2023), the total population with high connectivity to the Irish Sea was estimated as 96,268 (Table 6.35). Alternatively, the biologically defined minimum population scale (BDMPS) estimated by Furness (2015) for the UK Western Waters (which includes the Irish Sea) was 518,417 (autumn, winter and spring average). Adjusting this figure to incorporate colonies along the Irish coast of the Irish Sea a revised figure of 554,179 was obtained. Thus, the nonbreeding razorbill population was estimated to lie within a range from 96,268 and 554,179.

Table 6.35: British and Irish razorbill colonies associated with the Irish Sea nonbreeding region and estimated total nonbreeding population

County	Region	Adults	Immatures (@ 43%)	Total
Ireland	Antrim	24,730	10,634	35,364
Ireland	Dublin	9,232	3,970	13,202
Ireland	Wicklow	184	79	263
Ireland	Wexford	6,519	2,803	9,322
Ireland	Waterford	294	126	420
Ireland	Cork	571	246	817
Wales	West Glamorgan	83	36	119

County	Region	Adults	Immatures (@ 43%)	Total
Wales	Dyfed	18,090	7,779	25,869
Wales	Gwynedd	5,467	2,351	7,818
England	Cumbria	94	40	134
Isle of Man	-	626	269	895
Scotland	Wigtown	269	116	385
Scotland	Ailsa Craig	1,161	499	1,660
Total associated with Irish Sea colonies		67,320	28,948	96,268

CONSTRUCTION

6.8.2.53 In order to calculate the number of razorbills that potentially would be at risk of displacement from the Cable Corridor and Working Area during the cable laying process, the density of this species in the Cable Corridor and Working Area (corridor 1 and corridor 2) was estimated from the site-specific surveys carried out for the Proposed Development (Volume III, Appendix 12.1: Offshore Ornithology Technical Report - Overview).

6.8.2.54 During the breeding season (April to July), the seasonal peak density in corridor 1 was 0.3 birds/ km^2 and in corridor 2 was 0.3 birds/ km^2. Within a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), 2 individuals (0.3 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 2 (0.3 x 12.56 x 60%) along corridor 2, 4 in total. This means that, across all populations, 0.04 individuals (1%) would be at risk of mortality due to cable installation, of which 12.6% (0.005 individuals) would be at risk from Ireland's Eye SPA.

6.8.2.55 During autumn migration (August to October), at a seasonal peak density of 3.2 birds/ km^2 (corridor 1) and 4.5 birds/ km^2 (corridor 2), with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of 48 individuals (3.2 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 34 (4.5 x 12.56 x 60%) along corridor 2, 82 in total. This means that 0.82 individuals (1%) are at risk of mortality due to cable installation.

6.8.2.56 During the winter period (November and December), at a seasonal peak density of 9.5 birds/ km^2 (corridor 1) and 5.0 birds/ km^2 (corridor 2), with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of 72 individuals (9.5 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 38 (5.0 x 12.56 x 60%) along corridor 2, 110 in total. This means that 1.1 individuals (1%) are at risk of mortality due to cable installation.

6.8.2.57 During the spring migration (January to March), at a seasonal peak density of 0.7 birds/ km^2 (corridor 1) and 0.3 birds/ km^2 (corridor 2), with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of five individuals (0.7 x 12.56 x 60%) could be at risk of displacement along corridor 1 and two (0.3 x 12.56 x 60%) along corridor 2, seven in total. This means that 0.07 individuals (1%) are at risk of mortality due to cable installation.

6.8.2.58 Of the total autumn, winter and spring mortalities, the proportion originating from the Ireland's Eye SPA population was estimated to be between 0.29 and 1.66% (1,600 adults divided into 554,179 and 96,268). Thus, of the total nonbreeding construction displacement mortality 2.0 (0.82, 1.1, 0.07), a maximum of 0.03 of the nonbreeding mortalities would be apportioned to the Ireland's Eye SPA.

6.8.2.59 Thus, summing the breeding season (0.005) and nonbreeding season (0.03) construction displacement mortalities, the potential annual mortality on the Ireland's Eye SPA razorbill population would be 0.035 adults.

6.8.2.60 The background adult mortality rate for razorbill is 0.105 (Horswill and Robinson, 2015), which indicates that the natural mortality for this SPA population would be 168 individuals (1,600 x 0.105). Addition of a maximum of 0.035 individuals to this would increase the background rate by 0.02%. This is a very small increase and would be undetectable against natural variations. The threshold below which increases in background mortality are considered to be undetectable against natural variations is 1% (Parker et al. 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.2.61 **Therefore, on this basis there will be no AEoI on the razorbill feature of Ireland's Eye SPA, as defined by the COs of the site, as a result of construction displacement effects considered above, from Project Design Option 1.**

6.8.2.62 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL

6.8.2.63 The assumption for razorbills is that displacement from windfarms occurs at a constant level to a distance of 2 km in line with guidance (SNCBs 2022) and that within this area, 30% to 70% of birds will be displaced and mortality of displaced birds will be between 1% and 10%.

6.8.2.64 Empirical evidence indicates that auk (guillemot and razorbill) displacement from windfarms is likely to be lower than 70%, although pre- and post-construction monitoring data have yielded variable results (see Section 6.8.2.37 for a discussion).

6.8.2.65 The 10% mortality rate for auks is unconfirmed and this magnitude of impact is not supported in the literature. Given that this is equivalent to the existing natural adult annual mortality for razorbill from all other sources of mortality (baseline mortality is 10.5%; Horswill and Robinson 2015), it is highly improbable that such an effect would occur. Mortality due to displacement might arise if displacement increased competition for resources in the remaining areas of auk habitat outside the windfarm. However, it should be recognised that the mortality rate due to displacement may well be 0% since the increase in density of auks outside the windfarm area will be negligible (because the rest of the available habitat is vast) and is very unlikely to be as high as 10%.

6.8.2.66 MacArthur Green (2019) undertook a review of available evidence for auk displacement and concluded that precautionary rates of displacement and mortality from operational windfarms would be 50% and 1% respectively. Thus, this assessment presents displacement in the range from 30% displaced and 1% mortality to 70% displaced and 10% mortality, with a focus on the evidence-based rates of 50% displaced and 1% mortality.

6.8.2.67 During the breeding season (April to July), the seasonal peak abundance in the Array Area and 2 km buffer was 211 birds. Thus, in total, between 1 (30% displaced and 1% mortality) and 15 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence-based prediction of 1 (50% displaced and 1% mortality). Of these, 12.6% (Table 6.34) which equate to 0.01, 0.01 and 0.19 individuals at the respective rates, would be at risk from Ireland's Eye SPA.

6.8.2.68 During the autumn season (August to October), the seasonal peak abundance in the Array Area and 2 km buffer was 2,319 birds. Thus, in total, between 7 (30% displaced and 1% mortality) and

162 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence-based prediction of 12 (50% displaced and 1% mortality).

6.8.2.69 During the winter (November and December), the seasonal peak abundance in the Array Area and 2 km buffer was 2,072 birds. Thus, in total, between 6 (30% displaced and 1% mortality) and 145 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence-based prediction of 10 (50% displaced and 1% mortality).

6.8.2.70 During the spring season (January to March), the seasonal peak abundance in the Array Area and 2 km buffer was 3,711 birds. Thus, in total, between 11 (30% displaced and 1% mortality) and 260 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence based prediction of 19 (50% displaced and 1% mortality).

6.8.2.71 Of the total autumn, winter and spring mortalities, the proportion originating from the Ireland's Eye SPA population was estimated to be between 0.29 and 1.66% (1,600 adults divided into 554,179 and 96,268). Thus, of the total nonbreeding operational displacement mortality of 24, 41 and 567 (at each combination of rates respectively), maximums of between 0.4 (24 x 1.66%) and 9.4 (567 x 1.66%) of the nonbreeding mortalities would be apportioned to the Ireland's Eye SPA.

6.8.2.72 Thus, with the addition of the breeding season mortality the annual mortality on the Ireland's Eye SPA razorbill population would be between 0.4 and 9.6, with the evidence-based estimate of 0.7.

6.8.2.73 The background adult mortality rate for razorbill is 0.105 (Horswill and Robinson, 2015), which indicates that the natural mortality for this SPA population would be 168 individuals (1,600 x 0.105). Addition of individuals subject to displacement mortality would increase the background rate by 0.2%, 0.4% and 5.6%. While the most precautionary displacement rates result in an increase in background mortality above the 1% threshold of detectability (Parker et al. 2022), this is not the case at the evidence-based rates (50% displaced and 1% mortality). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.2.74 **Therefore, on this basis there will be no AEoI on the razorbill feature of Ireland's Eye SPA, as defined by the COs of the site, as a result of operational displacement effects considered above, from Project Design Option 1.**

6.8.2.75 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.8.3 Lambay Island SPA

Kittiwake

6.8.3.1 The conservation objective for kittiwake in Lambay Island SPA can be found in Table 5.2.

6.8.3.2 See section 6.7.2.7 for a summary of relevant kittiwake ecology.

6.8.3.3 The only potential impacts are present within the Operational and Maintenance phase and so therefore the other phases of development are not considered within this qualifying features assessment.

6.8.3.4 The Lambay Island SPA population of kittiwake at designation was 4,091 AON which equates to a breeding adult population of 8,182. More recent surveys have reported 3,320 AON (Burnell *et al.*, 2023).

6.8.3.5 Using the evidence-based rates, the total kittiwake breeding season collision estimates for Project Design Option 1a was 16.7, for Project Design Option 1b was 18.8 and for Project Design Option

2 was 16.8. The total kittiwake nonbreeding season collision estimates for Project Design Option 1a was 170.1, for Project Design Option 1b was 190.3 and for Project Design Option 2 was 172.0.

6.8.3.6 The percentage of kittiwakes on the Proposed Development predicted to originate from Lambay Island SPA in the breeding season was 13.8% (Table 6.30). Application of this rate to the total breeding season collision predictions indicated that 2.3 (Project Design Option 1a), 2.6 (Project Design Option 1b) and 2.3 (Project Design Option 2) collisions would be apportioned to the SPA.

6.8.3.7 As these collision predictions are derived from at sea survey data, they include all age classes. Kittiwake populations consist of an estimated 53% adults, with the remaining 47% distributed among sub-adult age classes (Furness, 2015). Thus, using these age class proportions the Lambay Island SPA adult collisions in the breeding season would be 1.2 (Project Design Option 1a), 1.4 (Project Design Option 1b) and 1.2 (Project Design Option 2).

6.8.3.8 The nonbreeding season total kittiwake collision estimates, summing the autumn and spring BDMPS periods, were 170.1 (Project Design Option 1a), 190.3 (Project Design Option 1b) and 172.0 (Project Design Option 2). The proportion originating from the Lambay Island SPA population was estimated to be between 0.81% and 1.59% (6,640 adults divided into 818,181 and 418,196; Table 6.31). Thus, a maximum of 2.7 (Project Design Option 1a), 3.0 (Project Design Option 1b) and 2.7 (Project Design Option 2) of the nonbreeding collisions would be apportioned to the Lambay Island SPA.

6.8.3.9 Thus, summing the breeding season collision estimates (1.2, 1.4 and 1.2 for Options 1a, 1b and 2 respectively) and nonbreeding season collision estimates (2.7, 3.0 and 2.7 for Options 1a, 1b and 2 respectively), the annual mortality for Lambay Island SPA would be 3.9 (Project Design Option 1a), 4.4 (Project Design Option 1b) and 3.9 (Project Design Option 2) adults.

6.8.3.10 The background adult mortality rate for kittiwake is 0.146 (Horswill and Robinson 2015), which indicates that the natural mortality for the SPA population using the most recent count (3,320 AON, Cummins *et al.*, 2019) would be 969. Addition of 3.9 to 4.4 adults to these would increase the background rate of the designated population by 0.40 to 0.45%. The threshold below which increases in background mortality are considered to be undetectable against natural variations is 1% (Parker *et al.* 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold (in this case around 0.40 to 0.45% rather than 1%), even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.3.11 **Therefore, on this basis there will be no AEoI on the kittiwake feature of Lambay Island SPA, as defined by the COs of the site, as a result of collision effects considered above, from Project Design Option 1.**

6.8.3.12 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Herring gull

6.8.3.13 The conservation objective for herring gull in Lambay Island SPA can be found in Table 5.2.

6.8.3.14 See section 6.7.2.14 for a summary of relevant herring gull ecology.

6.8.3.15 The only potential impacts are present within the Operational and Maintenance phase and so therefore the other phases of development are not considered within this qualifying features assessment.

6.8.3.16 The Lambay Island SPA population of herring gull at designation was 1,806 pairs which equates to a breeding adult population of 3,612 individuals. More recent surveys have reported 906 AON (Burnell et al., 2023).

6.8.3.17 Herring gull collisions were only predicted to occur in two months, February and November, with none in the breeding season, therefore there is no breeding season connectivity of relevance between the Lambay Island SPA and the Proposed Development.

6.8.3.18 The total nonbreeding season collisions (i.e. not apportioned among SPA colonies) was 1.3 (Project Design Option 1a), 1.5 (Project Design Option 1b) and 1.3 (Project Design Option 2). The most recent estimate of the herring gull population from Northern Irish and Irish colonies with connectivity to the Irish Sea (from Antrim to Waterford) is 8,635 AON (Burnell et al. 2023). Birds from Lambay Island SPA would make up 10.5% of this population, therefore 10.5% of the total collisions would equate to 0.16 individuals. The adult mortality rate for herring gull is 0.166 (Horswill and Robinson 2015). The background mortality of herring gull from Lambay Island SPA would therefore be 301 individuals. Addition of the apportioned mortality to this would increase the rate by 0.05% which would be undetectable against background variations (Parker et al. 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold (in this case around 0.05% rather than 1%), even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.3.19 **Therefore, on this basis there will be no AEoI on the herring gull feature of Lambay Island SPA, as defined by the COs of the site, as a result of collision effects considered above, from Project Design Option 1.**

6.8.3.20 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Lesser black-backed gull

6.8.3.21 The conservation objective for lesser black-backed gull in Lambay Island SPA can be found in Table 5.2.

6.8.3.22 See section 6.7.2.15 for a summary of relevant lesser black-backed gull ecology.

6.8.3.23 The only potential impacts are present within the Operational and Maintenance phase and so therefore the other phases of development are not considered within this qualifying features assessment.

6.8.3.24 The Lambay Island SPA population of lesser black-backed gull at designation was 309 pairs which equates to a breeding adult population of 618 individuals. More recent surveys have reported 345 AON (Burnell et al. 2023).

6.8.3.25 Lesser black-backed gull collisions were only predicted to occur in one month, March, with none in the breeding season, therefore there is no breeding season connectivity of relevance between the Lambay Island SPA and the Proposed Development.

6.8.3.26 The total nonbreeding season collisions (i.e. not apportioned among SPA colonies) was 0.7 (Project Design Option 1a), 0.7 (Project Design Option 1b) and 0.6 (Project Design Option 2). The most recent estimate of the lesser black-backed gull population from Northern Irish and Irish colonies with connectivity to the Irish Sea (from Antrim to Waterford) is 5,362 AON (Burnell et al. 2023). Birds from Lambay Island SPA would make up 6.4% of this population, therefore 6.4% of the total collisions would equate to 0.04 individuals. The adult mortality rate for lesser black-backed gull is 0.115 (Horswill and Robinson 2015). The background mortality of lesser black-backed gull from Lambay Island SPA would therefore be 79 individuals. Addition of the apportioned mortality to this would increase the rate by 0.05% which would be undetectable against background variations (Parker et al. 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold (in this case around 0.05% rather than 1%), even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.3.27 **Therefore, on this basis there will be no AEoI on the lesser black-backed gull feature of Lambay Island SPA, as defined by the COs of the site, as a result of collision effects considered above, from Project Design Option 1.**

6.8.3.28 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Guillemot

6.8.3.29 The conservation objective for guillemot in Lambay Island SPA can be found in Table 5.2.

6.8.3.30 See section 6.7.2.16 for a summary of relevant guillemot ecology.

6.8.3.31 The Lambay Island SPA population of guillemot at designation was 59,824 individuals. More recent surveys have reported 59,983 (Burnell et al., 2023).

6.8.3.32 On the basis of the apportioning (Table 6.32), 64.6% of the adult guillemots recorded on the Proposed Development in the breeding season would be predicted to originate from Lambay Island SPA. During the nonbreeding season, between 3.8% and 10.6% of the adult guillemots recorded on the Proposed Development in the breeding season would be predicted to originate from Lambay Island SPA (59,824 divided by 563,371 and 1,567,463 respectively).

CONSTRUCTION

6.8.3.33 In order to calculate the number of guillemots that potentially would be at risk of displacement from the Cable Corridor and Working Area during the cable laying process, the density of this species in the Cable Corridor and Working Area (corridor 1 and corridor 2) was estimated from the site-specific surveys carried out for the Proposed Development (Volume III, Appendix 12.1: Offshore Ornithology Technical Report - Overview).

6.8.3.34 During the breeding season (March to July), the seasonal peak density in corridor 1 was 2.9 birds/ km^2 and in corridor 2 was 3.3 birds/ km^2. Within a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), 22 individuals (2.9 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 25 (3.3 x 12.56 x 60%) along corridor 2, 47 in total. This means that, across all populations, 0.47 individuals (1%) would be at risk of mortality due to cable installation, of which 64.6% (0.3 individuals) would be at risk from Lambay Island SPA.

6.8.3.35 During the nonbreeding season (August to February), the seasonal peak density in corridor 1 was 27.3 birds/ km^2 and in corridor 2 was 12.6 birds/ km^2. Within a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), 206 individuals (27.3 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 95 (12.6 x 12.56 x 60%) along corridor 2, 301 in total. This means that, across all populations, 3 individuals (1%) would be at risk of mortality due to cable installation, of which between 3.8% and 10.6% (Table 6.33), 0.1 and 0.3 individuals, would be at risk from Lambay Island SPA.

6.8.3.36 Thus, summing the breeding season (0.3) and maximum nonbreeding season (0.3) construction displacement mortalities, the potential annual mortality on the Lambay Island SPA guillemot population would be 0.6 adults.

6.8.3.37 The background adult mortality rate for guillemot is 0.061 (Horswill and Robinson, 2015), which indicates that the natural mortality for this SPA population would be 3,659 individuals (59,983 x 0.061). Addition of a maximum of 0.6 individuals to this would increase the background rate by 0.02%. This is a very small increase and would be undetectable against natural variations. The threshold below which increases in background mortality are considered to be undetectable against natural variations is 1% (Parker et al. 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.3.38 **Therefore, on this basis there will be no AEoI on the guillemot feature of Lambay Island SPA, as defined by the COs of the site, as a result of construction displacement effects considered above, from Project Design Option 1.**

6.8.3.39 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL

6.8.3.40 As discussed above (Section 6.8.2.24) the assumption for guillemots is that displacement from windfarms occurs at a constant level to a distance of 2 km in line with guidance (SNCBs 2022) and that within this area, 30% to 70% of birds will be displaced and mortality of displaced birds will be between 1% and 10%, with evidence-based rates of 50% displaced and 1% mortality (MacArthur Green, 2019).

6.8.3.41 During the breeding season (March to July), the seasonal peak abundance in the Array Area and 2 km buffer was 3,033 birds. Thus, in total, between 9 (30% displaced and 1% mortality) and 212 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence-based prediction of 15 (50% displaced and 1% mortality). Of these, 64.6% (Table 6.32) which equate to 5.8, 9.7 and 137 individuals at the respective rates, would be at risk from Lambay Island SPA.

6.8.3.42 During the nonbreeding season (August to February), the seasonal peak abundance in the Array Area and 2 km buffer was 5,079 birds. Thus, in total, between 15 (30% displaced and 1% mortality) and 356 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence based prediction of 25 (50% displaced and 1% mortality). Of these, between 3.8% and 10.6% (Table 6.33) which equate to maximums of 1.6, 2.6 and 37.7 individuals at the respective rates, would be at risk from Lambay Island SPA.

6.8.3.43 Thus, summing the breeding season (5.8, 9.7, 137) and nonbreeding season (1.6, 2.6, 37.7) operational displacement mortalities, the potential annual mortality on the Lambay Island SPA guillemot population would be 7.4, 12.3 and 174.7 adults, respectively.

6.8.3.44 The background adult mortality rate for guillemot is 0.061 (Horswill and Robinson, 2015), which indicates that the natural mortality for this SPA population would be 3,659 individuals (59,983 x 0.061). Addition of individuals subject to displacement mortality would increase the background rate by 0.2%, 0.3% and 4.8%. While the most precautionary displacement rates result in an increase in background mortality above the 1% threshold of detectability (Parker et al. 2022), this is not the case at the evidence based rates (50% displaced and 1% mortality). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.3.45 **Therefore, on this basis there will be no AEoI on the guillemot feature of Lambay Island SPA, as defined by the COs of the site, as a result of operational displacement effects considered above, from Project Design Option 1.**

6.8.3.46 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Razorbill

6.8.3.47 The conservation objective for razorbill in Lambay Island SPA can be found in Table 5.2.

6.8.3.48 See Section 6.7.2.18 for a summary of relevant razorbill ecology.

6.8.3.49 The Lambay Island SPA population of razorbill at designation was 4,337 individuals. More recent surveys have reported 7,353 (Burnell et al., 2023).

6.8.3.50 On the basis of the apportioning (Table 6.34), 45.3% of the adult razorbills recorded on the Proposed Development in the breeding season would be predicted to originate from Lambay Island SPA. During the nonbreeding season, between 1.3% and 7.6% of the adult razorbills recorded on the Proposed Development in the breeding season would be predicted to originate from Lambay Island SPA (7,353 divided by 96,268 and 554,179 respectively).

CONSTRUCTION

6.8.3.51 In order to calculate the number of razorbills that potentially would be at risk of displacement from the Cable Corridor and Working Area during the cable laying process, the density of this species in the Cable Corridor and Working Area (corridor 1 and corridor 2) was estimated from the site-specific surveys carried out for the Proposed Development (Appendix 12.1: Offshore Ornithology Offshore Ornithology Technical Report - Overview).

6.8.3.52 During the breeding season (April to July), the seasonal peak density in corridor 1 was 0.3 birds/ km^2 and in corridor 2 was 0.3 birds/ km^2. Within a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), 2 individuals (0.3 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 2 (0.3 x 12.56 x 60%) along corridor 2, 4 in total. This means that, across all populations, 0.04 individuals (1%) would be at risk of mortality due to cable installation, of which 45.3% (0.02 individuals) would be at risk from Lambay Island SPA.

6.8.3.53 During autumn migration (August to October), at a seasonal peak density of 3.2 birds/ km^2 (corridor 1) and 4.5 birds/ km^2 (corridor 2), with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of 48 individuals (3.2 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 34 (4.5 x 12.56 x 60%) along corridor 2, 82 in total. This means that 0.82 individuals (1%) are at risk of mortality due to cable installation.

6.8.3.54 During the winter period (November and December), at a seasonal peak density of 9.5 birds/ km^2 (corridor 1) and 5.0 birds/ km^2 (corridor 2), with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of 72 individuals (9.5 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 38 (5.0 x 12.56 x 60%) along corridor 2, 110 in total. This means that 1.1 individuals (1%) are at risk of mortality due to cable installation.

6.8.3.55 During the spring migration (January to March), at a seasonal peak density of 0.7 birds/ km^2 (corridor 1) and 0.3 birds/ km^2 (corridor 2), with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of five individuals (0.7 x 12.56 x 60%) could be at risk of displacement along corridor 1 and two (0.3 x 12.56 x 60%) along corridor 2, seven in total. This means that 0.07 individuals (1%) are at risk of mortality due to cable installation.

6.8.3.56 Of the total autumn, winter and spring mortalities, the proportion originating from the Lambay Island SPA population was estimated to be between 1.3% and 7.6%. Thus, of the total nonbreeding construction displacement mortality 2.0 (0.82, 1.1, 0.07), a maximum of 0.15 of the nonbreeding mortalities would be apportioned to the Lambay Island SPA.

6.8.3.57 Thus, summing the breeding season (0.02) and nonbreeding season (0.15) construction displacement mortalities, the potential annual mortality on the Lambay Island SPA razorbill population would be 0.17 adults.

6.8.3.58 The background adult mortality rate for razorbill is 0.105 (Horswill and Robinson, 2015), which indicates that the natural mortality for this SPA population would be 779 individuals (7,353 x

0.105). Addition of a maximum of 0.17 individuals to this would increase the background rate by 0.02%. This is a very small increase and would be undetectable against natural variations. The threshold below which increases in background mortality are considered to be undetectable against natural variations is 1% (Parker et al. 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.3.59 **Therefore, on this basis there will be no AEoI on the razorbill feature of Lambay Island SPA, as defined by the COs of the site, as a result of construction displacement effects considered above, from Project Design Option 1.**

6.8.3.60 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL

6.8.3.61 The assumption for razorbills is that displacement from windfarms occurs at a constant level to a distance of 2 km in line with guidance (SNCBs 2022) and that within this area, 30% to 70% of birds will be displaced and mortality of displaced birds will be between 1% and 10%.

6.8.3.62 Empirical evidence indicates that auk (guillemot and razorbill) displacement from windfarms is likely to be lower than 70%, although pre- and post-construction monitoring data have yielded variable results (see Section 6.8.2.37 for a discussion).

6.8.3.63 The 10% mortality rate for auks is unconfirmed and this magnitude of impact is not supported in the literature. Given that this is equivalent to the existing natural adult annual mortality for razorbill from all other sources of mortality (baseline mortality is 10.5%; Horswill and Robinson 2015), it is highly improbable that such an effect would occur. Mortality due to displacement might arise if displacement increased competition for resources in the remaining areas of auk habitat outside the windfarm. However, it should be recognised that the mortality rate due to displacement may well be 0% since the increase in density of auks outside the windfarm area will be negligible (because the rest of the available habitat is vast) and is very unlikely to be as high as 10%.

6.8.3.64 MacArthur Green (2019) undertook a review of available evidence for auk displacement and concluded that precautionary rates of displacement and mortality from operational windfarms would be 50% and 1% respectively. Thus, this assessment presents displacement in the range from 30% displaced and 1% mortality to 70% displaced and 10% mortality, with a focus on the evidence-based rates of 50% displaced and 1% mortality.

6.8.3.65 During the breeding season (April to July), the seasonal peak abundance in the Array Area and 2 km buffer was 211 birds. Thus, in total, between 1 (30% displaced and 1% mortality) and 15 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence-based prediction of 1 (50% displaced and 1% mortality). Of these, 45.3% (Table 6.34) which equate to 0.05, 0.05 and 6.8 individuals at the respective rates, would be at risk from Lambay Island SPA.

6.8.3.66 During the autumn season (August to October), the seasonal peak abundance in the Array Area and 2 km buffer was 2,319 birds. Thus, in total, between 7 (30% displaced and 1% mortality) and 162 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence-based prediction of 12 (50% displaced and 1% mortality).

6.8.3.67 During the winter (November and December), the seasonal peak abundance in the Array Area and 2 km buffer was 2,072 birds. Thus, in total, between 6 (30% displaced and 1% mortality) and 145 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence-based prediction of 10 (50% displaced and 1% mortality).

6.8.3.68 During the spring season (January to March), the seasonal peak abundance in the Array Area and 2 km buffer was 3,711 birds. Thus, in total, between 11 (30% displaced and 1% mortality) and 260 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence-based prediction of 19 (50% displaced and 1% mortality).

6.8.3.69 Of the total autumn, winter and spring mortalities, the proportion originating from the Lambay Island SPA population was estimated to be between 1.3% and 7.6% (7,353 adults divided into 554,179 and 96,268). Thus, of the total nonbreeding operational displacement mortality of 24, 41 and 567 (at each combination of rates respectively), between 1.8 (24 x 7.6%) and 43.1 (567 x 7.6%) of the nonbreeding mortalities would be apportioned to the Lambay Island SPA.

6.8.3.70 Thus, with the addition of the breeding season mortality the annual mortality on the Lambay Island SPA razorbill population would be between 1.85 and 49.9, with the evidence-based estimate of 3.2.

6.8.3.71 The background adult mortality rate for razorbill is 0.105 (Horswill and Robinson, 2015), which indicates that the natural mortality for this SPA population would be 779 individuals (7,353 x 0.105). Addition of individuals subject to displacement mortality would increase the background rate by 0.2%, 0.4% and 6.4%. While the most precautionary displacement rates result in an increase in background mortality above the 1% threshold of detectability (Parker et al. 2022), this is not the case at the evidence-based rates (50% displaced and 1% mortality). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.3.72 **Therefore, on this basis there will be no AEoI on the razorbill feature of Lambay Island SPA, as defined by the COs of the site, as a result of operational displacement effects considered above, from Project Design Option 1.**

6.8.3.73 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.8.4 Saltee Island SPA

Kittiwake

6.8.4.1 The conservation objective for kittiwake in Saltee Islands SPA can be found in Table 5.2.

6.8.4.2 See Section 6.7.2.7 for a summary of relevant kittiwake ecology.

6.8.4.3 The only potential impacts are present within the Operational and Maintenance phase and so therefore the other phases of development are not considered within this qualifying features assessment.

6.8.4.4 The Saltee Islands SPA population of kittiwake at designation was 2,125 AON which equates to a breeding adult population of 4,250. More recent surveys have reported 1,038 AON (Burnell *et al.*, 2023).

6.8.4.5 Using the evidence-based rates, the total kittiwake breeding season collision estimates for Project Design Option 1a was estimated to be 16.7, for Project Design Option 1b was 18.8 and for Project Design Option 2 was 16.8. The total kittiwake nonbreeding season collision estimates for Project Design Option 1a was estimated to be 170.1, for Project Design Option 1b was 190.3 and for Project Design Option 2 was 172.0.

6.8.4.6 The percentage of kittiwake on the Proposed Development predicted to originate from Saltee Islands SPA in the breeding season was 2.3% (Table 6.30). Application of this rate to the total breeding season collision predictions indicated that 0.4 (Project Design Option 1a, Project Design Option 1b and Project Design Option 2) collisions would be apportioned to the SPA.

6.8.4.7 As these collision predictions are derived from at sea survey data, they include all age classes. Kittiwake populations consist of an estimated 53% adults, with the remaining 47% distributed among sub-adult age classes (Furness, 2015). Thus, using these age class proportions the Saltee Islands SPA adult collisions in the breeding season would be 0.2 (Project Design Option 1a, Project Design Option 1b and Project Design Option 2).

6.8.4.8 The nonbreeding season total kittiwake collision estimates, summing the autumn and spring BDMPS periods, were 170.1 (Project Design Option 1a), 190.3 (Project Design Option 1b) and 172.0 (Project Design Option 2). The proportion originating from the Saltee Islands SPA population was estimated to be between 0.25% and 0.5% (2,076 adults divided into 8181,181 and 418,196; Table 6.31). Thus, a maximum of 0.8 (Project Design Option 1a), 0.9 (Project Design Option 1b) and 0.8 (Project Design Option 2) of the nonbreeding collisions would be apportioned to the Saltee Islands SPA.

6.8.4.9 Thus, summing the breeding season collision estimates 0.2 (for Options 1a, 1b and 2 respectively) and nonbreeding season collision estimates 0.8, 0.9 and 0.8 (for Options 1a, 1b and 2 respectively), the annual mortality for Saltee Islands SPA would be 1.0 (Project Design Option 1a), 1.1 (Project Design Option 1b) and 1.0 (Project Design Option 2) adults.

6.8.4.10 The background adult mortality rate for kittiwake is 0.146 (Horswill and Robinson 2015), which indicates that the natural mortality for the SPA population using the most recent count (1,038 AON, Cummins *et al*., 2019) would be 303. Addition of 1.0 to 1.1 adults to these would increase the background rate of the designated population by 0.34 to 0.37%. The threshold below which increases in background mortality are considered to be undetectable against natural variations is 1% (Parker *et al.* 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold (in this case around 0.34 to 0.37% rather than 1%), even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.4.11 **Therefore, on this basis there will be no AEoI on the kittiwake feature of Saltee Island SPA, as defined by the COs of the site, as a result of collision effects considered above, from Project Design Option 1.**

6.8.4.12 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Gannet

6.8.4.13 The conservation objective for gannet in Saltee Islands SPA can be found in Table 5.2**.**

6.8.4.14 See section 6.7.2.11 for a summary of relevant gannet ecology.

6.8.4.15 The only potential impacts are present within the Operational and Maintenance phase and so therefore the other phases of development are not considered within this qualifying features assessment.

6.8.4.16 The Saltee Islands SPA population of gannet at designation was 2,446 pairs (apparently occupied nests) which equates to a breeding adult population of 4,892. More recent surveys have reported 4,772 AON (Burnell et al., 2023).

6.8.4.17 Using the evidence-based rates, the total gannet breeding season collision estimates for the Proposed Development was 0.6, (Project Design Option 1a, Project Design Option 1b and Project Design Option 2). The total gannet nonbreeding season collision estimates for Project Design Option 1a was 0.3, for Project Design Option 1b was 0.3 and for Project Design Option 2 was 0.2.

6.8.4.18 The percentage of gannets on the Proposed Development predicted to originate from Saltee Islands SPA in the breeding season was 100%, on the basis that there is very little overlap in the foraging ranges from different gannet colonies and records from tracking studies has indicated that birds in the region of Arklow are expected to have originated from Saltee Islands SPA (Wakefield et al. 2013). Thus, all of the breeding season collisions (0.6) were apportioned to this SPA.

6.8.4.19 As these collision predictions are derived from at sea survey data, they include all age classes. Gannet populations consist of an estimated 55% adults, with the remaining 45% distributed among sub-adult age classes (Furness, 2015). Thus, using these age class proportions the Saltee Islands SPA adult collisions in the breeding season would be 0.33 (Project Design Option 1a, Project Design Option 1b and Project Design Option 2).

6.8.4.20 Gannets range very widely during the nonbreeding season and many colonies could have the potential to pass through the Irish Sea in autumn and spring. The most recent all Britain and Ireland population estimate is 360,748 AON (Burnell et al. 2023). However, in order to be precautionary, for this assessment only Irish colonies in the Irish Sea have been considered. This gives a population of 12,386 AON which equates to an all age class population of 46,676 individuals (=12,836 x 2 x 1.82, to account for adults (x2) and immatures (x1.82)).

6.8.4.21 The nonbreeding season total gannet collision estimates, summing the autumn and spring BDMPS periods, were 0.3 (Project Design Option 1a), 0.3 (Project Design Option 1b) and 0.2 (Project Design Option 2). The proportion originating from the Saltee Islands SPA population was estimated to be 20% (9,544 adults divided into 46,676). Thus, 0.06 (Project Design Option 1a), 0.06 (Project Design Option 1b) and 0.04 (Project Design Option 2) of the nonbreeding collisions would be apportioned to the Saltee Islands SPA.

6.8.4.22 Thus, summing the breeding season collision estimates 0.33 (for Options 1a, 1b and 2 respectively) and nonbreeding season collision estimates 0.06, 0.06 and 0.04 (for Options 1a, 1b and 2 respectively), the annual mortality for Saltee Islands SPA would be 0.4 (Project Design Option 1a), 0.4 (Project Design Option 1b) and 0.4 (Project Design Option 2) adults.

6.8.4.23 The background adult mortality rate for gannet is 0.081 (Horswill and Robinson 2015), which indicates that the natural mortality for the SPA population using the most recent count (4,772 AON) would be 773. Addition of 0.4 adults to this would increase the background rate of the designated population by 0.05%. The threshold below which increases in background mortality are considered to be undetectable against natural variations is 1% (Parker et al. 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold (in this case around 0.05% rather than 1%), even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.4.24 **Therefore, on this basis there will be no AEoI on the gannet feature of Saltee Island SPA, as defined by the COs of the site, as a result of collision effects considered above, from Project Design Option 1.**

6.8.4.25 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Herring gull

6.8.4.26 The conservation objective for herring gull in Saltee Islands SPA can be found in Table 5.2.

6.8.4.27 See section 6.7.2.14 for a summary of relevant herring gull ecology.

6.8.4.28 The only potential impacts are present within the Operational and Maintenance phase and so therefore the other phases of development are not considered within this qualifying features assessment.

6.8.4.29 The Saltee Islands SPA population of herring gull at designation was 73 pairs which equates to a breeding adult population of 146 individuals. More recent surveys have reported 115 AON (Burnell et al., 2023).

6.8.4.30 Herring gull collisions were only predicted to occur in two months, February and November, with none in the breeding season, therefore there is no breeding season connectivity of relevance between the Saltee Islands SPA and the Proposed Development.

6.8.4.31 The total nonbreeding season collisions (i.e. not apportioned among SPA colonies) were estimated at 1.3 (Project Design Option 1a), 1.5 (Project Design Option 1b) and 1.3 (Project Design Option 2). The most recent estimate of the herring gull population from Northern Irish and Irish colonies with connectivity to the Irish Sea (from Antrim to Waterford) is 8,635 AON (Burnell et al. 2023). Birds from Saltee Islands SPA would make up 1.3% of this population, therefore 1.3% of the total collisions would equate to 0.02 individuals. The adult mortality rate for herring gull is 0.166 (Horswill and Robinson 2015). The background mortality of herring gull from Saltee Islands SPA would therefore be 38 individuals. Addition of the apportioned mortality to this would increase the rate by 0.05% which would be undetectable against background variations (Parker et al. 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold (in this case around 0.05% rather than 1%), even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.4.32 **Therefore, on this basis there will be no AEoI on the herring gull feature of Saltee Island SPA, as defined by the COs of the site, as a result of collision effects considered above, from Project Design Option 1.**

6.8.4.33 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Lesser black-backed gull

6.8.4.34 The conservation objective for lesser black-backed gull in Saltee Islands SPA can be found in Table 5.2.

6.8.4.35 See section 6.7.2.15 for a summary of relevant lesser black-backed gull ecology.

6.8.4.36 The only potential impacts are present within the Operational and Maintenance phase and so therefore the other phases of development are not considered within this qualifying features assessment.

6.8.4.37 The Saltee Islands SPA population of lesser black-backed gull at designation was 175 pairs which equates to a breeding adult population of 350 individuals. More recent surveys have reported 251 AON (Burnell et al., 2023).

6.8.4.38 Lesser black-backed gull collisions were only predicted to occur in one month, March, with none in the breeding season, therefore there is no breeding season connectivity of relevance between the Saltee Islands SPA and the Proposed Development.

6.8.4.39 The total nonbreeding season collisions (i.e. not apportioned among SPA colonies) were estimated at 0.7 (Project Design Option 1a), 0.7 (Project Design Option 1b) and 0.6 (Project Design Option 2). The most recent estimate of the lesser black-backed gull population from Northern Irish and Irish colonies with connectivity to the Irish Sea (from Antrim to Waterford) is 5,362 AON (Burnell et al. 2023). Birds from Saltee Islands SPA would make up 9.4% of this population, therefore 9.4% of the total collisions would equate to 0.06 individuals. The adult mortality rate for lesser black-backed gull is 0.115 (Horswill and Robinson 2015). The background mortality of lesser black-backed gull from Saltee Islands SPA would therefore be 58 individuals. Addition of the apportioned mortality to this would increase the rate by 0.01% which would be undetectable against background variations (Parker et al. 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold (in this case around 0.05% rather than 1%), even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.4.40 **Therefore, on this basis there will be no AEoI on the lesser black-backed gull feature of Saltee Island SPA, as defined by the COs of the site, as a result of collision effects considered above, from Project Design Option 1.**

6.8.4.41 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Guillemot

6.8.4.42 The conservation objective for guillemot in Saltee Islands SPA can be found in Table 5.2.

6.8.4.43 See section 6.7.2.16 for a summary of relevant guillemot ecology.

6.8.4.44 The Saltee Islands SPA population of guillemot at designation was 21,436 individuals. More recent surveys have reported 25,581 (Burnell et al. 2023).

6.8.4.45 On the basis of the apportioning (Table 6.32), 15.0% of the adult guillemots recorded on the Proposed Development in the breeding season would be predicted to originate from Saltee Islands SPA.

CONSTRUCTION

6.8.4.46 In order to calculate the number of guillemots that potentially would be at risk of displacement from the Cable Corridor and Working Area during the cable laying process, the density of this species in the Cable Corridor and Working Area (corridor 1 and corridor 2) was estimated from the site-specific surveys carried out for the Proposed Development (Appendix 12.1: Offshore Ornithology Technical Report - Overview).

6.8.4.47 During the breeding season (March to July), the seasonal peak density in corridor 1 was 2.9 birds/ km^2 and in corridor 2 was 3.3 birds/ km^2. Within a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), 22 individuals (2.9 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 25 (3.3 x 12.56 x 60%) along corridor 2, 47 in total. This means that, across all populations, 0.47 individuals (1%) would be at risk of mortality due to cable installation, of which 15% (0.07 individuals) would be at risk from Saltee Islands SPA.

6.8.4.48 During the nonbreeding season (August to February), the seasonal peak density in corridor 1 was 27.3 birds/ km^2 and in corridor 2 was 12.6 birds/ km^2. Within a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), 206 individuals (27.3 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 95 (12.6 x 12.56 x 60%) along corridor 2, 301 in total. This means that, across all populations, 3 individuals (1%) would be at risk of mortality due to cable installation, of which between 1.6% and 4.6% (Table 6.33), 0.05 and 0.14 individuals, would be at risk from Saltee Islands SPA.

6.8.4.49 Thus, summing the breeding season (0.07) and maximum nonbreeding season (0.14) construction displacement mortalities, the potential annual mortality on the Saltee Islands SPA guillemot population would be 0.21 adults.

6.8.4.50 The background adult mortality rate for guillemot is 0.061 (Horswill and Robinson, 2015), which indicates that the natural mortality for this SPA population would be 1,577 individuals (25,851 x 0.061). Addition of a maximum of 0.21 individuals to this would increase the background rate by 0.01%. This is a very small increase and would be undetectable against natural variations. The threshold below which increases in background mortality are considered to be undetectable against natural variations is 1% (Parker et al. 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so there is no reasonable scientific doubt as to the absence of an effect.

6.8.4.51 **Therefore, on this basis there will be no AEoI on the guillemot feature of Saltee Island SPA, as defined by the COs of the site, as a result of construction displacement effects considered above, from Project Design Option 1.**

6.8.4.52 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL

6.8.4.53 As discussed above (Section 6.8.2.24), the assumption for guillemots is that displacement from windfarms occurs at a constant level to a distance of 2 km in line with guidance (SNCBs 2022) and that within this area, 30% to 70% of birds will be displaced and mortality of displaced birds will be between 1% and 10%, with evidence based rates of 50% displaced and 1% mortality (MacArthur Green 2019).

6.8.4.54 During the breeding season (March to July), the seasonal peak abundance in the Array Area and 2 km buffer was 3,033 birds. Thus, in total, between 9 (30% displaced and 1% mortality) and 212 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence based prediction of 15 (50% displaced and 1% mortality). Of these, 15.0% (Table 6.32) which equate to 1.3, 2.2 and 32 individuals at the respective rates, would be at risk from Saltee Islands SPA.

6.8.4.55 During the nonbreeding season (August to February), the seasonal peak abundance in the Array Area and 2 km buffer was 5,079 birds. Thus, in total, between 15 (30% displaced and 1% mortality) and 356 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence based prediction of 25 (50% displaced and 1% mortality). Of these, between 1.6% and 4.6% (Table 6.33) which equate to maximums of 0.7, 1.1 and 16.4 individuals at the respective rates, would be at risk from Saltee Islands SPA.

6.8.4.56 Thus, summing the breeding season (1.3, 2.2, 32) and nonbreeding season (0.7, 1.1, 16.4) operational displacement mortalities, the potential annual mortality on the Saltee Islands SPA guillemot population would be 2.0, 3.3 and 48.4 adults, respectively.

6.8.4.57 The background adult mortality rate for guillemot is 0.061 (Horswill and Robinson, 2015), which indicates that the natural mortality for this SPA population would be 1,577 individuals (25,851 x 0.061). Addition of individuals subject to displacement mortality would increase the background rate by 0.13%, 0.2% and 3.1%. While the most precautionary displacement rates result in an increase in background mortality above the 1% threshold of detectability (Parker et al. 2022), this is not the case at the evidence based rates (50% displaced and 1% mortality). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.4.58 **Therefore, on this basis there will be no AEoI on the guillemot feature of Saltee Island SPA, as defined by the COs of the site, as a result of operational displacement effects considered above, from Project Design Option 1.**

6.8.4.59 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Razorbill

6.8.4.60 The conservation objective for razorbill in Saltee Islands SPA can be found in Table 5.2.

6.8.4.61 See section 6.7.2.18 for a summary of relevant razorbill ecology.

6.8.4.62 The Saltee Islands SPA population of razorbill at designation was 5,200 individuals. More recent surveys have reported 6,519 (Burnell et al. 2023).

6.8.4.63 On the basis of the apportioning (Table 6.34), 21.6% of the adult razorbills recorded on the Proposed Development in the breeding season would be predicted to originate from Saltee Islands SPA. During the nonbreeding season, between 1.2% and 6.8% of the adult razorbills recorded on the Proposed Development in the breeding season would be predicted to originate from Saltee Islands SPA (6,519 divided by 96,268 and 554,179 respectively).

CONSTRUCTION

6.8.4.64 In order to calculate the number of razorbills that potentially would be at risk of displacement from the Cable Corridor and Working Area during the cable laying process, the density of this species in the Cable Corridor and Working Area (corridor 1 and corridor 2) was estimated from the site-specific surveys carried out for the Proposed Development (Volume III, Appendix 12.1: Offshore Ornithology Technical Report - Overview).

6.8.4.65 During the breeding season (April to July), the seasonal peak density in corridor 1 was 0.3 birds/ km^2 and in corridor 2 was 0.3 birds/ km^2. Within a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), 2 individuals (0.3 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 2 (0.3 x 12.56 x 60%) along corridor 2, 4 in total. This means that, across all populations, 0.04 individuals (1%) would be at risk of mortality due to cable installation, of which 21.6% (0.001 individuals) would be at risk from Saltee Islands SPA.

6.8.4.66 During autumn migration (August to October), at a seasonal peak density of 3.2 birds/ km^2 (corridor 1) and 4.5 birds/ km^2 (corridor 2), with a 2 km radius of disturbance around a cable laying vessel (12.56 km2), a maximum of 48 individuals (3.2 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 34 (4.5 x 12.56 x 60%) along corridor 2, 82 in total. This means that 0.82 individuals (1%) are at risk of mortality due to cable installation.

6.8.4.67 During the winter period (November and December), at a seasonal peak density of 9.5 birds/ km^2 (corridor 1) and 5.0 birds/ km^2 (corridor 2), with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of 72 individuals (9.5 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 38 (5.0 x 12.56 x 60%) along corridor 2, 110 in total. This means that 1.1 individuals (1%) are at risk of mortality due to cable installation.

6.8.4.68 During the spring migration (January to March), at a seasonal peak density of 0.7 birds/ km^2 (corridor 1) and 0.3 birds/ km^2 (corridor 2), with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of five individuals (0.7 x 12.56 x 60%) could be at risk of displacement along corridor 1 and two (0.3 x 12.56 x 60%) along corridor 2, seven in total. This means that 0.07 individuals (1%) are at risk of mortality due to cable installation.

6.8.4.69 Of the total autumn, winter and spring mortalities, the proportion originating from the Saltee Islands SPA population was estimated to be between 1.1% and 6.8%. Thus, of the total nonbreeding construction displacement mortality 2.0 (0.82, 1.1, 0.07), a maximum of 0.14 of the nonbreeding mortalities would be apportioned to the Saltee Islands SPA.

6.8.4.70 Thus, summing the breeding season (0.02) and nonbreeding season (0.14) construction displacement mortalities, the potential annual mortality on the Saltee Islands SPA razorbill population would be 0.16 adults.

6.8.4.71 The background adult mortality rate for razorbill is 0.105 (Horswill and Robinson, 2015), which indicates that the natural mortality for this SPA population would be 684 individuals (6,519 x 0.105). Addition of a maximum of 0.16 individuals to this would increase the background rate by 0.02%. This is a very small increase and would be undetectable against natural variations. The threshold below which increases in background mortality are considered to be undetectable against natural variations is 1% (Parker et al. 2022). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.4.72 **Therefore, on this basis there will be no AEoI on the razorbill feature of Saltee Island SPA, as defined by the COs of the site, as a result of construction displacement effects considered above, from Project Design Option 1.**

6.8.4.73 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

OPERATIONAL

6.8.4.74 The assumption for razorbills is that displacement from windfarms occurs at a constant level to a distance of 2 km in line with guidance (SNCBs 2022) and that within this area, 30% to 70% of birds will be displaced and mortality of displaced birds will be between 1% and 10%.

6.8.4.75 Empirical evidence indicates that auk (guillemots and razorbills) displacement from windfarms is likely to be lower than 70%, although pre- and post-construction monitoring data have yielded variable results.

6.8.4.76 The 10% mortality rate for auks is unconfirmed and this magnitude of impact is not supported in the literature. Given that this is equivalent to the existing natural adult annual mortality for razorbill from all other sources of mortality (baseline mortality is 10.5%; Horswill and Robinson 2015), it is highly improbable that such an effect would occur. Mortality due to displacement might arise if displacement increased competition for resources in the remaining areas of auk habitat outside the windfarm. However, it should be recognised that the mortality rate due to displacement may well be 0% since the increase in density of auks outside the windfarm area will be negligible (because the rest of the available habitat is vast) and is very unlikely to be as high as 10%.

6.8.4.77 MacArthur Green (2019) undertook a review of available evidence for auk displacement and concluded that precautionary rates of displacement and mortality from operational windfarms would be 50% and 1% respectively. Thus, this assessment presents displacement in the range from 30% displaced and 1% mortality to 70% displaced and 10% mortality, with a focus on the evidence-based rates of 50% displaced and 1% mortality.

6.8.4.78 During the breeding season (April to July), the seasonal peak abundance in the Array Area and 2 km buffer was 211 birds. Thus, in total, between 1 (30% displaced and 1% mortality) and 15 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence-based prediction of 1 (50% displaced and 1% mortality). Of these, 21.6% (Table 6.34) which equate to 0.22, 0.22 and 3.2 individuals at the respective rates, would be at risk from Saltee Islands SPA.

6.8.4.79 During the autumn season (August to October), the seasonal peak abundance in the Array Area and 2 km buffer was 2,319 birds. Thus, in total, between 7 (30% displaced and 1% mortality) and 162 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence based prediction of 12 (50% displaced and 1% mortality).

6.8.4.80 During the winter (November and December), the seasonal peak abundance in the Array Area and 2 km buffer was 2,072 birds. Thus, in total, between 6 (30% displaced and 1% mortality) and 145 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence based prediction of 10 (50% displaced and 1% mortality).

6.8.4.81 During the spring season (January to March), the seasonal peak abundance in the Array Area and 2 km buffer was 3,711 birds. Thus, in total, between 11 (30% displaced and 1% mortality) and 260 (70% displaced, 10% mortality) could be at risk of displacement mortality, with the evidence based prediction of 19 (50% displaced and 1% mortality).

6.8.4.82 Of the total autumn, winter and spring mortalities, the proportion originating from the Saltee Islands SPA population was estimated to be between 1.1% and 6.8% (6,519 adults divided into 554,179 and 96,268). Thus, of the total nonbreeding operational displacement mortality of 24, 41 and 567 (at each combination of rates respectively), between 1.6 (24 x 6.8%) and 38.5 (567 x 6.8%) of the nonbreeding mortalities would be apportioned to the Saltee Islands SPA.

6.8.4.83 Thus, with the addition of the breeding season mortality the annual mortality on the Saltee Islands SPA razorbill population would be between 1.82 and 41.7, with the evidence-based estimate of 3.0.

6.8.4.84 The background adult mortality rate for razorbill is 0.105 (Horswill and Robinson, 2015), which indicates that the natural mortality for this SPA population would be 684 individuals (6,519 x 0.105). Addition of individuals subject to displacement mortality would increase the background rate by 0.2%, 0.4% and 6.1%. While the most precautionary displacement rates result in an increase in background mortality above the 1% threshold of detectability (Parker et al. 2022), this is not the case at the evidence-based rates (50% displaced and 1% mortality). Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.4.85 **Therefore, on this basis there will be no AEoI on the razorbill feature of Saltee Island SPA, as defined by the COs of the site, as a result of operational displacement effects considered above, from Project Design Option 1.**

6.8.4.86 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.8.5 Skerries Island SPA

Herring Gull

6.8.5.1 The conservation objective for herring gull in Skerries Islands SPA can be found in Table 5.2.

6.8.5.2 See section 6.7.2.14 for a summary of relevant herring gull ecology.

6.8.5.3 The only potential impacts are present within the Operational and Maintenance phase and so therefore the other phases of development are not considered within this qualifying features assessment.

6.8.5.4 The Skerries Islands SPA population of herring gull at designation was 250 pairs which equates to a breeding adult population of 500 individuals. No update is available for this site (Burnell *et al.* 2023).

6.8.5.5 Herring gull collisions were only predicted to occur in two months, February and November, with none in the breeding season, therefore there is no breeding season connectivity between the Skerries Islands SPA and the Proposed Development.

6.8.5.6 The total nonbreeding season collision estimates (i.e. not apportioned among SPA colonies) were 1.3 (Project Design Option 1a), 1.5 (Project Design Option 1b) and 1.3 (Project Design Option 2). The most recent estimate of the herring gull population from Northern Irish and Irish colonies with connectivity to the Irish Sea (from Antrim to Waterford) is 8,635 AON (Burnell *et al.* 2023). Birds from Skerries Islands SPA would make up 2.9% of this population, therefore 2.9% of the total collisions would equate to 0.04 individuals. The adult mortality rate for herring gull is 0.166 (Horswill and Robinson 2015). The background mortality of herring gull from Skerries Islands SPA would therefore be 83 individuals. Addition of the apportioned mortality to this would increase the rate by 0.05% which would be undetectable against background variations (Parker *et al.* 2022).

Since the additional mortality based on a reasonable but precautionary assessment is far below the 1% threshold, even if the impact was substantially greater than this (already precautionary) estimate, the impact would still most likely fall well below the 1% threshold, and so we can be confident that there is no reasonable scientific doubt as to the absence of an effect.

6.8.5.7 **Therefore, on this basis there will be no AEoI on the herring gull feature of Skerries Island SPA, as defined by the COs of the site, as a result of collision effects considered above, from Project Design Option 1.**

6.8.5.8 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.8.6 Wicklow Head SPA

Kittiwake

6.8.6.1 The conservation objective for kittiwake in Wicklow Head SPA can be found in Table 5.2.

6.8.6.2 See section 6.7.2.7 for a summary of relevant kittiwake ecology.

6.8.6.3 The Wicklow Head SPA population of kittiwake at designation was 956 AON which equates to a breeding adult population of 1,912. More recent surveys have reported 773 AON (Burnell *et al.* 2023).

6.8.6.4 Using the evidence-based rates, the total kittiwake breeding season collision estimate for the Project Design Option 1a was 16.7, for Option 1b was 18.8 and for Option 2 was 16.8. The total kittiwake nonbreeding season collision estimates for the Project Design Option 1a was estimated to be 170.1, for Option 1b was 190.3 and for Option 2 was 172.0.

6.8.6.5 The percentage of kittiwakes on the Proposed Development predicted to originate from Wicklow Head SPA in the breeding season was 58.1% (Table 6.30). Application of this rate to the total breeding season collision predictions indicated that 9.7 (Project Design Option 1a), 10.9 (Project Design Option 1b) and 9.7 (Project Design Option 2) collisions would be apportioned to the SPA.

6.8.6.6 As these collision predictions are derived from at sea survey data, they include all age classes. Kittiwake populations consist of an estimated 53% adults, with the remaining 47% distributed among sub-adult age classes (Furness, 2015). Thus, using these age class proportions the Wicklow Head SPA adult collisions in the breeding season would be 5.1 (Project Design Option 1a), 5.8 (Project Design Option 1b) and 5.1 (Project Design Option 2).

6.8.6.7 The nonbreeding season total kittiwake collision estimates, summing the autumn and spring BDMPS periods, were 170.1 (Project Design Option 1a), 190.3 (Project Design Option 1b) and 172.0 (Project Design Option 2). The proportion originating from the Wicklow Head SPA population was estimated to be between 0.19% and 0.37% (1,546 adults divided into 818,181 and 418,196; Table 6.31). Thus, a maximum of 0.6 (Project Design Option 1a), 0.7 (Project Design Option 1b) and 0.6 (Project Design Option 2) of the nonbreeding collisions would be apportioned to the Wicklow Head SPA.

6.8.6.8 Thus, summing the breeding season collision estimates 5.1 (Project Design Option 1a), 5.8 (Project Design Option 1b), and 5.1 (Project Design Option 2) and nonbreeding season collision estimates 0.6 (Project Design Option 1a), 0.7 (Project Design Option 1b) and 0.6 (Project Design Option 2), the annual adult mortality for Wicklow Head SPA would be 5.7 (Project Design Option 1a), 6.5 (Project Design Option 1b) and 5.7 (Project Design Option 2).

6.8.6.9 The background adult mortality rate for kittiwake is 0.146 (Horswill and Robinson 2015), which indicates that the natural mortality for the SPA population using the most recent count (773 AON, Cummins *et al.*, 2019) would be 226. Addition of 5.7 to 6.5 adults to these would increase the background rate of the designated population by 2.5% to 2.8%. The threshold below which increases in background mortality are considered to be undetectable against natural variations is 1% (Parker *et al.* 2022). Therefore, additional consideration of the potential impact on the SPA population has been undertaken using the results from a kittiwake population model of the Wicklow Head SPA population (Volume III, Technical Appendix 12.10 Offshore Ornithology: Kittiwake Population Viability Analysis).

6.8.6.10 The kittiwake population viability analysis (PVA) was run both with the incorporation of density dependent regulation (to simulate the natural feedback processes by which wild populations are regulated) and without this regulation (density independent). The justification for using the results of density independent models, rather than those from more realistic density dependent ones, is typically because it is considered there is insufficient information available to define the relationships between a population's size and the rates of survival and reproduction (which are expected to vary as levels of competition among members of the population for limiting resources varies). However, this situation does not prevent reasonable assumptions being made about the action of density dependent regulation, for example derived from similar species or alternative locations, with which to parameterise a population model. Furthermore, natural populations of seabirds will, with rare exceptions, almost never be expected to change in size without experiencing density dependent regulation. In that sense, a density independent model for a seabird population can be considered to be the *most* unrealistic form of population model. Thus, by presenting results from both a density independent model and a precautionary density dependent one (i.e. with the feedback set to be relatively weak), the results are intended to bracket the range of expected responses, albeit that (for the reasons outlined above and discussed in more detail in Volume III, Technical Appendix 12.10 Offshore Ornithology: Kittiwake Population Viability Analysis) the density dependent results are expected to be more appropriate.

6.8.6.11 The model results, presented as comparisons of the predicted population size and population growth rate between unimpacted (baseline) model runs and impacted ones, presented as proportions and referred to as counterfactuals: CPS (counterfactual of population size) and CPGR (counterfactual of population growth rate), are provided in Table 6.36.

6.8.6.12 Due to the differences in how population change is predicted using density independent and density dependent models, it is also appropriate to give greater weight to a different counterfactual for each type. Density independent population projections undergo exponential increase, so the baseline and impacted populations will diverge by an ever-increasing margin as the duration of the simulation increases. However, the growth rate of the two projections will be constant, hence the CPGR is more appropriate than the CPS. In contrast, density dependent projections will stabilise around a level, with no net growth or decline. Thus, there is little to be gained from comparing the growth rate of baseline and impacted runs, since these will be the same in both (once the populations have settled to their new levels). However, the size of the population will differ. Hence, for density dependent simulations the CPS is more appropriate than the CPGR. The relevant metrics, in line with the above considerations, have been highlighted

Table 6.36: Summary outputs from Wicklow Head SPA kittiwake population model, mean values (and 95% confidence intervals)

Impact magnitude (annual adult collisions)	Model type	Counterfactual of population size (CPS)	Counterfactual of population growth rate (CPGR)
4	Density independent	0.9130 (0.7820 – 1.0630)	0.9971 (0.9928 – 1.0013)
	Density dependent	0.9675 (0.8664 – 1.0356)	0.9990 (0.9959 – 1.0019)
5	Density independent	0.8920 (0.7721 – 1.0368)	0.9964 (0.9922 – 1.0007)
	Density dependent	0.9590 (0.8910 – 1.0272)	0.9986 (0.9958 – 1.0017)
6	Density independent	0.8679 (0.7523 – 1.0050)	0.9956 (0.9915 – 0.9996)

Impact magnitude (annual adult collisions)	Model type	Counterfactual of population size (CPS)	Counterfactual of population growth rate (CPGR)
	Density dependent	0.9503 (0.8855 – 1.0191)	0.9984 (0.9954 – 1.0014)
7	Density independent	0.8491 (0.7326 – 0.9889)	0.9949 (0.9907 – 0.9992)
	Density dependent	0.9423 (0.8775 – 1.0097)	0.9981 (0.9952 – 1.0010)

6.8.6.13 The first aspect to note is that the 95% confidence intervals for annual mortality for both the CPS (counterfactual of population size) and CPGR (counterfactual of population growth rate) for all but three of the results presented include 1.0. Therefore, none of these results would be considered to indicate a statistically significant effect, and even those outputs that did not include 1 were very close (e.g. 0.9996).

6.8.6.14 The CPGR for the density independent models indicates that the growth rate would be reduced by no more than 0.5% (0.9949) and the population would be reduced by no more than 5.8% (0.9423). The latter (density dependent) would indicate the number of pairs, after 36.5 years, might be reduced from 773 to 728, while the former (density independent) suggests there might be a reduction in the long-term growth rate from 0.992 to 0.987 (=0.992 x 0.9949).

6.8.6.15 As noted above, while the strength and form of density dependence in kittiwake populations is not fully understood, there is strong evidence for density dependence acting on kittiwake populations in terms of their competition for food around the colony (Furness and Birkhead, 1984; Ford *et al.*, 2007, Wakefield *et al.*, 2017), and in terms of colony growth and net immigration rates (Coulson 2011; Miller *et al.*, 2019). There is also strong evidence that kittiwake colonies form a meta-population with high levels of immigration of young birds into colonies (Coulson, 2011). That flow of immigrant birds will also tend to reduce the assessed impact of additional mortality at the focal colony compared with population models (such as used here) that assume each SPA population to be a closed population (Miller *et al.*, 2019). Therefore, the prediction that the population size would be 5% smaller than it would otherwise have been without the additional mortality, is considered to represent a more reliable guide to the level of potential impact on the population.

6.8.6.16 It is also important to note however, that offshore windfarm collision risk assessments include several sources of precaution in the input parameters used and that the magnitude of impact predicted here is very likely to over-estimate the true impacts. If accounting for this over-precaution reduced predicted collisions to around 2 per year, then the predicted effect on the population would be considered undetectable (Parker *et al.* 2022).

6.8.6.17 In view of the predicted small effects on the population status, it is concluded that the population dynamics of the species indicate that any additional mortality due to the Proposed Development will not materially affect the population's ability to maintain itself on a long-term basis as a viable component of its natural habitats; the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

6.8.6.18 **Overall therefore, on the basis of the precautionary impact predictions and PVA results it is concluded beyond reasonable scientific doubt that there will be no AEoI on the kittiwake feature of Wicklow Island SPA, as defined by the COs of the site, as a result of collision effects considered above, from Project Design Option 1.**

6.8.6.19 **Based on the increased risk of effect of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

6.8.7 Summary of Stage 2 Appraisal for Sites Screened in for Intertidal and Offshore Ornithology QIs

6.8.7.1 The potential effects on seabird features of SPAs with connectivity to the Proposed Development have been assessed with respect to collision and displacement risks. Table 6.37 provides a summary of the assessment and conclusions.

Table 6.37: Conclusion for the assessment of potential impacts on intertidal and offshore ornithology receptors

Potential impact	Differences between Project Design Option 1 and 2	Conclusion
Collision risk with operational turbines	No difference between Project Design Option 1 and 2	No AEoI for Howth Head Coast SPA, Ireland's Eye SPA, Lambay Island SPA, Skerries Islands SPA, Saltee Islands SPA and Wicklow Head SPA for any seabird features.
Displacement risk during construction	No difference between Project Design Option 1 and 2	No AEoI for Howth Head Coast SPA, Ireland's Eye SPA, Lambay Island SPA, Skerries Islands SPA, Saltee Islands SPA and Wicklow Head SPA for any seabird features.
Displacement risk during operation	No difference between Project Design Option 1 and 2	No AEoI for Howth Head Coast SPA, Ireland's Eye SPA, Lambay Island SPA, Skerries Islands SPA, Saltee Islands SPA and Wicklow Head SPA for any seabird features.

7 Stage 2 Information to inform the In-Combination Assessment

7.1 Approach to tiering

7.1.1.1 The in-combination assessment takes into account the effects associated with the Proposed Development together with other projects and plans. The projects and plans selected as relevant to the in-combination assessment are based upon the results of the Stage 1 Screening Assessment exercise and also the more in-depth Stage 2 appraisal on each of the QIs of the European sites concerned, in the foregoing sections of this NIS.

7.1.1.2 Each project is considered on a case by case basis for screening into or out of this assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

7.1.1.3 In assessing the potential in-combination impacts, it is important to note that projects, predominately those currently ‘proposed’, may or may not be, ultimately, taken forward for development. Therefore, there is a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which might arise from such proposals. For example, projects which are already under construction are more likely to contribute to in-combination effects than those development applications that are not yet determined.

7.1.1.4 To account for these uncertainties all the relevant long list projects have been allocated into ‘Tiers’, reflecting their current status within the planning and development process. This allows the in-combination assessment to present several scenarios, reflecting the varying levels of certainty of an activity proceeding and therefore the potential for impacts to arise that might act in-combination with the impacts arising from the Proposed Development. It is important to note that for the purposes of the NIS, the level of assessment made for ‘future projects’ will be greatly influenced by, and reflective of, the level of information available on such projects at the time of compilation of the NIS.

7.1.1.5 A tiered approach to assessment has been adopted as follows:

Table 7.1: Tiered approach to the in-combination assessment

Tiers	Development Stage
Tier 1	• The other elements of the project, which are required for the operation of the Proposed Development, including: the Operation and Maintenance (O&M) Facility, Onshore Grid Infrastructure (OGI) and EirGrid Upgrade works; • Projects under construction. Those projects that are only partially constructed at the time that baseline characterisation was undertaken; • Those that were only recently completed, during the development of the baseline characterisation, the full extent of the impacts arising from the development(s) may not be reflected in the baseline; and/ or • Those plans and projects which may have consent or licences to undertake further work, such as maintenance dredging or notable maintenance works which may arise in additional effects. • Built and operational projects will be included within the in-combination assessment where they have not been included within the environmental characterisation, i.e. they were not operational when the baseline characterisations were undertaken, and/ or any residual impact may not have yet fed through to and been captured in estimates of ’baseline’ conditions or there is an ongoing effect.
Tier 2	• Permitted application(s), but not yet implemented;

Tiers	Development Stage
Tier 3	• Submitted application(s), but not yet determined;
	• Identified in the relevant development plan (and emerging development plans – with appropriate weight given as they move closer to adoption) recognising that much information on any relevant proposals will be limited; and
	• Identified in other plans and programmes (as appropriate) which set the framework for future development consents/ approvals, where such development is reasonably likely to come forward.

7.1.1.6 The Developer submitted a Foreshore Licence Application for Site Surveys (associated with the Proposed Development) to the Minister for Housing, Local Government and Heritage in April 2023 (FS007555) and this application is pending determination. The Developer confirms and commits that they will not conduct any activities the subject of the Foreshore Licence Application for Site Surveys (should a licence be granted) at the same time as any development is being carried out under this permission (if granted). As such there is no temporal overlap between the activities proposed in the Foreshore Licence Application and the Proposed Development. For this reason, FS007555 is not included within the in-combination assessment of this NIS.

7.2 Phase 1 Offshore Wind Projects in Ireland

7.2.1.1 All Phase 1 projects have been awarded a MAC, due to the likely similar development timelines of the Phase 1 projects, and the resultant risk associated with in-combination effects, there is a requirement to assess Phase 1 projects within the NIS, as appropriate and as information allows. As a result, Phase 1 projects fall outside of the tiered hierarchy described above.

7.2.1.2 The approach will need to be clearly documented. For a number of topics, Phase 1 projects have been assessed similarly to Tiers 1 and 2 where sufficient information exists, or where information isn't available, a very high-level assessment has been undertaken. For all projects, scoping has been published, and for a number of topics coordinated consultation is ongoing to enable sharing of information for assessments to allow an informed and robust assessment to be undertaken. The availability of suitable information will be largely topic driven, with authors aware, and actively involved.

7.2.1.3 Phase 1 projects comprise:

- Dublin Array;
- Codling Wind Park I and II;
- Oriel Wind Park;
- North Irish Sea Array (NISA); and
- Fuinneamh Sceirde Teoranta (Sceirde Rocks).

7.2.1.4 Shipping noise is a key characteristic of the ambient underwater noise in the area, and the noise produced by vessels during construction and operational phases of the Proposed Development, when considered in-combination with noise associated with existing shipping, shall not increase peak background underwater noise to levels that could disrupt communication due to masking, or alter behaviour patterns, in mobile marine species. The Array Area and Cable Corridor and Working Area are subject to relatively high levels of shipping activity currently, and it is expected that the vessel activity would be no greater than the baseline during construction activities (due to construction exclusion zones reducing current shipping activity and the number of construction vessels expected to be much lower than that which currently transit the area). The underwater noise impacts from vessel noise are generally spatially limited to the immediate area around the vessel rather than having impacts over a wide area (e.g., Mitson, 1993). This is the case for both Project Design Options.

7.2.1.5 On this basis, projects considered have been limited to those with the potential to have in-combination effects with the Proposed Development, namely marine developments or activities in the vicinity of the Array Area and marine developments at a greater distance where disturbance, displacement and collision risks arise in the case of mobile Habitats Directive Annex II species and Birds Directive species. Projects were identified using the same distances used for screening of European sites.

7.2.1.6 A longlist of reasonably foreseeable plans and projects has been identified and has been reduced to a shortlist for assessment based on whether there is a spatial or temporal overlap between the potential effects of the projects.

7.3 Other elements of the Proposed Development

7.3.1 Onshore Grid Infrastructure and Operational and Maintenance Facility

7.3.1.1 In May 2022, ABP granted planning approval to develop the Onshore Grid Infrastructure (OGI) (Case Reference: 310090). The OGI includes a 220 kV substation at Shelton Abbey, with an associated connection from the new substation to the existing National Electricity Transmission Network. The consented development also includes an underground cable route and associated infrastructure connecting the substation to the landfall point at Johnstown North (approximately 5 km north of Arklow harbour), where it will meet the proposed offshore export cables connecting to ABWP2.

7.3.1.2 In June 2022, the Developer received planning permission from Wicklow County Council (Planning Register Reference: 21/1316) to develop an Operations and Maintenance Facility (OMF) at South Dock, Arklow Harbour. The building and associated pontoon and ancillary infrastructure will serve as the support base for ABWP2 throughout its operational lifetime and will support around 60-70 long term local jobs. This facility will also incorporate a Sustainable Education Centre.

7.3.2 EirGrid upgrade works

7.3.2.1 EirGrid published the Shaping Our Electricity Future (SOEF) Roadmap Version 1.0 in November 2021 and Version 1.1. in July 2023 which is a roadmap for how EirGrid plans to develop the network in line with Ireland's climate change policies which are reflected in the Climate Action Plan (CAP). One of the key targets of the CAP, and a key input to SOEF, is delivery of 5,000MW of Offshore Wind by 2030. EirGrid included all Phase 1 Offshore projects, which includes this development, in their SOEF analysis and confirmed that Arklow-Ballybeg-Carrickmines would need to be up-voltaged to 220kV with a new 220kV/110kV substation at Ballybeg. This project (CP1196) is now in the EirGrid Network Delivery Portfolio (NDP) and is progressing through the EirGrid Project Development Gateways.

7.3.2.2 The Developer has also received a Grid Connection Assessment (GCA) for an 800 MW offshore project connecting via a loop-in connection just south of Arklow on the Arklow-Lodgewood 220 kV OHL which passes within 230 m of the proposed loop-in site. The 220 kV double circuit pylons extend south of Arklow 220 kV substation to this location. Currently only one side of the pylons is strung so the other side will need to be strung between Arklow and the proposed substation site. The stringing of the second circuit is defined as non-contestable works required to facilitate the project and will be subject to a separate consent application which will be progressed by EirGrid. A Final Connection Offer will be issued to Developer and executed by EirGrid once the developer achieves full consent for the project and provides proof of route to market.

7.4 Other Projects and Plans Included in In-combination Assessment

7.4.1.1 The plans and projects included within the in-combination assessment can be seen in Table 7.2 – Table 7.5 below.

7.4.1.2 Although plans have been considered, none have been screened in for the in-combination assessment below.

Table 7.2: List of other projects and plans considered within the in-combination assessment for Annex I coastal and marine habitats

Project/Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors and Working Areas	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
Tier 1							
Arklow Bank Wind Park 1 Power Cable	Operational	0.0	0.0	Power	Complete	Ongoing	Temporal overlap of operational phase with the Proposed Development construction and Operational and Maintenance phases.
ABWP2 Onshore Grid Infrastructure (OGI)	Consented	10.2	0.0	Onshore grid infrastructure located onshore and required for the operation of the Proposed Development. Includes onshore grid infrastructure including 220kV export cable circuits and fibre optic cables, new 220kV GIS substation at Shelton Abbey and overhead line connection and all associated ancillary works	2026 - 2030	2030 - 2066	Potential temporal overlap with the Proposed Development construction, operational and maintenance phases.

Project/Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors and Working Areas	Description of Project/Plan	Dates of Construction	Dates of Operatio n	Justification for screening in
ABWP1	Operational	0.0	0.5	Initial foreshore lease granted in 2002	Complete	Ongoing	Temporal overlap of operational phase with the Proposed Development construction and Operational and Maintenance phases.
Arklow Waste Water Treatment Plant	Construction	3.4	10.8	Relates to ABWP2. The Project (proposed development) will comprise a new Wastewater Treatment Plant (WwTP), associated infrastructure including the interceptor sewer network and marine outfalls as well as an upgrade to the existing coastal revetment. 80% Complete as of 2022.	2021-2024	2025 onwards	Temporal overlap of operational phase with the Proposed Development construction and Operational and Maintenance phases.
Development to the south of South Quay Arklow - ABWP2 OMF	Approved	4.3	11.9	Relates to ABWP2. As part of the works, a pontoon is proposed along with up to 4 cranes for loading and unloading of vessels. Additionally, dredging of approximately 6,000 m^3 of material from the nearshore is also proposed, to provide for	2026-2030	2030 onwards	Temporal overlap of construction and operational phases with the Proposed Development construction and

Project/Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors and Working Areas	Description of Project/Plan	Dates of Construction	Dates of Operatio n	Justification for screening in
				navigational depth, berthing area and manoeuvring area for vessels.			Operational and Maintenance phases.
Hibernia Atlantic	Operational	15.4	14.8	Telecom	Complete	Ongoing	Temporal overlap of operational phase with the Proposed Development construction and Operational and Maintenance phases.
Irish Mussel Seed Company Ltd.	Operational	9.9	5.3	Aquaculture	Complete	Ongoing	Temporal overlap of operational phase with the Proposed Development construction and Operational and Maintenance phases.
Wicklow Port Company dredge disposal	Operational	8.8	7.9	Dredge disposal	N/A	2024 onwards	Potential for temporal overlap of operation with Proposed Development construction and Operational and Maintenance phases.

Project/Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors and Working Areas	Description of Project/Plan	Dates of Construction	Dates of Operatio n	Justification for screening in
Tier 2							
Arklow Flood Relief Scheme	Conditionally approved	4.01	11.5	Wicklow County Council funded by the Office of Public Works (OPW), proposes to undertake engineering works along the Avoca River and surrounds to mitigate the risk of flooding in the Arklow town area in County Wicklow. Proposed works include dredging, installation of flood defence embankments/ walls and gravel/ debris traps.	2024 - 2028	2028 -	Potential for temporal overlap with Proposed Development construction phase.
Tier 3							
ABWP1	Decommissio ning	0.0	0.5	ABWP 1 which is an operational OWF decommissioning phase activities			Temporal overlap of *operational phase with* the Proposed Development construction phase.
Phase 1 Projects							
Codling Wind Park (formerly	Early planning	18.2	17.3	Updated application expected to be made under the Maritime	2027 - 2028	2028 onwards	Potential for temporal overlap of construction

Project/Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors and Working Areas	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
known as Codling I and Codling II)				Area Planning Act 2021. Scoping Report indicates up to 140 wind turbines and up to five OSPs (CWP, 2020).			and operation with Proposed Development construction and Operational and Maintenance phases.

Table 7.3: List of other projects and plans considered within the in-combination assessment for migratory fish

Project/Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors and Working Areas	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
Tier 1							
ABWP1	Operational	0	0.5	Initial foreshore lease granted in 2002"	Complete	2021 onwards	Temporal overlap of operational phase with the Proposed Development construction and Operational and Maintenance phases.
Hibernia Atlantic Telecom	Operational	15.4	14.8	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and Operational and Maintenance phases.

Project/Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors and Working Areas	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
UK-Ireland 2 Telecom	Operational	39.0	38.4	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and Operational and Maintenance phases.
ESAT 2	Operational	46.3	45.4	Telecom	2021	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and Operational and Maintenance phases.
CeltixConnect - Sea Fibre Networks	Operational	49.2	48.3	Telecom cable	2022 - 2026	2026 onwards	Potential for temporal overlap of operation with Proposed Development

Project/Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors and Working Areas	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
							construction and Operational and Maintenance phases.
Arklow Bank dredge disposal	Operational	0.0	0.8	Dredge disposal	N/A	2021 onwards	Potential for temporal overlap with Proposed Development construction and Operational and Maintenance phases.
Hibernia Atlantic – Hibernia C	Operational	54.8	53.9	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and Operational and Maintenance phases.

Project/Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors and Working Areas	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
ZAYO Emerald Bridge One - Telecom	Operational	58.5	57.6	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and Operational and Maintenance phases.
SIRIUS South - Telecom	Operational	58.7	57.8	Telecom	Complete	2021 onwards	Potential for temporal overlap of operation with Proposed Development construction and Operational and Maintenance phases.
Wicklow Port Company dredge disposal	Operational	8.8	7.9	Dredge disposal	N/A	2024 onwards	Potential for temporal overlap of operation with Proposed Development

Project/Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors and Working Areas	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
							construction and Operational and Maintenance phases.
Tier 3							
Mares Connect	Proposed	37.5	36.6	Power cable	2024 - 2027	2027 onwards	Potential for temporal overlap of construction and operation with Proposed Development construction and Operational and Maintenance phases.
ABWP1	Decommissioning	0.0	0.5	ABWP 1 which is an operational OWF decommissioning phase activities			Temporal overlap of operational phase with the Proposed Development

Project/Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors and Working Areas	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
							construction phase.
Phase 1 Projects							
Codling Wind Park (formerly known as Codling I and Codling II)	Early planning	18.2	17.3	Updated application expected to be made under the Maritime Area Planning Act 2021. Scoping Report indicates up to 140 wind turbines and up to five OSPs (CWP, 2020).	2027 - 2028	2028 onwards	Potential for temporal overlap of construction and operation with Proposed Development construction and Operational and Maintenance phases.
Dublin Array (formerly known as Bray and Kish Offshore Windfarms)	Proposed	25.8	24.9	Updated application expected to be made under the Maritime Area Planning Act 2021. Scoping Report indicates up to 61	2028-2032	2032 onwards	Potential for temporal overlap of construction and operation with Proposed Development construction and Operational and

Project/Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors and Working Areas	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
				wind turbines with up to 308 m tip height and indicative hub height of 165.5 m above mean high water springs (Innogy, 2020).			Maintenance phases.
North Irish Sea Array	Early planning	65.1	64.1	Site investigation works from 2021-2026 Foreshore licence applied for surveys from summer 2020. Planning submission targeted 2023.	2027 - 2029	2029 onwards	Potential for temporal overlap of construction and operation with Proposed Development construction and Operational and Maintenance phases.

Table 7.4: List of other projects and plans considered within the in-combination assessment for marine mammals

Project/ Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
Tier 1							
Saint-Brieuc	Under construction	480.6	479.9	A 496 MW offshore windfarm with 62 turbines.	2021 – 2024	From 2025	Within the ZoI for potential in-combination impacts.
CeltixConnect	Active	49.2	48.3	Telecom cable.	2022 – 2026	From 2027	Potential for temporal overlap with Proposed Development construction phase.
Greenlink Interconnector	In construction	79.6	79.0	Power cable.	2021 – 2024	From 2025	Within the ZoI for potential in-combination impacts.
Celtic Interconnector	In construction	151.9	151.3	Power cable.	2023 – 2026	From 2027	Potential for temporal overlap with Proposed Development construction phase.
West Anglesey demonstration zone	Under construction	85.0	84.1	Tidal.	2023 – 2026	From 2027	Potential for temporal overlap with Proposed Development construction phase.
Tier 2							

Project/ Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
Erebus Floating Wind Demo	Consented	133.3	132.7	Consented for up to 7 turbines.	2025/2026 – 2026/2027	From 2028	Potential for temporal overlap with Proposed Development construction phase.
Awel y Môr	Consented	148.5	147.6	Consented for up to 50 turbines.	2026 – 2030	From 2031	Potential for temporal overlap with Proposed Development construction phase.
Atlantic Marine Energy Test Site	Consented	314.3	308.8	Test site for wave energy converters and floating wind.	2024 – 2025	From 2026	Within the ZoI for potential in-combination impacts.
Holyhead Deep	Consented	84.0	83.1	Tidal.	2026 – 2029	From 2030	Potential for temporal overlap with Proposed Development construction phase.
Tier 3							
Valorous	Pre-planning application	141.9	141.3	Pre-lease offshore windfarm (Project planning and design phase).	2029	From 2030	Potential for temporal overlap with Proposed Development construction phase.
Mona	Planning application submitted	146.7	145.7	English Round 4 project with up to 107 turbines. Lease awarded.	2026 – 2027	From 2028	Potential for temporal overlap with Proposed Development construction phase.

Project/ Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
Llyr 1	Pre-planning application	148.0	147.3	A 200 MW test and demonstration site for floating offshore wind with up to 10 turbines.	2026 – 2027	From 2028	Potential for temporal overlap with Proposed Development construction phase.
Llyr 2	Pre-planning application	151.9	151.2	A 200 MW test and demonstration site for floating offshore wind with up to 10 turbines.	2026 – 2027	From 2028	Potential for temporal overlap with Proposed Development construction phase.
Morgan	Pre-planning application	165.3	164.3	English Round 4 project with up to 96 turbines.	2028 – 2029	From 2030	Potential for temporal overlap with Proposed Development construction phase.
Morecambe	Pre-planning application	174.2	173.3	English Round 4 project with up to 40 turbines.	2026/2027 – 2028/2029	From 2030	Potential for temporal overlap with Proposed Development construction phase.
White Cross	Planning application submitted	174.7	174.0	A 100 MW floating offshore wind demonstration project with up to 8 turbines.	2026 – 2027	From 2028	Potential for temporal overlap with Proposed Development construction phase.
Isle of Man (Mooir Vannin)	Pre-planning application	179.2	178.2	A 1.4 GW offshore windfarm with up to 100 turbines.	2030 – unknown	unknown	Potential for temporal overlap with Proposed Development construction phase.

Project/ Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
North Channel Wind 2	Pre-planning application	204.0	203.1	A 420 MW offshore windfarm in Northern Ireland.	2029 – 2030	From 2031	Potential for temporal overlap with Proposed Development construction phase.
North Channel Wind 1	Pre-planning application	227.9	227.0	A 1 GW offshore windfarm in Northern Ireland.	2029 – 2030	From 2031	Potential for temporal overlap with Proposed Development construction phase.
Mares Connect	Proposed	37.5	36.6	Power cable.	2024 – 2027	From 2028	Potential for temporal overlap with Proposed Development construction phase.
Xlinks	Proposed	192.3	191.6	Power cable.	2027 – 2029	From 2030	Potential for temporal overlap with Proposed Development construction phase.
Erebus / Valorous proposed cable route	Proposed	123.7	123.0	Power cable.	2025 – 2026	From 2027	Potential for temporal overlap with Proposed Development construction phase.
LirIC	Proposed	204.6	203.7	Power cable.	Unknown – 2028	From 2029	Potential for temporal overlap with Proposed Development construction phase.

Project/ Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
ABWP1	Decommissioning	0.0	0.5	ABWP 1 which is an operational OWF decommissioning phase activities			Temporal overlap of operational phase with *the* Proposed Development construction phase.
Phase 1 Projects							
Codling Wind Park (formerly known as Codling I and Codling II)	Early planning	18.2	17.3	Updated application expected to be made under the Maritime Area Planning Act 2021. Scoping Report indicates up to 140 wind turbines and up to five OSPs (CWP, 2020).	2027 - 2028	2028 onwards	Potential for temporal overlap of construction and operation with Proposed Development construction and Operational and Maintenance phases.
Dublin Array (formerly known as Bray and Kish Offshore Windfarms)	Proposed	25.8	24.9	Updated application expected to be made under the Maritime Area Planning Act 2021. Scoping Report indicates up to 61 wind turbines with up to 308 m tip height and indicative hub height of 165.5 m above mean high water springs (Innogy, 2020).	2028-2032	2032 onwards	Potential for temporal overlap of construction and operation with Proposed Development construction and Operational and Maintenance phases.

Project/ Plan	Status	Distance from Array Area (km)	Distance from Export Cable Corridors	Description of Project/Plan	Dates of Construction	Dates of Operation	Justification for screening in
North Irish Sea Array	Early planning	65.1	64.1	Site investigation works from 2021-2026 Foreshore licence applied for surveys from summer 2020. Planning submission targeted 2023.	2027 - 2029	2029 onwards	Potential for temporal overlap of construction and operation with Proposed Development construction and Operational and Maintenance phases.
Oriel	Proposed	108.1	107.2	'Relevant Project'. Updated application expected to be made under the Maritime Area Planning Act 2021. 'Relevant Project'. Phase 1 Concept/Early Planning (MAC awarded) Foreshore licence application determined 2023.	2026-2028 (piling from 2026 – 2027)	From 2030	Potential for temporal overlap with Proposed Development construction phase.
Sceirde Rocks	Proposed	264.3	254.1	'Relevant Project'. Updated application expected to be made under the Maritime Area Planning Act 2021.A 450 MW Irish offshore windfarm. MAC awarded in 2022	2026 – 2030	From 2031	Potential for temporal overlap with Proposed Development construction phase.

Table 7.5: List of other projects and plans considered within the in-combination assessment for waders and offshore ornithology

Project/Plan	Status	Distance from Array Area (km)	Distance from offshore export cable routes (km)	Description of Project/Plan	Dates of Construction (if applicable)	Dates of Operation (if applicable)	Overlap with the Proposed Development
Tier 1							
ABWP1	Operational	0	0.5	ABWP1, consisting of seven wind turbines at a capacity of 25.2 MW.	2003 to 2004	2004 to ongoing	Screened in due to ongoing impact. Located within the Array Area.
Rhyl Flats	Operational	156.3	155.5	Operational windfarm comprising 25 turbines	N/A	2009 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Barrow Offshore Windfarm	Operational	208.6	207.6	Operational windfarm comprising 30 turbines	N/A	2006 to ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Gwynt y Mor Offshore Windfarm	Operational	159	158.1	Operational windfarm comprising 160 turbines	N/A	2015 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
North Hoyle	Operational	170.9	170.1	Operational windfarm comprising 30 turbines	N/A	2003 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to

Project/Plan	Status	Distance from Array Area (km)	Distance from offshore export cable routes (km)	Description of Project/Plan	Dates of Construction (if applicable)	Dates of Operation (if applicable)	Overlap with the Proposed Development
							impacts on regional seabird populations
Walney Extension	Operational	187.1	186.1	Operational windfarm comprising 47 turbines	N/A	2018 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Burbo Bank	Operational	189.9	189.0	Operational windfarm comprising 25 turbines	N/A	2007 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Burbo Bank Extension	Operational	180.6	179.8	Operational windfarm comprising 32 turbines	N/A	2017- ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Robin Rigg Offshore Windfarm	Operational	247.3	246.3	Operational windfarm comprising 58 turbines	N/A	2010 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
West of Duddon Sands Offshore Windfarm	Operational	196.9	195.9	Operational windfarm comprising 108 turbines	N/A	2014 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to

Project/Plan	Status	Distance from Array Area (km)	Distance from offshore export cable routes (km)	Description of Project/Plan	Dates of Construction (if applicable)	Dates of Operation (if applicable)	Overlap with the Proposed Development
							impacts on regional seabird populations
Walney Offshore Windfarm	Operational	199.1	198.1	Operational windfarm comprising 102 turbines	N/A	2010 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Ormonde	Operational	207.4	206.4	Operational windfarm comprising 30 turbines	N/A	2012 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Tier 2							
Erebus Offshore Windfarm	Consented	133.3	132.7	Consented for up to 7 turbines	2025-2027	From 2028	Potential for overlap with Proposed Development construction and Operational and Maintenance phases
Awel y Mor Offshore Windfarm	Consented	148.5	147.6	Consented for up to 50 turbines	2026-2030	From 2031	Potential for overlap with Proposed Development construction and Operational and Maintenance phases
Twin Hub Offshore Windfarm	Consented	256.2	255.6	Floating test site with 4 turbines	2026	2027	Potential for overlap with Proposed Development construction and

Project/Plan	Status	Distance from Array Area (km)	Distance from offshore export cable routes (km)	Description of Project/Plan	Dates of Construction (if applicable)	Dates of Operation (if applicable)	Overlap with the Proposed Development
							Operational and Maintenance phases.
Tier 3							
ABWP1	Decommissioning	0	0.5	ABWP1, consisting of seven wind turbines at a capacity of 25.2 MW.	2026	N/A	Screened in due to potential for overlap between decommissioning of ABWP1 and construction of ABWP2.
Mona Offshore Windfarm	Proposed	146.7	145.7	English Round 4 project with up to 107 turbines	2026-2027	From 2028	Potential for overlap with Proposed Development construction and Operational and Maintenance phases
Morgan Offshore Windfarm	Proposed	165.3	164.3	English Round 4 project with up to 96 turbines	2028-2029	From 2030	Potential for overlap with Proposed Development construction and Operational and Maintenance phases
Morecambe Offshore Windfarm	Proposed	174.2	173.3	English Round 4 project with up to 40 turbines	2026-2029	From 2030	Potential for overlap with Proposed Development construction and Operational and Maintenance phases
Valorous Offshore Windfarm	Proposed	141.9	141.3	Early stage planning	2029	From 2030	Potential overlap of Operational and Maintenance phases.
Phase 1 Projects							

Project/Plan	Status	Distance from Array Area (km)	Distance from offshore export cable routes (km)	Description of Project/Plan	Dates of Construction (if applicable)	Dates of Operation (if applicable)	Overlap with the Proposed Development
Codling Wind Park (formerly known as Codling I and Codling II)	Proposed	18.2	17.3	'Relevant Project'. Updated application expected to be made under the Marine Planning and Development Management (MPDM) regime. Scoping Report indicates up to 140 wind turbines and up to five OSPs (CWP, 2020).	2026-2028	From 2029	Potential for overlap with Proposed Development construction and Operational and Maintenance phases.
Dublin Array (formerly known as Bray and Kish Offshore Windfarms)	Proposed	25.8	24.9	'Relevant Project'. Updated application expected to be made under the MPDM regime. Scoping Report indicates up to 61 wind turbines with up to 308 m tip height and indicative hub height of 165.5 m above mean high water springs (Innogy, 2020).	2028-2032	From 2033	Potential for overlap with Proposed Development construction and Operational and Maintenance phases.
North Irish Sea Array	Proposed	65.1	64.1	'Relevant Project'. Updated application expected to be	2027-2029	From 2030	Potential for overlap with Proposed Development construction and

Project/Plan	Status	Distance from Array Area (km)	Distance from offshore export cable routes (km)	Description of Project/Plan	Dates of Construction (if applicable)	Dates of Operation (if applicable)	Overlap with the Proposed Development
				made under the MPDM regime.			Operational and Maintenance phases.
Oriel Wind Park	Proposed	108.1	107.2	'Relevant Project'. Updated application expected to be made under the MPDM regime.	2026-2028	From 2029	Potential for overlap with Proposed Development construction and Operational and Maintenance phases.

7.5 In-Combination Assessment

7.5.1 Annex I Coastal and Marine Habitats

7.5.1.1 The in-combination coastal and marine habitats assessment has considered the same potential impacts, SAC and features screened in for assessment of the Proposed Development alone (section 6.2). The additional Plans and Projects considered are listed in Table 7.2 above.

7.5.1.2 Tier 1 projects screened in include ABWP1, subsea cables for ABWP1 and Hibernia Atlantic, Arklow Wastewater Treatment Plant, ABWP2 OMF, ABWP2 OGI and aquaculture for the Irish Mussel Seed Company Ltd. All Tier 1 projects other than ABWP2 OMF and OGI will be operational at the time construction works of the proposed development commence and the operation and potential decommissioning of these projects may overlap with the construction, operational and maintenance and decommissioning phases of the Proposed Development. The construction of ABWP2 OMF and OGI may overlap with the construction and operational and maintenance phases of the Proposed Development, whilst the operation and decommissioning of ABWP2 OMF and OGI may overlap with the operational and maintenance and decommissioning phases of the Proposed Development. Although the majority of works associated with ABWP2 OMF will be completed onshore, some elements will exist within the offshore environment. For example, plans for the development of the ABWP2 OMF will include a pontoon for vessels and dredging of approximately 6,000 m^3 of material from a nearshore area. The OGI will only contribute to suspended sediment concentrations and associated deposition.

7.5.1.3 The only Tier 2 project screened in is the Arklow Flood Relief Scheme, which will involve engineering works along the Avoca River and surrounds. These works will include dredging, installation of flood defence embankments/ walls and gravel/ debris traps. These works will occur between 2024-2028 and may overlap with the construction phase of the Proposed Development. This project only has potential to impact via suspended sediment concentrations and associated deposition.

7.5.1.4 The only Tier 3 project screened in is the decommissioning of ABWP1 infrastructure, which will involve the cutting of monopiles at a depth of 2 m below seabed, removal of monopiles and cutting, burial and backfilling of proportions of the inter-array cables. Decommissioning is anticipated to take 4 months between 2025 and 2027 and may overlap with the construction phase of the Proposed Development.

7.5.1.5 Phase 1 projects screened in include Codling Wind Park and Dublin Array. The construction phase of Codling Wind Park and Dublin Array may overlap with the construction phase of the Proposed Development. The operation phase of Codling Wind Park and Dublin Array may overlap with the construction and operation phases of the Proposed Development. Plans for Dublin Array indicate that the proposed development will comprise a maximum of 61 WTGs, three OSP's and three export cables (Innogy, 2020). Plans for Codling Wind Park indicate that the proposed development may comprise up to 140 WTGs, 6 export cables and up to 5 OSPs (CWP, 2020). Phase 1 projects show similar construction, operational and decommissioning activities and therefore the impacts and magnitudes of the impacts are expected to be similar in nature to that of the Proposed Development.

Construction and Decommissioning

ELEVATED LEVELS OF SUSPENDED SEDIMENT CONCENTRATIONS AND ASSOCIATED DEPOSITION

7.5.1.6 The following in-combination assessment considers the Wicklow Reef SAC which is designated for Reefs and Blackwater Bank SAC which is designated for Sandbanks which are slightly covered by seawater all the time.

7.5.1.7 There is the potential for in-combination elevated levels of suspended sediment concentrations and associated deposition as a result of both the construction and decommissioning activities associated with the Proposed Development and the Tier 1, 2, 3 and Phase 1 projects identified in Table 7.2.

TIER 1 PROJECTS

7.5.1.8 From the Tier 1 projects, elevated levels of suspended sediment concentrations and associated deposition may occur as a result of as a result of the installation of the pontoon and associated dredging required for the ABWP2 OMF and construction of the ABWP2 OGI. All other Tier 1 projects will be operational during the construction phase of the Proposed Development. However, increased suspended sediment concentrations and associated deposition may occur as a result of any repair and maintenance activities required to infrastructure for ABWP1, ABWP1 and Hibernia Atlantic subsea cables and the long sea outfall for the Arklow Waste Water Treatment Plant. Elevated levels of suspended sediment concentrations and associated deposition during construction and operational and maintenance activities as part of the Tier 1 projects are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected to be localised and small in the context of subtidal habitats within the Coastal and Marine Habitats ZoI, being 20 km. Elevated levels of suspended sediment concentrations and associated deposition are not anticipated to occur during the operational phase of the aquaculture of shellfish from the Irish Mussel Seed Company Ltd, so are not considered here. As highlighted within the alone assessment (Section 6.2), the results of the modelling (Volume III, Appendix 6.1: Marine Physical Processes Numerical Modelling) confirm that there is no potential for construction phase sediment plumes or associated sediment deposition to reach the QIs within the European sites designated for Coastal and Marine habitats.

7.5.1.9 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 1 Projects as a result of elevated levels of suspended sediment concentrations on 'Reefs' or 'Sandbanks which are slightly covered by seawater all the time' from Project Design Option 1.**

7.5.1.10 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 2 PROJECTS

7.5.1.11 Due to the nature of the work during the construction phase it is considered that any impacts that occur will be temporary and localised. Interaction between sediment plumes generated by the flood relief work and the construction works associated with the proposed development could occur in two ways:

- Where plumes generated from the two different activities meet and coalesce to form one larger plume; or
- Where seabed sediment disturbance occurs within the plume generated by Proposed Development's construction activities (or vice versa).

7.5.1.12 Within the options considered above, the physical laws of dispersion theory mean concentrations within the plumes are not additive but instead a larger plume is created, with regions of potentially differing concentrations representative of the separate respective plumes. In contrast, in the case of plumes formed by dredging operating within the plume created by foundation installation or bed preparation activities (or vice versa), the two plumes would be additive, creating a plume with higher SSC. The assessment undertaken for the Proposed Development alone shows that in almost all cases, sediment plumes are rapidly indistinguishable from background levels. Furthermore, the assessment also indicates that the sediment plumes disperse along the north-south orientated tidal axis which further limits the potential for sediment plumes from Proposed Development activities to interact with those from other activities resulting in seabed disturbance.

7.5.1.13 **Therefore, when considered in combination, it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 2 Project as a result of elevated levels of suspended sediment concentrations on 'Reefs' or 'Sandbanks which are slightly covered by seawater all the time' from Project Design Option 1.**

7.5.1.14 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 3 PROJECTS

7.5.1.15 Elevated levels of suspended sediment concentrations and associated deposition may occur as a result of the anticipated decommissioning of seven wind turbines for ABWP1. Elevated levels of suspended sediment concentrations and associated deposition during decommissioning activities as part of ABWP1 are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected to be localised and small in the context of subtidal habitats within the Coastal and Marine Habitats ZoI, being 20 km. As highlighted within the alone assessment (Section 6.2), the results of the modelling (Volume III, Appendix 6.1: Marine Physical Processes Numerical Modelling) confirm that there is no potential for construction phase sediment plumes or associated sediment deposition to reach the QIs within the European sites designated for Coastal and Marine habitats.

7.5.1.16 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 3 Projects as a result of elevated levels of suspended sediment concentrations on 'Reefs' or 'Sandbanks which are slightly covered by seawater all the time' from Project Design Option 1.**

7.5.1.17 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

PHASE 1 PROJECTS

7.5.1.18 From the Phase 1 projects, elevated levels of suspended sediment concentrations and associated deposition may occur as a result the installation of WTGs, OSPs and associated cables during the construction phase of Codling Wind Park and Dublin Array, and during any repair and maintenance activities required for Codling Wind Park, and/ or decommissioning activities associated with the development at the end of their project timelines. Elevated levels of suspended sediment concentrations and associated deposition during construction and operation activities as part of Phase 1 projects are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected to be localised and small in the context of subtidal habitats within the Coastal and Marine Habitats ZoI, being 20 km. As highlighted within the alone assessment (Section 6.2), the results of the modelling (Volume III, Appendix 6.1: Marine Physical Processes Numerical Modelling) confirm that there is no potential for construction phase sediment plumes or associated sediment deposition to reach the QIs within the European sites designated for Coastal and Marine habitats.

7.5.1.19 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Phase 1 Projects as a result of elevated levels of suspended sediment concentrations on 'Reefs' or 'Sandbanks which are slightly covered by seawater all the time' from Project Design Option 1.**

7.5.1.20 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

ACCIDENTAL POLLUTION

7.5.1.21 The following in-combination assessment considers the Wicklow Reef SAC which is designated for Reefs and Blackwater Bank SAC which is designated for Sandbanks which are slightly covered by seawater all the time.

7.5.1.22 There is the potential for in-combination accidental pollution as a result of both the construction and decommissioning activities associated with the Proposed Development and the Tier 1, 3 and Phase 1 projects identified in Table 7.2.

TIER 1 PROJECTS

7.5.1.23 From the Tier 1 projects, accidental pollution may occur as a result of any vessels and machinery required during the installation of the pontoon and associated dredging required for the Arklow ABWP2 OMF. All other Tier 1 projects will be operational during the construction phase of the Proposed Development and accidental pollution may occur as a result of vessels and machinery required during operational and maintenance activities. Accidental pollution during construction activities as part of the Tier 1 projects is expected to be highly infrequent and of short-term duration where any chemicals released to the water column will be quickly dispersed and diluted via currents and other water movement. As highlighted within the alone assessment (Section 6.2), the avoidance of effect through factored in measures for the Proposed Development includes an EMP (Appendix 25.1) and Marine Pollution Contingency Plan (Annex 2 of Appendix 25.1). Adherence to the avoidance by design measures outlined in Table 6.2 and good working practices will significantly reduce the likelihood of an accidental pollution incident occurring. Given the factored-in measures, the likelihood of accidental release is considered to be extremely low.

7.5.1.24 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 1 Projects as a result of accidental pollution on 'Reefs' or 'Sandbanks which are slightly covered by seawater all the time' from Project Design Option 1.**

7.5.1.25 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 3 PROJECTS

7.5.1.26 Accidental pollution may occur as a result of any vessels and machinery required as a result of a result of the anticipated decommissioning of seven wind turbines for ABWP1. Accidental pollution during decommissioning activities as part of ABWP1 are expected to be highly infrequent and of short-term duration where any chemicals released to the water column will be quickly dispersed and diluted via currents and other water movement. As highlighted within the alone assessment (Section 6.2), the avoidance of effect through factored in measures for the Proposed Development includes an EMP and Marine Pollution Contingency Plan. Adherence to the avoidance by design measures outlined in Table 6.2 and good working practices will significantly reduce the likelihood of an accidental pollution incident occurring. Given the factored-in measures, the likelihood of accidental release is considered to be extremely low.

7.5.1.27 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 3 Projects as a result of accidental pollution on 'Reefs' or 'Sandbanks which are slightly covered by seawater all the time' from Project Design Option 1.**

7.5.1.28 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

PHASE 1 PROJECTS

7.5.1.29 From the Phase 1 projects, accidental pollution may occur as a result of any vessels and machinery required for the installation of WTGs, OSPs and associated cables during the construction phase of Codling Wind Park and Dublin Array, and during any repair and maintenance activities required for Codling Wind Park. Accidental pollution during construction and operation activities as part of Codling Wind Park and Dublin Array are expected to be highly infrequent and of short-term duration where any chemicals released to the water column will be quickly dispersed and diluted via currents and other water movement. As highlighted within the alone assessment (Section 6.2), the avoidance of effect through factored in measures for the Proposed Development includes an EMP and Marine Pollution Contingency Plan. Adherence to the avoidance by design measures outlined in Table 6.2 and good working practices will significantly reduce the likelihood of an accidental pollution incident occurring. Given the factored-in measures, the likelihood of accidental release is considered to be extremely low.

7.5.1.30 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Phase 1 Projects as a result of accidental pollution on 'Reefs' or 'Sandbanks which are slightly covered by seawater all the time' from Project Design Option 1.**

7.5.1.31 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Operational and Maintenance

ELEVATED LEVELS OF SUSPENDED SEDIMENT CONCENTRATIONS AND ASSOCIATED DEPOSITION

7.5.1.32 The following in-combination assessment considers the Wicklow Reef SAC which is designated for Reefs and Blackwater Bank SAC which is designated for Sandbanks which are slightly covered by seawater all the time.

7.5.1.33 There is the potential for in-combination elevated levels of suspended sediment concentrations and associated deposition as a result of the operation activities associated with the Proposed Development and the Tier 1, 2 and Phase 1 projects identified in Table 7.2.

TIER 1 PROJECTS

7.5.1.34 From the Tier 1 projects, elevated levels of suspended sediment concentrations and associated deposition may occur as a result of the installation of the pontoon and associated dredging required for the Arklow ABWP2 OMF during construction and any repair and maintenance required during operation. All other Tier 1 projects will be operational during the operational and maintenance phase of the Proposed Development and therefore, increased suspended sediment concentrations and associated deposition may also occur as a result of any operational and maintenance activities required for these projects. Elevated levels of suspended sediment concentrations and associated deposition during the construction and operation activities as part of the Tier 1 projects are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected to be localised and small in the context of subtidal habitats within the Coastal and Marine Habitats ZoI, being 20 km. Elevated levels of suspended sediment concentrations and associated deposition are not anticipated to occur during the operational phase of the aquaculture of shellfish from the Irish Mussel Seed Company Ltd, so are not considered here. As highlighted within the alone assessment (Section 6.2), the results of the modelling (Volume III, Appendix 6.1: Marine Physical Processes Numerical Modelling) confirm that there is no potential for construction phase sediment plumes or associated sediment deposition to reach the QIs within the European sites designated for Coastal and Marine habitats.

Any sediment plumes and associated deposition during operation are expected to be smaller than those during construction and as a result, there will be no potential for these to reach the QIs within the European sites designated for Coastal and Marine habitats.

7.5.1.35 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 1 Projects as a result of elevated levels of suspended sediment concentrations and associated deposition on 'Reefs' or 'Sandbanks which are slightly covered by seawater all the time' from Project Design Option 1.**

7.5.1.36 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 2 PROJECTS

7.5.1.37 Sediment plumes from operational and maintenance activities are generally short-lived, with major maintenance works being infrequent. Interaction between sediment plumes generated by the flood relief work and the operational and maintenance works associated with the proposed development could occur in two ways:

- Where plumes generated from the two different activities meet and coalesce to form one larger plume; or
- Where seabed sediment disturbance occurs within the plume generated by Proposed Development's construction activities (or vice versa).

7.5.1.38 Within the options considered above, the physical laws of dispersion theory mean concentrations within the plumes are not additive but instead a larger plume is created, with regions of potentially differing concentrations representative of the separate respective plumes. In contrast, in the case of plumes formed by dredging operating within the plume created by foundation installation or bed preparation activities (or vice versa), the two plumes would be additive, creating a plume with higher SSC. The assessment undertaken for the Proposed Development alone shows that in almost all cases, sediment plumes are rapidly indistinguishable from background levels. Furthermore, the assessment also indicates that the sediment plumes disperse along the north-south orientated tidal axis which further limits the potential for sediment plumes from Proposed Development activities to interact with those from other activities resulting in seabed disturbance.

7.5.1.39 **Therefore, when considered in combination, it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 2 Project as a result of elevated levels of suspended sediment concentrations on 'Reefs' or 'Sandbanks which are slightly covered by seawater all the time' from Project Design Option 1.**

7.5.1.40 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

PHASE 1 PROJECTS

7.5.1.41 From the Phase 1 projects, elevated levels of suspended sediment concentrations and associated deposition may occur as a result of the installation of WTGs, OSPs and associated cables during the construction phase of Dublin Array, and during any repair and maintenance activities associated with Codling Wind Park and Dublin Array. Elevated levels of suspended sediment concentrations and associated deposition during operation activities as part of Phase 1 projects are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities. Any areas likely to be exposed to heavy sediment deposition are expected to be localised and small in the context of subtidal habitats within the Coastal and Marine Habitats ZoI, being 20 km. As highlighted within the alone assessment (Section 6.2), the results of the modelling (Volume III, Appendix 6.1: Marine Physical Processes Numerical Modelling) confirm that there is no potential for construction phase sediment plumes or associated sediment deposition to reach the QIs within the European sites designated for Coastal and Marine habitats. Any sediment plumes and associated deposition during operation are expected to be smaller than those during construction and as a result, there will be no potential for these to reach the QIs within the European sites designated for Coastal and Marine habitats.

7.5.1.42 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Phase 1 Projects as a result of elevated levels of suspended sediment concentrations and associated deposition on 'Reefs' or 'Sandbanks which are slightly covered by seawater all the time' from Project Design Option 1.**

7.5.1.43 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

ACCIDENTAL POLLUTION

7.5.1.44 The following in-combination assessment considers the Wicklow Reef SAC which is designated for Reefs and Blackwater Bank SAC which is designated for Sandbanks which are slightly covered by seawater all the time.

7.5.1.45 There is the potential for in-combination accidental pollution as a result of the operation activities associated with the Proposed Development and the Tier 1 and Phase 1 projects identified in Table 7.2.

TIER 1 PROJECTS

7.5.1.46 From the Tier 1 projects, accidental pollution may occur as a result of any vessels and machinery required during the installation of the pontoon and associated dredging required for the Arklow ABWP2 OMF. All other Tier 1 projects will be operational during the operational phase of the Proposed Development and accidental pollution may occur as a result of vessels and machinery required during operational and maintenance activities. Accidental pollution during construction and operational activities as part of the Tier 1 projects is expected to be highly infrequent and of short-term duration where any chemicals released to the water column will be quickly dispersed and diluted via currents and other water movement. As highlighted within the alone assessment (Section 6.2), the avoidance of effect through factored in measures for the Proposed Development includes an EMP and Marine Pollution Contingency Plan. Adherence to the avoidance by design measures outlined in Table 6.2 and good working practices will significantly reduce the likelihood of an accidental pollution incident occurring. Given the factored-in measures, the likelihood of accidental release is considered to be extremely low.

7.5.1.47 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 1 Projects as a result of accidental pollution on 'Reefs' or 'Sandbanks which are slightly covered by seawater all the time' from Project Design Option 1.**

7.5.1.48 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

PHASE 1 PROJECTS

7.5.1.49 From the Phase 1 projects, accidental pollution may occur as a result of any vessels and machinery required during the construction and operational phases of Dublin Array and the operational phase of Codling Wind Park. Accidental pollution during construction and operational activities as part of Codling Wind Park and Dublin Array are expected to be highly infrequent and of short-term duration where any chemicals released to the water column will be quickly dispersed and diluted via currents and other water movement. As highlighted within the alone assessment

(Section 6.2), the avoidance of effect through factored in measures for the Proposed Development includes an EMP and Marine Pollution Contingency Plan. Adherence to the avoidance by design measures outlined in Table 6.2 and good working practices will significantly reduce the likelihood of an accidental pollution incident occurring. Given the factored-in measures, the likelihood of accidental release is considered to be extremely low.

7.5.1.50 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Phase 1 Projects as a result of accidental pollution on 'Reefs' or 'Sandbanks which are slightly covered by seawater all the time' from Project Design Option 1.**

7.5.1.51 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

7.5.2 Annex II Marine Mammal Species

7.5.2.1 Certain impacts assessed solely for the Proposed Development are not factored into the marine mammal in-combination assessment due to several factors:

- The impacts are highly localised in nature;
- Existing management and mitigation measures implemented at the Proposed Development and other projects will effectively diminish the likelihood of these impacts; and
- The potential significance of the effect from the Proposed Development alone has been evaluated as either Not Significant (due to Negligible conclusion for magnitude of impact) or Imperceptible (due to Negligible conclusion for sensitivity of the receptor).

7.5.2.2 The impacts excluded from the marine mammal in-combination assessment for these reasons encompass:

- Auditory injury (PTS): Activities such as pile driving and UXO clearance may lead to PTS, but robust mitigation measures will be enforced to minimise injury risk to marine mammals to imperceptible levels, as mandated by European Protected Species (EPS) legislation;
- Injury from vessel activities: It is anticipated that all offshore energy projects will adopt a EVMP or adhere to guidelines to further reduce the already minimal risk of collisions with marine mammals;
- Disturbance from vessel activities: Similar to collision risks, it is expected that all offshore energy projects will implement a EVMP or adhere to best practice recommendations to mitigate the potential for disturbance to marine mammals;
- Changes in fish and shellfish community affecting prey resources: Changes in prey availability are highly localised and Not Significant.
- Accidental pollution: It is anticipated that all offshore energy projects will implement an EMP to ensure that the potential release from pollutants is minimised and strictly controlled; and
- Changes in EMF from subsea cabling: Changes are of Imperceptible significance.

7.5.2.3 Consequently, the impacts considered within the marine mammal in-combination assessment are primarily focused on the potential for disturbance arising from underwater noise during the construction and decommissioning phases of offshore developments. The projects screened in for the in-combination assessment are presented in Table 7.4.

Construction and Decommissioning

DISTURBANCE FROM UNDERWATER NOISE ON HARBOUR PORPOISE – PILING ACTIVITIES

7.5.2.4 The following are the designated sites for harbour porpoise considered within this in-combination assessment:

- Blackwater Bank SAC
- Rockabill to Dalkey Island SAC

- Codling Fault Zone SAC
- West Wales Marine/ Gorllewin Cymru Forol SAC
- North Anglesey Marine/ Gogledd Môn Forol SAC
- Lambay Island SAC
- Carnsore Point SAC
- Hook Head SAC
- Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC
- North Channel SAC
- Roaring Bay and Islands SAC
- Blasket Island SAC
- Kenmare River SAC
- Transboundary sites with Mainland Europe (listed in Section 6.4.23)
- Belgica Mound Province SAC
- Bunduff Lough and Machair/ Trawalua/ Mullaghmore SAC
- Inishmore Island SAC
- Kilkieran Bay and Islands SAC
- West Connacht Coast SAC

TIER 1 PROJECTS

7.5.2.5 The highest number of harbour porpoises predicted to be disturbed across Tier 1 projects between 2021 and 2034 is in 2028, which coincides with the expected pile driving campaign of the Proposed Development. The maximum cumulative number of harbour porpoise predicted to be disturbed in 2028 is estimated as 3,380 animals (5.41% of the MU population). The number of harbour porpoise predicted to be impacted by the Proposed Development represents 100% of this total. As a result, the in-combination impact is considered to be equal to that of the alone assessment and as per conclusions within the alone assessment, **it is concluded there will be no AEoI, from the Proposed Development in-combination with Tier 1 Projects, upon the integrity of any of the following designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting harbour porpoise from Project Design Option 1.**

7.5.2.6 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 1 AND 2 PROJECTS

7.5.2.7 The highest number of harbour porpoises predicted to be disturbed across Tier 1 and 2 projects between 2021 and 2034 is in 2028, which coincides with the expected pile driving campaign of the Proposed Development. The maximum cumulative number of harbour porpoise predicted to be disturbed in 2028 is estimated as 4,496 animals (7.19% of MU population), assuming piling on the same day as the Proposed Development at Awel y Môr offshore windfarm and Holyhead Deep tidal energy project. The number of harbour porpoises predicted to be impacted by the Proposed Development represents 75% of this total. With consideration of the conclusions in within the assessment alone, in that impacts are recoverable, short-term and only impact a small proportion of the population, **it is concluded there will be no AEoI, from the Proposed Development in-combination with Tier 1 and 2 Projects, upon the integrity of any of the above designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting harbour porpoise from Project Design Option 1.**

7.5.2.8 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 1, 2 AND 3 PROJECTS

7.5.2.9 The highest number of harbour porpoises predicted to be disturbed across Tier 1, 2, and 3 projects between 2021 and 2034 is in 2028, which coincides with the expected pile driving campaign of the Proposed Development. The maximum cumulative number of harbour porpoise predicted to be disturbed in 2028 is estimated as 6,865 animals (10.98% of the MU population), assuming four offshore windfarms are piling, two cable projects are constructing, and two seismic surveys occur on the same day as piling at the Proposed Development. The number of harbour porpoises predicted to be impacted by the Proposed Development represents 49% of this total. With consideration of the conclusions in within the assessment alone, it is concluded that the in-combination impacts are also recoverable, short-term, unlikely to impact any of the COs and only impact a small proportion of the population though an increase proportion. However, as the overall disturbance effect is predicted occur across multiple projects over several years, the temporary changes in behaviour and/or distribution of individuals could result in potential reductions in reproductive rates of some individuals, although is unlikely to affect the population trajectory. It is should also be noted that this assessment is highly precautionary and is the worst case scenario assessment, many of the projects considered within Tier 3 are not consented and so there is little confidence on if they will have an impact due to the uncertainty that they will go ahead. With this in consideration **it is concluded there will be no AEoI, from the Proposed Development in-combination with Tier 1, 2 and 3 Projects, upon the integrity of any of the above designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting harbour porpoise from Project Design Option 1.**

7.5.2.10 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 1, 2, 3 AND PHASE 1 PROJECTS

7.5.2.11 For projects with higher data confidence (Tier 1 and 2), the cumulative number of harbour porpoise predicted to be disturbed is low (≤ 1% of the MU population) across the majority of years in the period under consideration (2021 – 2034), with higher numbers between 2026 and 2030 (≥7.19% of the MU population). The average proportion of the population potentially disturbed by Tier 1 and 2 projects between all years considered in this in-combination assessment (2021 to 2034) is 1.21% of the MU population.

7.5.2.12 Across all Tiers and Phase 1 projects, the highest impact is predicted to occur in 2028 which coincides with the expected pile driving campaign of the Proposed Development. The maximum cumulative number of harbour porpoise predicted to be disturbed in 2028 is estimated as 8,250 animals (13.20% of the MU population) assuming five offshore windfarms are piling, high order UXO clearance at one offshore windfarm, one tidal project and two cable projects are constructing, and two seismic surveys occur on the same day as piling at the Proposed Development. The number of harbour porpoises predicted to be impacted by the Proposed Development represents 41% of this total.

7.5.2.13 However, it is important to recognise that the likelihood of all Tier 1, 2, 3 and Phase 1 projects undertaking noisy activities at the same time is extremely unlikely. The highest predicted impact occurs in 2028 when five offshore windfarms are assumed to be piling, high order UXO clearance at one offshore windfarm, one tidal project and two cable projects are constructing, and two seismic surveys occur as well as pile driving at the Proposed Development. Logistically, this is improbable due to the number of vessels, particularly for piling, that are currently available for such works.

7.5.2.14 There is also precaution surrounding the estimated number of harbour porpoise predicted to experience behavioural disturbance from seismic surveys. Large 2D and 3D seismic surveys used in oil and gas exploration can produce large impact ranges (12 km EDR for harbour porpoise). Thompson *et al.* (2013) show that the disturbance impact is short-lived as harbour porpoise have been shown to return to the impacted area within 19 hours following the cessation of survey activity. This change in behaviour is therefore considered to be short-term and recoverable.

7.5.2.15 Overall, the predicted extent of the cumulative disturbance is to a small proportion of the MU population, with short-term behavioural changes expected from each disturbance event. With consideration of this being carried out across multiple projects and multiple years, this could result in temporary changes in behaviour, distribution and a possible reduction in reproductive rates for the small proportion impacted. With consideration of the proportion of individuals impacted however, this is unlikely to affect the natural population trajectory. The COs for the various designated sites are focused on maintaining the FCS of the species, ensuring the protected sites still function and are a protected area for the species, with the reference population being use being the MUs population. With consideration of the conclusions within the alone assessment, and above in-combination conclusions, **it is concluded that the increase to in-combination disturbance will not result in an AEoI, from the Proposed Development in-combination with Tier 1, 2, 3, and Phase 1 Projects, upon the integrity of any of the above designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting harbour porpoise from Project Design Option 1.**

7.5.2.16 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

DISTURBANCE FROM UNDERWATER NOISE ON HARBOUR SEAL – PILING ACTIVITIES

7.5.2.17 The following are the designated sites for harbour seal considered within this in-combination assessment:

- Slaney River Valley SAC

TIER 1 PROJECTS

7.5.2.18 The highest number of harbour seals predicted to be disturbed across Tier 1 projects between 2021 and 2034 is in 2022, 2023, 2024, 2025, and 2026. This is predicted to occur within the construction period of the Proposed Development (2026 – 2030), although for the purposes of the assessment the number of animals disturbed has been calculated assuming that UXO clearance will occur in 2027 and piling in 2028. Therefore, the highest number of harbour seals is predicted to occur in the absence of the Proposed Development.

7.5.2.19 The maximum cumulative number of harbour seal predicted to be disturbed is estimated as 23 animals (12.64% of the MU population). With consideration that the alone assessment concluded up to 1 harbour seal will be disturbed by this development, **it is concluded that there will be no AEoI, from the Proposed Development in-combination with Tier 1 Projects, upon the integrity of any of the above designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting harbour seal from Project Design Option 1.**

7.5.2.20 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 1 AND 2 PROJECTS

7.5.2.21 No Tier 2 projects were included in this part of the cumulative assessment for harbour seals, as none are within their respective MU. Therefore, there are no changes from the Tier 1 conclusions for this in-combination assessment.

TIER 1 AND 3 PROJECTS

7.5.2.22 The highest number of harbour seals predicted to be disturbed across Tier 1, 2, and 3 projects between 2021 and 2034 is in 2024, 2025, and 2026. For the purposes of the assessment the number of animals disturbed has been calculated assuming that UXO clearance will occur in 2027 and piling in 2028, therefore, the highest number of seals is predicted to occur in the absence of the Proposed Development.

7.5.2.23 The maximum cumulative number of harbour seals predicted to be disturbed is estimated as 46 animals (25.27% of the MU population), assuming two cable projects are constructing.

7.5.2.24 When the Proposed Development is expected to be piling in 2028, the maximum cumulative number of harbour seals predicted to be disturbed is estimated as up to one animal (0.55% of the MU population). With consideration that the alone assessment concluded up to 1 harbour seal will be disturbed by this development, **it is concluded that there will be no AEoI, from the Proposed Development in-combination with Tier 1 and 3 Projects, upon the integrity of any of the above designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting harbour seal from Project Design Option 1.**

7.5.2.25 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 1, 3 AND PHASE 1 PROJECTS

7.5.2.26 For projects with higher data confidence (Tier 1 and 2), the cumulative number of harbour seals predicted to be disturbed is very low (0% of the MU population) across the majority of years in the period under consideration (2021 – 2034), with higher numbers from 2022 to 2026 (12.64% of the MU population). The average proportion of the population potentially disturbed by Tier 1 and 2 projects between all years considered in this in-combination assessment (2021 to 2034) is 4.59% of the MU population.

7.5.2.27 The highest number of harbour seals predicted to be disturbed across Tier 1, 2, 3, and Phase 1 projects between 2021 and 2034 is in 2027, which coincides with the assumed UXO clearance campaign of the Proposed Development. The maximum cumulative number of harbour seals predicted to be disturbed in 2027 is estimated as 694 animals (381.32% of the MU population) assuming two offshore windfarms are piling, two offshore windfarms are undertaking UXO clearance, and one cable project is constructing on the same day as the Proposed Development. The number of harbour seals predicted to be impacted by the Proposed Development represents <1% of this total.

7.5.2.28 When the Proposed Development is expected to be piling in 2028, the maximum cumulative number of harbour seals predicted to be disturbed is estimated as 304 animals (167.03% of the MU population), assuming one offshore windfarm is piling, and one is undertaking UXO clearance on the same day as piling at the Proposed Development. The number of harbour seals predicted to be impacted by the Proposed Development represents <1% of this total.

7.5.2.29 The number of animals available in the area that could be disturbed are being over-predicted as it exceeds the MU population size of 182 animals within the East region of Ireland. Considering the typical foraging distances of seals (Carter *et al.,* 2022), it is possible that seals from the East and South-east survey regions of the Ireland presented in Morris and Duck (2019), and from the Wales and Northern Ireland Management Units (SCOS, 2022), could also be disturbed by construction activities at projects screened into this assessment, including the Proposed Development. Therefore, for the purposes of the in-combination assessment it is more appropriate to consider the population of the East and South-east Ireland, Wales MU, and Northern Ireland MU for harbour seal as 1,378 animals. If the population size is assumed to be 1,378 animals, the percentage of the population predicted to be disturbed in 2028 reduces to 22.06%.

7.5.2.30 Given the residency of harbour seals and their limited home ranges, it is possible that the same individuals could experience sufficient days of repeated disturbance to impact vital rates, potentially to a sufficient proportion of the population to result in changes in the population trajectory. To investigate the impact of disturbance on harbour seals, iPCoD modelling was used on two different piling scenarios. The modelling results showed that the level of disturbance predicted is not sufficient to result in any changes at the population level, since the impacted population is predicted to continue at a stable trajectory at 100% of the size of the un-impacted population.

7.5.2.31 It is important to note that there are numerous precautions and assumptions made within this assessment relating to the MU population size, EDR approach, and inclusion of Tier 3 projects which result in an assessment with limited confidence which should be interpreted with a high level of precaution. Overall, the predicted extent of the cumulative disturbance is to a relatively small proportion of the MU population (assuming the population includes the East and South-east regions of Ireland, Wales, and Northern Ireland) with short-term behavioural changes expected from each disturbance event that an individual is exposed to. However, as the overall disturbance effect is predicted to occur across multiple projects and over several years, the temporary changes in behaviour and/or distribution of individuals could result in potential reductions in reproductive rates of some individuals, although is unlikely to affect the population trajectory.

7.5.2.32 With consideration that the alone assessment concluded up to one harbour seal will be disturbed by this development, **it is concluded that there will be no AEoI, from the Proposed Development in-combination with Tier 1, 3 and Phase 1 Projects, upon the integrity of any of the above designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting harbour seal from Project Design Option 1.**

7.5.2.33 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

DISTURBANCE FROM UNDERWATER NOISE ON GREY SEAL – PILING ACTIVITIES

7.5.2.34 The following are the designated sites for grey seal considered within this in-combination assessment:

- Lambay Island SAC
- Saltee Islands SAC
- Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC
- Cardigan Bay/ Bae Ceredigion SAC

TIER 1 PROJECTS

7.5.2.35 The highest number of grey seals predicted to be disturbed across Tier 1 projects between 2021 and 2034 is in 2028, which coincides with the expected pile driving campaign of the Proposed Development. The maximum cumulative number of harbour porpoise predicted to be disturbed in 2028 is estimated as 300 animals (18.01% of the MU population). The number of grey seals predicted to be impacted by the Proposed Development represents 100% of this total. With consideration that the alone assessment grey seal have negligible sensitivity to this kind of disturbance, **it is concluded that there will be no AEoI, from the Proposed Development in-combination with Tier 1 Projects, upon the integrity of any of the above designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting grey seal from Project Design Option 1.**

7.5.2.36 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 1 AND 2 PROJECTS

7.5.2.37 No Tier 2 projects were included in this part of the cumulative assessment for grey seals, as none are within their respective MU. Therefore, there are no changes from the Tier 1 conclusions for this in-combination assessment.

TIER 1 AND 3 PROJECTS

7.5.2.38 The highest number of grey seals predicted to be disturbed across Tier 1, 2, and 3 projects between 2021 and 2034 is in 2024, 2025, and 2026. For the purposes of the assessment the number of animals disturbed has been calculated assuming that UXO clearance will occur in 2027 and piling in 2028, therefore, the highest number of seals is predicted to occur in the absence of the Proposed Development.

7.5.2.39 The maximum cumulative number of grey seals predicted to be disturbed is estimated as 309 animals (18.59% of the MU population), assuming two cable projects are constructing.

7.5.2.40 When the Proposed Development is expected to be piling in 2028, the maximum cumulative number of grey seals predicted to be disturbed is estimated as 300 animals (18.05% of the MU population). The number of grey seals predicted to be impacted by the Proposed Development represents 100% of this total. With consideration that the alone assessment grey seal have negligible sensitivity to this kind of disturbance, **it is concluded that there will be no AEoI, from the Proposed Development in-combination with Tier 1 and 3 Projects, upon the integrity of any of the above designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting grey seal from Project Design Option 1.**

7.5.2.41 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 1, 3 AND PHASE 1 PROJECTS

7.5.2.42 For projects with higher data confidence (Tier 1 and 2), the cumulative number of grey seals predicted to be disturbed is very low (0% of the MU population) across the majority of years in the period under consideration (2021 – 2034), with higher numbers from 2022 to 2028 (≤18.05% of the MU population). The average proportion of the population potentially disturbed by Tier 1 and 2 projects between all years considered in this in-combination assessment (2021 to 2034) is 6.79% of the MU population.

7.5.2.43 The highest number of grey seals predicted to be disturbed across Tier 1, 2, 3, and Phase 1 projects between 2021 and 2034 is in 2027, which coincides with the assumed UXO clearance campaign of the Proposed Development. The maximum cumulative number of grey seals predicted to be disturbed in 2027 is estimated as 2,422 animals (145.73% of the MU population) assuming two offshore windfarms are piling, two offshore windfarms are undertaking UXO clearance, and one cable project is constructing on the same day as the Proposed Development. The number of grey seals predicted to be impacted by the Proposed Development represents 7% of this total.

7.5.2.44 When the Proposed Development is expected to be piling in 2028, the maximum cumulative number of grey seals predicted to be disturbed is estimated as 2,019 animals (121.48% of the MU population), assuming one offshore windfarm is piling, and one is undertaking UXO clearance on the same day as piling at the Proposed Development. The number of grey seals predicted to be impacted by the Proposed Development represents 15% of this total.

7.5.2.45 The number of animals available in the area that could be disturbed are being over-predicted as it exceeds the MU population size of 1,662 animals within the East region of Ireland. Considering the typical foraging distances of grey seals (Carter *et al.,* 2022), it is possible that seals from the East and South-east survey regions of the Ireland presented in Morris and Duck (2019), and from the Wales and Northern Ireland Management Units (SCOS, 2022), could also be disturbed by construction activities at projects screened into this assessment, including the Proposed Development. Therefore, for the purposes of the in-combination assessment, it is more appropriate to consider the population of the East and South-east Ireland, Wales MU, and Northern Ireland MU for grey seal as 9,936 animals. If the population size is assumed to be 9,936 animals, the percentage of the population predicted to be disturbed in 2028 reduces to 20.32%.

7.5.2.46 With consideration that the alone assessment grey seal have negligible sensitivity to this kind of disturbance, **it is concluded that there will be no AEoI, from the Proposed Development in-combination with Tier 1, 3 and Phase 1 Projects, upon the integrity of any of the above designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting grey seal from Project Design Option 1.**

7.5.2.47 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

DISTURBANCE FROM UNDERWATER NOISE ON BOTTLENOSE DOLPHIN – PILING ACTIVITIES

7.5.2.48 The following are the designated sites for bottlenose dolphin considered within this in-combination assessment:

- Lleyn Peninsula and the Sarnau/ Pen Llyn a'r Sarnau SAC
- Cardigan Bay/ Bae Ceredigion SAC
- Hook Head SAC
- Belgica Mound Province SAC

TIER 1 PROJECTS

7.5.2.49 The highest number of bottlenose dolphins predicted to be disturbed across Tier 1 projects between 2021 and 2034 is in 2028, which coincides with the expected pile driving campaign of the Proposed Development (2028). The maximum cumulative number of bottlenose dolphins predicted to be disturbed in 2028 is estimated as 2,092 animals (713.96% of MU population). The number of bottlenose dolphins predicted to be impacted by the Proposed Development represents 100% of this total. As with the above alone assessment, this is clearly an over estimation with consideration that the MU population size is 293. However, this population size does not take into account the connectivity of the MU population with other areas. Studies have shown large scale movement of bottlenose dolphins around Ireland and indicated connectivity with the population on the west coast of the Ireland (O'Brien *et al.*, 2009). Long distance movements from the Atlantic to the North Sea between populations in the UK and Ireland have also been reported by Robinson *et al.* (2012). Therefore, the size of the reference population used from the Irish Sea MU is likely to be an under-representation of the number of bottlenose dolphins that may be present in the Proposed Development. Equally, the most recent abundance estimates from the semi-resident population at Cardigan Bay in West Wales (which is within the Irish Sea MU) alone were 147 individuals (95% CI: 127 to 194; NRW, 2018). The design of broad scale surveys, such as SCANS, used to derive MU population estimates are not designed to capture localised, coastal populations such as that of the semi-resident population in Cardigan Bay, providing further evidence to suggest that the reference population size has been under-estimated.

7.5.2.50 As concluded within the alone assessment, studies have shown that dolphin species show comparatively less of a disturbance response from underwater noise compared to harbour porpoise (e.g. Culloch *et al.*, 2016; Kastelein *et al.*, 2006; Stone *et al.*, 2017). For example, bottlenose dolphins in the Moray Firth have been shown to remain in the impacted area during both seismic activities and pile installation activities (Fernandez-Betelu *et al.,* 2021) which suggests a lack of displacement response. Considering the above, it is concluded that using porpoise response data as a proxy for bottlenose dolphins is likely to result in an over-estimate of the number of bottlenose dolphins predicted to experience disturbance or change their behaviour due to disturbance. With consideration that none of the designated sites with bottlenose dolphins as QIs have COs relating specifically to human disturbance, and that there is no evidence that the predicted disturbance would result in an impact on the other COs, **it is concluded that there will be no AEoI, from the Proposed Development in-combination with Tier 1 Projects, upon the integrity of any of the above designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting bottlenose dolphin from Project Design Option 1.**

7.5.2.51 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 1 AND 2 PROJECTS

7.5.2.52 The highest number of bottlenose dolphins predicted to be disturbed across Tier 1 and 2 projects between 2021 and 2034 is in 2028, which coincides with the expected pile driving campaign of the Proposed Development (2028). The maximum cumulative number of bottlenose dolphins predicted to be disturbed in 2028 is estimated as 2,132 animals (727.65% of MU population), assuming piling on the same day as the Proposed Development at Awel y Môr offshore windfarm and Holyhead Deep tidal energy project. If the population size is assumed to be 8,326 animals, the percentage of the population predicted to be disturbed reduces to 25.60%. The number of bottlenose dolphins predicted to be impacted by the Proposed Development represents 98% of this total.

7.5.2.53 The above conclusions with Tier 1 projects (Section 7.5.2.3) are applicable to this wider consideration of projects, and therefore, **it is concluded that there will be no AEoI, from the Proposed Development in-combination with Tier 1 and 2 Projects, upon the integrity of any of the above designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting bottlenose dolphin from Project Design Option 1.**

7.5.2.54 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 1, 2 AND 3 PROJECTS

7.5.2.55 The highest number of bottlenose dolphins predicted to be disturbed across Tier 1, 2, and 3 projects between 2021 and 2034 is in 2027 and 2028, which coincides with the assumed UXO clearance campaign and the expected pile driving campaign of the Proposed Development. The maximum cumulative number of bottlenose dolphins predicted to be disturbed in 2027 and 2028 is estimated as 2,353 animals (807.07% of the MU population), assuming three offshore windfarms are piling, one tidal project and one cable project are constructing, and one seismic survey occurs on the same day as piling at the Proposed Development. If the population size is assumed to be 8,326 animals, the percentage of the population predicted to be disturbed reduces to 28.26%. The number of bottlenose dolphins predicted to be impacted by the Proposed Development represents 89% of this total.

7.5.2.56 Overall, the predicted extent of the cumulative disturbance is to a relatively small proportion of the MU population relative to the most recent abundance estimates for this area using the SCANS IV surveys, with short-term behavioural changes expected from each disturbance event that an individual is exposed to. The overall disturbance effect is predicted to occur across multiple projects and over several years, the temporary changes in behaviour and/or distribution of individuals could result in potential reductions in reproductive rates of some individuals. However, the cumulative disturbance is not considered enough to affect the long-term viability of the population.

7.5.2.57 The above conclusions with Tier 1 projects (Section 7.5.2.3) are applicable to this wider consideration of projects, and therefore, **it is concluded that there will be no AEoI, from the Proposed Development in-combination with Tier 1, 2 and 3 Projects, upon the integrity of any of the above designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting bottlenose dolphin from Project Design Option 1.**

7.5.2.58 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 1, 2, 3 AND PHASE 1 PROJECTS

7.5.2.59 For projects with higher data confidence (Tier 1 and 2), the cumulative number of bottlenose dolphins predicted to be disturbed is low (≤ 1% of the MU population) across the majority of years in the period under consideration (2021 – 2034), with higher numbers in 2028 (≥25.61% of the MU population). The average proportion of the population potentially disturbed by Tier 1 and 2 projects between all years considered in this in-combination assessment (2021 to 2034) is 2.63% of the MU population, assuming a population size of 8,326 animals.

7.5.2.60 The highest number of bottlenose dolphins predicted to be disturbed across Tier 1, 2, 3, and Phase 1 projects between 2021 and 2034 is in 2028, which coincides with the expected pile driving campaign of the Proposed Development. The maximum cumulative number of bottlenose dolphins predicted to be disturbed in 2028 is estimated as 3,351 animals, assuming four offshore windfarms are piling, high order UXO clearance at one offshore windfarm, one tidal project and one cable project are constructing, and one seismic survey occurs on the same day as piling at the Proposed Development. If the population size is assumed to be 8,326 animals, the percentage of the population predicted to be disturbed is 40.25%. The number of bottlenose dolphins predicted to be impacted by the Proposed Development represents 62% of this total. The average proportion of the population potentially disturbed between all years considered in this in-combination assessment (2021 to 2034) represents 8.70% of the MU population, assuming a population size of 8,326 animals based on the most recent SCANS IV surveys that covered the MU area. It is important to note that the Tier 3 projects are less likely to contribute to a cumulative impact due to the uncertainty that they will go ahead, and thus there is little confidence in the result of this assessment.

7.5.2.61 The above conclusions with Tier 1 projects (Section 7.5.2.3) are applicable to this wider consideration of projects, and therefore, **it is concluded that there will be no AEoI, from the Proposed Development in-combination with Tier 1, 2, 3 and Phase 1 Projects, upon the integrity of any of the above designated sites, as defined by the COs of the site, as a result of disturbance from underwater noise impacting bottlenose dolphin from Project Design Option 1.**

7.5.2.62 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

7.5.3 Migratory Fish Species

7.5.3.1 The in-combination migratory fish species assessment has considered the same potential impacts, SAC and features screened in for assessment of the Proposed Development alone (Section 6.6). The additional Plans and Projects considered are listed in Table 7.3 above.

7.5.3.2 Tier 1 projects screened in include a number of power and telecommunication cables. All, other than CeltixConnect, will be operational at the time construction works of the Proposed Development commence. The construction of CeltixConnect may overlap with the construction phase for the Proposed Development and the operation of all Tier 1 cables may overlap the construction and operational phase of the Proposed Development.

7.5.3.3 Tier 1 projects screened in also includes dredge disposal. Dublin Port company are licensed for the disposal of 1,102,723 tonnes of dredged material and the exact numbers on the extent and volume of sediment to be disposed of are not available for Wexford County Council dredge disposal. Disposal is scheduled to take place during the construction and operational and maintenance phases of the Proposed Development for Dublin Port Company and during the construction phase of the Proposed Development for Wexford County Council. Tier 1 projects also include the operation of ABWP1. ABWP1 is currently operational and consists of seven WTGs and the operation phase of ABWP1 may overlap with the construction and operation phases of the Proposed Development.

7.5.3.4 Tier 3 projects screened in include the construction and operation of Mares Connect and decommissioning of ABWP1. The construction and operation of Mares connect may overlap with the construction and operational and maintenance phase for the Proposed Development. The decommissioning of ABWP1 may overlap with the construction phase of the Proposed Development.

7.5.3.5 Decommissioning of ABWP1 will involve the cutting of monopiles at a depth of 3m below seabed, removal of monopiles and cutting, burial and backfilling of proportions of the inter-array cables. Decommissioning is anticipated to take 4 months between 2025 and 2027.

7.5.3.6 Phase 1 projects screened in include Codling wind Park, Dublin Array and North Irish Sea Array. The construction phase of Codling Wind Park, Dublin Array and North Irish Sea Array may overlap with the construction phase of the Proposed Development. The operation phase of Codling Wind Park, Dublin Array and North Irish Sea Array may overlap with the construction and/or operation phases of the Proposed Development.

7.5.3.7 Plans for Dublin Array indicate that the proposed development will comprise a maximum of 61 WTGs, three OSP's and three export cables (Innogy, 2020). Plans for Codling Wind Park indicate that the proposed development may comprise up to 140 WTGs, six export cables and up to five OSPs (CWP, 2020). Plans for North Irish Sea Array indicate 35 to 46 WTGs with associated OSPs and cabling (Arup, 2021). All the Phase 1 projects show similar construction, operation and decommissioning activities and therefore the impacts and magnitudes of the impacts are expected to be similar in nature to that of the Proposed Development.

Construction and Decommissioning

INJURY AND/OR DISTURBANCE FROM UNDERWATER NOISE – PILING ACTIVITIES

7.5.3.8 The following in-combination assessment considers the River Boyne and River Blackwater SAC designated for Atlantic salmon, as well as the following sites designated for Atlantic salmon, Twaite shad, sea lamprey, river lamprey and freshwater pearl mussels:

- Slaney River Valley SAC
- River Barrow and River Nore SAC
- Lower River Suir SAC

TIER 1 PROJECTS

7.5.3.9 All Tier 1 projects, other than Celtix connect, will be operational at the time construction works of the Proposed Development commence. The construction of Celtix connect may overlap with the construction phase for the Proposed Development. The construction methods of Celtix connect are uncertain however may consist of a range of activities such as ploughing, trenching (via jet and/or mechanical) and Horizontal Directional Drilling (HDD). The noise produced by these activities are expected to be of a lesser magnitude and extent than that produced during piling.

7.5.3.10 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 1 Projects as a result of noise generated during piling on Atlantic salmon, freshwater pearl mussels, twaite shad and lamprey from Project Design Option 1.**

7.5.3.11 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 3 PROJECTS

7.5.3.12 The construction of Mares connect may overlap with the construction phase for the Proposed Development. The construction methods of Mares connect are uncertain however may consist of a range of activities such as ploughing, trenching (via jet and/or mechanical) and Horizontal Directional Drilling (HDD). The noise produced by these activities are expected to be of a lesser magnitude and extent than that produced during piling.

7.5.3.13 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 3 Projects as a result of noise generated during piling on Atlantic salmon, freshwater pearl mussel, twaite shad and lamprey from Project Design Option 1.**

7.5.3.14 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

PHASE 1 PROJECTS

7.5.3.15 From the Phase 1 projects, underwater noise will occur as a result of the installation of WTGs, OSPs and associated cables during the construction phase of Codling Wind Park, Dublin Array and North Irish Sea Array, and during repair and maintenance activities associated with Codling Wind Park and North Irish Sea Array.

7.5.3.16 The greatest risk of cumulative impacts from underwater noise has been identified as that generated during the concurrent piling of the construction phase of the Proposed Development along with the construction phases of the Phase 1 projects.

7.5.3.17 The piling during the construction of Codling Bank Wind Park is due to take place the year before that of piling at the Proposed Development during 2027 and piling for Dublin Array is due to take place the year after that of piling at the Proposed Development during 2029. The piling at North Irish Sea Array is due to take place during the same year as that of the Proposed Development and therefore piling may temporally overlap. Piling operations during the construction of these Phase 1 projects are expected to be similar to that of the Proposed Development (intermittent and short-term duration).

7.5.3.18 Mortality and mortal injuries and recoverable injuries are expected to be small in extent, with migratory fish species being able to avoid the noise sources during soft start procedures before the onset of these effects. However, temporary TTS and behavioural effects will affect a larger number of individuals.

7.5.3.19 The piling at North Irish Sea Array is due to take place during the same year as that of the Proposed Development and therefore piling may temporally overlap. Atlantic salmon, European eel, twaite shad and sea trout occur within the European sites assessed above, and may migrate past the Proposed Development. While these species are highly mobile and able to avoid noise sources before the onset of mortality and recoverable injuries, disruption and delay to their migration may occur as a result. Should piling at the Proposed Development and North Irish Sea Array coincide with each other, as well as coinciding with migration periods for diadromous species, the effect may be greater than that for the project alone. Furthermore, piling at all the

Phase 1 projects during migratory periods could result in prolonged impacts to diadromous species (i.e. disruption to migration over several years).

7.5.3.20 Piling operations will represent intermittent occurrences at these offshore windfarm sites, with each individual piling event likely to be similar in duration to that of the Proposed Development. The total duration of piling during the construction of all Phase 1 projects is anticipated to be at most short-term (i.e., lasting one to seven years).

TWAITE SHAD

7.5.3.21 It is considered that in-combination risks of recoverable injury or mortality of twaite shad, from piling noise would not be expected to occur as a result of the Proposed Development and these projects due to the distances between these OWFs being larger than the impact ranges (i.e. >207 dB SPL_{peak} thresholds for mortality and recoverable injury occur up to 340 m away from SW monopile) or there being no temporal overlap in piling events.

7.5.3.22 Should piling at the Proposed Development and North Irish Sea Array coincide with each other, as well as coinciding with migration periods for twaite shad, behavioural and TTS effects may be greater than that for the project alone. Behavioural effects are likely to consist of avoidance behaviour of the noise source, which may interfere with their migration. However, behavioural effects are likely to be short term in duration given the short term and intermittent nature of piling events.

7.5.3.23 **In-combination risks are expected to be largely restricted to behavioural effects and are not expected to manifest at levels that would compromise the maintenance of the population. Considering the low duration and low frequency of piling events it is concluded that there will be no AEoI from the Proposed Development in-combination with the Phase 1 Projects as a result of noise generated during piling on twaite shad from Project Design Option 1.**

7.5.3.24 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

ATLANTIC SALMON

7.5.3.25 It is considered that in-combination risks of recoverable injury or mortality of Atlantic salmon, from piling noise would not be expected to occur as a result of the Proposed Development and these projects due to the distances between these OWFs being larger than the impact ranges (i.e. >207 dB SPL_{peak} thresholds for mortality and recoverable injury occur up to 340 m away from SW monopile) or there being no temporal overlap in piling events.

7.5.3.26 Should piling at the Proposed Development and North Irish Sea Array coincide with each other, as well as coinciding with northerly migration periods for Atlantic salmon, behavioural and TTS effects may be greater than that for the project alone. Behavioural effects are likely to consist of avoidance behaviour of the noise source, which may interfere with their migration. However, behavioural effects are likely to be short term in duration given the short term and intermittent nature of piling events.

7.5.3.27 **In-combination risks are expected to be largely restricted to behavioural effects and are not expected to manifest at levels that would compromise the maintenance of the population. Considering the low duration and low frequency of piling events it is concluded that there will be no AEoI from the Proposed Development in-combination with Phase 1 Projects as a result of noise generated during piling on Atlantic salmon from Project Design Option 1.**

7.5.3.28 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

FRESHWATER PEARL MUSSEL

7.5.3.29 **As it was concluded that there would be no AEoI for Atlantic salmon, the same is concluded for freshwater pearl mussels and therefore there is no AEoI on the freshwater pearl mussel feature from the Proposed Development in-combination with Phase 1 Projects as a result of noise generated during piling from Project Design Option 1.**

7.5.3.30 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

RIVER AND SEA LAMPREY

7.5.3.31 It is considered that in-combination risks of recoverable injury or mortality of river and sea lamprey, from piling noise would not be expected to occur as a result of the Proposed Development and these projects due to the distances between these OWFs being larger than the impact ranges (i.e. >213 dB SPL_{peak} thresholds for mortality and recoverable injury occur up to 130 m away from SW monopile) or there being no temporal overlap in piling events.

7.5.3.32 Should piling at the Proposed Development and North Irish Sea Array coincide with each other, as well as coinciding with migration periods for lamprey, behavioural effects may be greater than that for the project alone. Behavioural effects are likely to consist of avoidance behaviour of the noise source, which may interfere with their migration. However, behavioural effects are likely to be short term in duration given the short term and intermittent nature of piling events.

7.5.3.33 **In-combination risks are expected to be largely restricted to behavioural effects and are not expected to manifest at levels that would compromise the maintenance of the population. Considering the low duration and low frequency of piling events it is concluded that there will be no AEoI from the Proposed Development in-combination with Phase 1 Projects as a result of noise generated during piling on lamprey from Project Design Option 1.**

7.5.3.34 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

INJURY AND/OR DISTURBANCE FROM UNDERWATER NOISE – OTHER ACTIVITIES

7.5.3.35 The following in-combination assessment considers the River Boyne and River Blackwater SAC designated for Atlantic salmon, as well as the following sites designated for Atlantic salmon, Twaite shad, sea lamprey, river lamprey and freshwater pearl mussels:

- Slaney River Valley SAC
- River Barrow and River Nore SAC
- Lower River Suir SAC

TIER 1 PROJECTS

7.5.3.36 Noise generated from continuous noise sources (e.g. vessel activity) and UXO detonation is likely to be low in extent and intermittent for both the Proposed Development and the Tier 1 projects.

7.5.3.37 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 1 Projects as a result of noise generated during piling on Atlantic salmon, freshwater pearl mussel, twaite shad and lamprey from Project Design Option 1.**

7.5.3.38 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 3 PROJECTS

7.5.3.39 The underwater noise generated from activities other than piling as a result of the Tier 3 projects in expected to be similar or less than that of the Proposed Development.

7.5.3.40 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 3 Projects as a result of noise generated during piling on Atlantic salmon, freshwater pearl mussel, twaite shad and lamprey from Project Design Option 1.**

7.5.3.41 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

PHASE 1 PROJECTS

7.5.3.42 Noise generated from continuous noise sources (e.g. vessel activity) and UXO detonation is likely to be low in extent and intermittent for both the Proposed Development and the Phase 1 projects.

7.5.3.43 **Therefore, it is concluded that there will be no AEoI from the Proposed Development in-combination with Phase 1 Projects as a result of noise generated during piling on Atlantic salmon, freshwater pearl mussel, twaite shad and lamprey from Project Design Option 1.**

7.5.3.44 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

Operational and Maintenance

INJURY AND/OR DISTURBANCE FROM UNDERWATER NOISE – OTHER ACTIVITIES

7.5.3.45 The following in-combination assessment considers the River Boyne and River Blackwater SAC designated for Atlantic salmon, as well as the following sites designated for Atlantic salmon, Twaite shad, sea lamprey, river lamprey and freshwater pearl mussels:

- Slaney River Valley SAC
- River Barrow and River Nore SAC
- Lower River Suir SAC

TIER 1 PROJECTS

7.5.3.46 The operation of several subsea cables overlap with the operational and maintenance phase of the Proposed Development. The underwater noise generated during the operation of the Tier 1 projects is expected to be low and infrequent.

7.5.3.47 **Given the low extent and infrequency it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 1 Projects as a result of injury and disturbance from underwater noise from activities other than piling Atlantic salmon, twaite shad, freshwater pearl mussel and lamprey from Project Design Option 1.**

7.5.3.48 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 3 PROJECTS

7.5.3.49 The operation of Mares connect overlaps with the operational and maintenance phase of the Proposed Development. The underwater noise generated during the operation of the Tier 3 projects is expected to be low and infrequent.

7.5.3.50 **Given the low extent and infrequency it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 3 Projects as a result of injury and**

disturbance from underwater noise from activities other than piling Atlantic salmon, freshwater pearl mussel, twaite shad and lamprey from Project Design Option 1.

7.5.3.51 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

PHASE 1 PROJECTS

7.5.3.52 The impact during the operational and maintenance phases of the Proposed Development and the Phase 1 projects is expected to be low in extent, long term and continuous in the case of WTGs and short term and infrequent in the case of noise generated by vessels during repair activities.

7.5.3.53 **Given the low extent and/or infrequency it is concluded that there will be no AEoI from the Proposed Development in-combination with Phase 1 Projects as a result of injury and disturbance from underwater noise from activities other than piling Atlantic salmon, freshwater pearl mussel, twaite shad and lamprey from Project Design Option 1.**

7.5.3.54 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

CHANGES IN EMF

7.5.3.55 The following in-combination assessment considers the River Boyne and River Blackwater SAC designated for Atlantic salmon, as well as the following sites designated for Atlantic salmon, Twaite shad, sea lamprey, river lamprey and freshwater pearl mussels:

- Slaney River Valley SAC
- River Barrow and River Nore SAC
- Lower River Suir SAC

TIER 1 PROJECTS

7.5.3.56 EMF affects associated with the Tier 1 projects are expected to be highly localised and restricted to discrete areas within the proposed development areas (within metres of the cables).

7.5.3.57 **Given the highly localised nature of EMF effects it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 1 Projects on Atlantic salmon, freshwater pearl mussel, twaite shad and lamprey from Project Design Option 1.**

7.5.3.58 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

TIER 3 PROJECTS

7.5.3.59 EMF affects associated with Mares connect are expected to be highly localised and restricted to discrete areas within the proposed development area (within metres of the cables).

7.5.3.60 **Given the highly localised nature of EMF effects it is concluded that there will be no AEoI from the Proposed Development in-combination with Tier 3 Projects on Atlantic salmon, freshwater pearl mussel, twaite shad and lamprey from Project Design Option 1.**

7.5.3.61 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

PHASE 1 PROJECTS

7.5.3.62 From the Phase 1 projects, EMFs may be emitted by cables associated with ABWP1, Codling Wind Park, Dublin Array and North Irish Sea Array. Given the similarity in project designs, EMF affects associated with the other Tier 2 projects are expected to be highly localised and restricted to discrete areas within the proposed development areas (within metres of the cables).

7.5.3.63 **Given the highly localised nature of EMF effects it is concluded that there will be no AEoI from the Proposed Development in-combination with Phase 1 Projects on Atlantic salmon, freshwater pearl mussel, twaite shad and lamprey from Project Design Option 1.**

7.5.3.64 **Based on the increased risk of in-combination effects of Project Design Option 1, it is concluded that no AEoI would also apply to Project Design Option 2.**

7.5.4 Intertidal and Offshore Ornithology Receptors

7.5.4.1 The in-combination offshore ornithology assessment has considered the same potential impacts, SPAs and features screened in for assessment of the Proposed Development alone (section 6.8). The additional Plans and Projects considered are listed in Table 7.5.

Howth Head Coast SPA

COLLISION RISK

KITTIWAKE

7.5.4.2 Assessment of the Project alone impact (paragraph 6.8.1.1 *et seq.*) concluded there would be no AEoI on the Howth Head Coast SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

Ireland's Eye SPA

COLLISION RISK

KITTIWAKE

7.5.4.3 Assessment of the Project alone impact (paragraph 6.8.2.1 *et seq.*) concluded there would be no AEoI on the Ireland's Eye SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

HERRING GULL

7.5.4.4 Assessment of the Project alone impact (paragraph 6.8.2.13 *et seq.*) concluded there would be no AEoI on the Ireland's Eye SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any

[2] https://curia.europa.eu/juris/document/document.jsf?text=&docid=130253&doclang=EN

effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

DISPLACEMENT

GUILLEMOT

7.5.4.5 Assessment of the Project alone impact (paragraph 6.8.2.21 *et seq.*) concluded there would be no AEoI on the Ireland's Eye SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

RAZORBILL

7.5.4.6 Assessment of the Project alone impact (paragraph 6.8.2.46 *et seq.*) concluded there would be no AEoI on the Ireland's Eye SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

Lambay Island SPA

COLLISION RISK

KITTIWAKE

7.5.4.7 Assessment of the Project alone impact (paragraph 6.8.3.1 *et seq.*) concluded there would be no AEoI on the Lambay Island SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

HERRING GULL

7.5.4.8 Assessment of the Project alone impact (paragraph 6.8.3.13 *et seq.*) concluded there would be no AEoI on the Lambay Island SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

LESSER BLACK-BACKED GULL

7.5.4.9 Assessment of the Project alone impact (paragraph 6.8.3.21 *et seq.*) concluded there would be no AEoI on the Lambay Island SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

DISPLACEMENT

GUILLEMOT

7.5.4.10 Assessment of the Project alone impact (paragraph 6.8.3.29 *et seq.*) concluded there would be no AEoI on the Lambay Island SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

RAZORBILL

7.5.4.11 Assessment of the Project alone impact (paragraph 6.8.3.47 *et seq.*) concluded there would be no AEoI on the Lambay Island SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

Saltee Islands SPA

COLLISION RISK

KITTIWAKE

7.5.4.12 Assessment of the Project alone impact (paragraph 6.8.4.1 *et seq.*) concluded there would be no AEoI on the Saltee Islands SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

GANNET

7.5.4.13 Assessment of the Project alone impact (paragraph 6.8.4.13 *et seq.*) concluded there would be no AEoI on the Saltee Islands SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

HERRING GULL

7.5.4.14 Assessment of the Project alone impact (paragraph 6.8.4.26 *et seq.*) concluded there would be no AEoI on the Saltee Islands SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

LESSER BLACK-BACKED GULL

7.5.4.15 Assessment of the Project alone impact (paragraph 6.8.4.34 *et seq.*) concluded there would be no AEoI on the Saltee Islands SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

DISPLACEMENT

GUILLEMOT

7.5.4.16 Assessment of the Project alone impact (paragraph 6.8.4.42 *et seq.*) concluded there would be no AEoI on the Saltee Islands SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

RAZORBILL

7.5.4.17 Assessment of the Project alone impact (paragraph 6.8.4.60 *et seq.*) concluded there would be no AEoI on the Saltee Islands SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

Skerries Islands SPA

COLLISION RISK

HERRING GULL

7.5.4.18 Assessment of the Project alone impact (section 6.8.5) concluded there would be no AEoI on the Skerries Islands SPA, and that the impact was comfortably below the threshold at which any effects could be distinguished from natural background variations (Parker et al. 2022). Plans or Projects which have no appreciable effect on a site are considered excluded as any effects, if there are any at all, are entirely negligible[2]. Therefore, there is no requirement to undertake an in-combination assessment for this feature.

Wicklow Head SPA

COLLISION RISK

KITTIWAKE

7.5.4.19 Assessment of the Project alone impact (section 6.8.6) concluded there would be no AEoI on the Wicklow Head SPA. However, the impact was estimated to be above the threshold at which any effects could be distinguished from natural background variations (Parker *et al.* 2022). Therefore, since there is potential for the Project Alone effect to contribute to an in-combination effect on this feature, it is appropriate to undertake an in-combination assessment.

7.5.4.20 For Irish Phase 1 windfarms seasonal collision are available, however for UK Irish Sea windfarms only annual estimates were available. Since all the UK Irish Sea windfarms are at least 150 km from the SPA it has been assumed that kittiwakes from Wicklow Head SPA would only have the potential to be present in the nonbreeding season. Thus, for UK Irish Sea windfarms the nonbreeding season percentages estimated for Wicklow Head SPA of between 0.19% to 0.37%

(paragraph 6.8.6.7) were applied. These gave UK windfarm apportioned collisions of 1.1 to 2.2 (Table 7.6).

7.5.4.21 The Phase 1 annual total collisions was estimated to be 7.2-7.8 (Table 7.6). Summing the Phase 1 and UK Irish Sea windfarm totals gives a combined total of between 8.0 to 9.4 collisions per year apportioned to the Wicklow Head SPA.

7.5.4.22 The background adult mortality rate for kittiwake is 0.146 (Horswill and Robinson 2015), which indicates that the natural mortality for the SPA population using the most recent count (773 AON, Cummins *et al.*, 2019) would be 226. Addition of 8.0 to 9.4 adults to these would increase the background rate of the designated population by 3.5% to 4.1%. The threshold below which increases in background mortality are considered to be undetectable against natural variations is 1% (Parker *et al.* 2022). Therefore, additional consideration of the potential impact on the SPA population has been undertaken using the results from a kittiwake population model of the Wicklow Head SPA population (Volume III, Technical Appendix 12.10 Offshore Ornithology: Kittiwake Population Viability Analysis).

Table 7.6: In-combination annual collision risk for kittiwake using the highest collision predictions for Project Design Option 1b, apportioned to the Wicklow Head SPA

Windfarm	Breeding season		Nonbreeding season		Annual	
	Total	SPA	Total	SPA	Total	SPA
Awel-y-Mor	-	-	-	-	53.9	
Gwynt y Mor	-	-	-	-	-	
Rhyl Flats	-	-	-	-	-	
Burbo Bank Extension	-	-	-	-	22.3	
North Hoyle	-	-	-	-	-	
Walney Extension 3 + 4	-	-	-	-	187.6	
West of Duddon Sands	-	-	-	-	-	
Walney 1 + 2	-	-	-	-	-	
Burbo Bank	-	-	-	-	-	
Ormonde	-	-	-	-	2.2	
Barrow	-	-	-	-	-	
Robin Rigg	-	-	-	-	-	
ABWP1	-	-	-	-	-	
Twin Hub	-	-	-	-	10.8	
Erebus	-	-	-	-	58.0	
Morgan	-	-	-	-	39.8	

Windfarm	Breeding season		Nonbreeding season		Annual	
	Total	SPA	Total	SPA	Total	SPA
Morecambe	-	-	-	-	32.0	
Mona	-	-	-	-	37.1	
Total UK	**-**	**-**	**-**	**-**	**443.6**	**0.8-1.6**
Phase 1 Projects	56.1	-	134.1	-	190.3	1.3
Proposed Development –Project Design Option 1a	16.7	5.1	170.1	0.6	186.8	5.7
Proposed Development –Project Design Option 1b	18.8	5.8	190.2	0.7	209.1	6.5
Proposed Development – Project Design Option 2	16.8	5.1	171.9	0.6	188.8	5.7
Total Ireland	**72.8-74.9**		**304.2–324.3**		**377.1-399.4**	**7.0-7.8**
Total Ireland and UK	**72.8-74.9**		**304.2 – 324.3**		**820.7-843.0**	**7.8-9.4**

7.5.4.23 The model results, presented as comparisons of the predicted population size and population growth rate between unimpacted (baseline) model runs and impacted ones, presented as proportions and referred to as counterfactuals: CPS (counterfactual of population size) and CPGR (counterfactual of population growth rate), are provided in Table 7.7.

Table 7.7: Summary outputs from Wicklow Head SPA kittiwake population model, mean values (and 95% confidence intervals)

Impact magnitude (annual adult collisions)	Model type	Counterfactual of population size (CPS)	Counterfactual of population growth rate (CPGR)
8	Density independent	0.8306 (0.7096 – 0.9669)	0.9941 (0.9897 – 0.9983)
	Density dependent	0.9365 (0.8706 – 1.0051)	0.9979 (0.9949 – 1.0008)
9	Density independent	0.8065 (0.6986 – 0.9429)	0.9934 (0.9893 – 0.9976)
	Density dependent	0.9285 (0.8613 – 0.9954)	0.9976 (0.9946 – 1.0005)
10	Density independent	0.7901 (0.6831 – 0.9180)	0.9926 (0.9884 – 0.9969)
	Density dependent	0.9196 (0.8554 – 0.9868)	0.9974 (0.9944 – 1.0002)

7.5.4.24 The first aspect to note is that density dependent the 95% confidence intervals at the lower mortality (8) for both the CPS (counterfactual of population size) and CPGR (counterfactual of population growth rate) include 1.0. Therefore, these outcomes would not be considered to indicate a statistically significant effect.

7.5.4.25 The CPGR for the density independent models indicates that the growth rate would be reduced by no more than 0.74% (0.9926) and the population would be reduced by no more than 8% (0.9196). The latter (density dependent) would indicate the number of pairs, after 36.5 years, might be reduced from 773 to 711, while the former (density independent) suggests there might be a reduction in the long term growth rate from 0.992 to 0.985 (=0.992 x 0.9926).

7.5.4.26 As noted above (section 6.8.6.10), while the strength and form of density dependence in kittiwake populations is not fully understood, there is strong evidence for density dependence acting on kittiwake populations in terms of their competition for food around the colony (Furness and Birkhead, 1984; Ford *et al.*, 2007, Wakefield *et al.*, 2017), and in terms of colony growth and net immigration rates (Coulson 2011; Miller *et al.*, 2019). There is also strong evidence that kittiwake colonies form a meta-population with high levels of immigration of young birds into colonies (Coulson, 2011). That flow of immigrant birds will also tend to reduce the assessed impact of additional mortality at the focal colony compared with population models (such as used here) that assume each SPA population to be a closed population (Miller *et al.*, 2019). Therefore, the prediction that the population size would be 8% smaller (0.9196) than it would otherwise have been without the additional mortality, is considered to represent a more reliable guide to the level of potential impact on the population.

7.5.4.27 It is also important to note however, that offshore windfarm collision risk assessments include several sources of precaution in the input parameters used and that the magnitude of impact predicted here is very likely to over-estimate the true impacts. If accounting for this over-precaution reduced predicted collisions to around 2 per year, then the predicted effect on the population would increase background mortality by less than 1% and consequently be considered undetectable (Parker *et al.* 2022).

7.5.4.28 In view of the predicted small effects on the population status, it is concluded that the population dynamics of the species indicate that any additional mortality due to the Proposed Development will not materially affect the population's ability to maintain itself on a long-term basis as a viable component of its natural habitats; the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

7.5.4.29 Overall therefore, on the basis of the precautionary impact predictions and PVA results it is concluded beyond reasonable scientific doubt that there will be no AEoI of the Wicklow Head SPA from collision effects on kittiwake due to the Proposed Development in-combination with other plans and projects.

8 Conclusion of Stage 2 Appraisal

8.1.1.1 The Stage 2 Appropriate Assessment of implications for European sites in light of their COs was completed in compliance with EU and Irish law and relevant European Commission and national guidelines to determine whether or not AEoI of any European site would occur as a result of the construction, operational and maintenance, or decommissioning of the Proposed Development.

8.1.1.2 This NIS has been prepared to inform and to enable the competent authority to determine if the Proposed Development, individually or in-combination with any other plans or projects will have AEoI on any European site when they are undertaking an AA.

8.1.1.3 Having considered site specific surveys, scientific investigations, and assessments, which are set out in the NIS and its appendices, in the light of the best scientific knowledge in the field, all aspects of the Proposed Development which, by itself, or in combination with other plans or projects, may affect the relevant European Sites have been considered.

8.1.1.4 This NIS contains information which the relevant public authority, as competent authority, must consider in making its own complete, precise and definitive findings and conclusions and upon which the relevant public authority is capable of determining that all reasonable scientific doubt has been removed as to the effects of the Proposed Development on the integrity of the relevant European sites.

8.1.1.5 In light of the conclusions of the assessment conducted in this NIS, the authors are of the view that the construction, operational and maintenance, and decommissioning of the Proposed Development will not adversely affect the integrity of any European site.

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10 Appendix I Descriptions of Projects and Plans included in the In-Combination Assessment

Project/Plan	Status	Closest Distance from the Proposed Development (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
Tier 1 – Other Arklow Bank Wind Park 2 Developments						
Arklow Bank Wind Park 2 Onshore Grid Infrastructure	Proposed	0.0	Development of the onshore grid infrastructure.	2026 to 2030	2030 to 2066	Screened out due to no pathway with offshore ornithology receptors
Arklow Bank Wind Park 2 OMF Onshore Infrastructure	Proposed	4.5	Development of an OMF to support the Proposed Development, located at Arklow Port.	2026 to 2029	2030 to 2066	Screened out due to no pathway with offshore ornithology receptors
Arklow Bank Wind Park 2 OMF Nearshore Infrastructure	Proposed	4.5	Development of an OMF to support the Proposed Development, located at Arklow Port.	2026 to 2029	2030 to 2066	Screened out due to no pathway with offshore ornithology receptors
EirGrid Grid Upgrade Works	Proposed	2.9	Grid upgrade works including a new 220 kV substation at Ballybeg and the stringing of new conductors on the currently unused side of 220 kV pylons between the proposed Arklow Bank Wind Park Phase 2 OGI substation and the existing Arklow 220 kV substation	2023 to 2029	2029 to 2074	Screened out due to no pathway with offshore ornithology receptors

Project/Plan	Status	Closest Distance from the Proposed Development (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
Irish Water Upgrade Works	Proposed	4.2	Upgrade of 2.3 km of 2inch watermain to 100 mm from Arklow Town in a north-westerly direction towards Shelton Abbey.	2026-2029	In perpetuity	Screened out due to no pathway with offshore ornithology receptors
Development to the south of South Quay Arklow- ABWP2 Operations and Maintenance Facility (OMF)	Approved	4.3	Relates to ABWP2. As part of the works, a pontoon is proposed along with up to 4 cranes for loading and unloading of vessels. Additionally, dredging of approximately 6,000 m^3 of material from the nearshore is also proposed, to provide for navigational depth, berthing area and manoeuvring area for vessels.	2026-2033	2034 onwards	Temporal overlap of construction and operational phases with the Proposed Development construction and Operational and Maintenance phases.
Tier 2 – Offshore Windfarms						
Arklow Bank Wind Park 1	Operational	0	Arklow Bank Wind Park 1, consisting of seven wind turbines at a capacity of 25.2 MW.	2003 to 2004	2004 to ongoing	Screened in due to ongoing impact. Located within the Array Area.
Arklow Flood Relief Scheme	Conditionally approved	4.01	Wicklow County Council funded by the Office of Public Works (OPW), proposes to undertake engineering works along the Avoca River and surrounds to mitigate the risk of flooding in the Arklow town area in County Wicklow. Proposed works include dredging, installation of flood	2024 - 2028	2028 - ongoing	Potential for temporal overlap with Proposed Development construction phase.

Project/Plan	Status	Closest Distance from the Proposed Development (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
			defence embankments/ walls and gravel/ debris traps.			
Codling Wind Park (formerly known as Codling I and Codling II)	Proposed	10.2	'Relevant Project'. Updated application expected to be made under the Marine Planning and Development Management (MPDM) regime. Scoping Report indicates up to 140 wind turbines and up to five OSPs (CWP, 2020).	Unknown	Unknown	Potential for overlap with Proposed Development construction and Operational and Maintenance phases.
Dublin Array (formerly known as Bray and Kish Offshore Windfarms)	Proposed	25.8	'Relevant Project'. Updated application expected to be made under the MPDM regime. Scoping Report indicates up to 61 wind turbines with up to 308 m tip height and indicative hub height of 165.5 m above mean high water springs (Innogy, 2020).	Unknown	Unknown	Potential for overlap with Proposed Development construction and Operational and Maintenance phases.
North Irish Sea Array	Proposed	65	'Relevant Project'. Updated application expected to be made under the MPDM regime.	Unknown	Unknown	Potential for overlap with Proposed Development construction and Operational and Maintenance phases.
Oriel Wind Park	Proposed	108.1	'Relevant Project'. Updated application expected to be made under the MPDM regime.	Unknown	Unknown	Potential for overlap with Proposed Development construction and Operational and Maintenance phases.
Erebus Offshore Windfarm	Consented	142	Consented for up to 7 turbines	N/A	N/A	Potential for overlap with Proposed Development construction and

Project/Plan	Status	Closest Distance from the Proposed Development (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
						Operational and Maintenance phases
Valorous Offshore Windfarm	Proposed	142	Early-stage planning	N/A	N/A	Potential overlap of Operational and Maintenance phases.
Awel y Mor Offshore Windfarm	Consented	152	Consented for up to 50 turbines	N/A	N/A	Potential for overlap with Proposed Development construction and Operational and Maintenance phases
Rhyl Flats	Operational	156	Operational windfarm comprising 25 turbines	N/A	2009 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Mona Offshore Windfarm	Proposed	158	English Round 4 project with up to 107 turbines	N/A	N/A	Potential for overlap with Proposed Development construction and Operational and Maintenance phases
Gwynt y Mor Offshore Windfarm	Operational	159	Operational windfarm comprising 160 turbines	N/A	2015 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations

Project/Plan	Status	Closest Distance from the Proposed Development (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
North Hoyle	Operational	170	Operational windfarm comprising 30 turbines	N/A	2003 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Morgan Offshore Windfarm	Proposed	181	English Round 4 project with up to 96 turbines	N/A	N/A	Potential for overlap with Proposed Development construction and Operational and Maintenance phases
Walney Extension	Operational	187	Operational windfarm comprising 47 turbines	N/A	2018 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Burbo Bank	Operational	189	Operational windfarm comprising 25 turbines	N/A	2007 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Burbo Bank Extension	Operational	181	Operational windfarm comprising 32 turbines	N/A	2017- ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations

Project/Plan	Status	Closest Distance from the Proposed Development (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
Morecambe Offshore Windfarm	Proposed	189	English Round 4 project with up to 40 turbines	N/A	N/A	Potential for overlap with Proposed Development construction and Operational and Maintenance phases
Robin Rigg Offshore Windfarm	Operational	275	Operational windfarm comprising 58 turbines	N/A	2010 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
West of Duddon Sands Offshore Windfarm	Operational	196	Operational windfarm comprising 108 turbines	N/A	2014 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Walney Offshore Windfarm	Operational	197	Operational windfarm comprising 102 turbines	N/A	2010 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Ormonde	Operational	207	Operational windfarm comprising 30 turbines	N/A	2012 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations

Project/Plan	Status	Closest Distance from the Proposed Development (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
Barrow Offshore Windfarm	Operational	208	Operational windfarm comprising 30 turbines	N/A	2006 to ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Twin Hub Offshore Windfarm	Consented	296	Floating test site with 4 turbines	N/A	N/A	Potential for overlap with Proposed Development construction and Operational and Maintenance phases.
Tier 3 – Other Plans and Projects						
Arklow Bank Wind Park 1 Power Cable	Operational	0.0	Power	Complete	Ongoing	Temporal overlap of operational phase with the Proposed Development construction and Operational and Maintenance phases
Arklow Waste Water Treatment Plant	Construction	3.4	Arklow Waste Water Treatment Plant	2021-2024	2025 onwards	Temporal overlap of operational phase with the Proposed Development construction and Operational and Maintenance phases.
Irish Mussel Seed Company Ltd.	Operational	5.3	Aquaculture	Complete	Ongoing	Temporal overlap of operational phase with the Proposed Development construction

Project/Plan	Status	Closest Distance from the Proposed Development (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
						and Operational and Maintenance phases.
Hibernia Atlantic	Operational	14.8	Telecom	Complete	Ongoing	Temporal overlap of operational phase with the Proposed Development construction and Operational and Maintenance phases.
Mares Connect	Proposed	36.6	Power Cable	2024-2027	2027 Onward	Potential for temporal overlap of construction and operation with Proposed Development construction and Operational and Maintenance phases.
ESAT 2	Operational	45.4	Telecom	2021	2021 Onward	Potential for temporal overlap of operation with Proposed Development construction and Operational and Maintenance phases.
CeltixConnect - Sea Fibre Networks	Operational	48.3	Telecom	2022-2026	2021 Onward	Potential for temporal overlap of operation with Proposed Development construction and Operational and Maintenance phases.

Project/Plan	Status	Closest Distance from the Proposed Development (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
Rosslare Europort	Proposed	51.9	Expansion to the existing Europort including a purpose-built ORE quay and berth, quayside ORE storage and construction up to 50 acres in area, navigation channel dredged down to a minimum of -9 m depth and construction of a management control centre and management offices.	2025/2026	2026 Onwards	Potential for temporal overlap of construction with Proposed Development construction and Operational and Maintenance phases.
Hibernia Atlantic – Hibernia C	Operational	53.9	Telecom	Complete	2021 Onwards	Potential for temporal overlap of operation with Proposed Development construction and Operational and Maintenance phases.
SIRIUS South - Telecom	Operational	57.8	Telecom	Complete	2021 Onwards	Potential for temporal overlap of operation with Proposed Development construction and Operational and Maintenance phases.
Dredging and disposal						
Wicklow Port Company dredge disposal	Operational	7.9	Dredge disposal	N/A	2024 Onwards	Potential for temporal overlap of operation with Proposed Development construction and Operational and Maintenance phases.

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