MORGAN AND MORECAMBE OFFSHORE WIND FARMS: TRANSMISSION ASSETS

Environmental Statement

Volume 2, Chapter 4: Marine mammals

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Glossary

Term	Meaning
Anthropogenic	An activity resulting from or relating to the influence of humans.
Applicants	Morgan Offshore Wind Limited (Morgan OWL) and Morecambe Offshore Windfarm Ltd (Morecambe OWL).
Acoustic Deterrent Device	Acoustic Deterrent Device intend to deter animals from approaching the activity and leave the area.
Baseline	The status of the environment without the Transmission Assets in place.
Climate change	A change in global or regional climate patterns, in particular a change apparent from the mid to late 20 century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.
Collision	The act or process of colliding (crashing) between two moving objects.
Commitment	This term is used interchangeably with mitigation and enhancement measures. The purpose of commitments is to avoid, prevent, reduce or, if possible, offset significant adverse environmental effects. Primary and tertiary commitments are taken into account and embedded within the assessment set out in the Environmental Statement.
Cumulative Effects	The combined effect of the Transmission Assets in combination with the effects from other proposed developments, on the same receptor or resource.
Design envelope	A description of the range of possible elements and parameters that make up the Transmission Assets options under consideration, as set out in detail in Volume 1, Chapter 3: Project Description. This envelope is used to define the Transmission Assets for EIA purposes when the exact engineering parameters are not yet known. This is also referred to as the Maximum Design Scenario or Rochdale Envelope approach.
Development Consent Order	An order made under the Planning Act 2008, as amended, granting development consent.
Duration (of impact)	The time over which an impact occurs. An impact may be described as short, medium or long-term and permanent or temporary.
Effect	The term used to express the consequence of an impact. The significance of effect is determined by correlating magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
EIA Scoping Report	A report setting out the proposed scope of the Environmental Impact Assessment process. The Transmission Assets Scoping Report was submitted to The Planning Inspectorate (on behalf of the Secretary of State) for the Morgan and Morecambe Offshore Windfarms Transmission Assets in October 2022.
Environmental Impact Assessment	The process of identifying and assessing the significant effects likely to arise from a project. This requires consideration of the likely changes to the environment, where these arise as a consequence of a project, through comparison with the existing and projected future baseline conditions.

Term	Meaning
Environmental Statement	The document presenting the results of the Environmental Impact Assessment process.
European sites	Designated nature conservation sites which include the National Site Network (designated within the UK) and Natura 2000 sites (designated in any European Union country). This includes Sites of Community Importance, Special Areas of Conservation and Special Protection Areas.
Evidence Plan Process	A voluntary consultation process with specialist stakeholders to agree the approach to, and information to support, the EIA and Habitats Regulations Assessment processes for certain topics.
Expert Working Group	A forum for targeted engagement with regulators and interested stakeholders through the Evidence Plan process.
Frequency (of impact)	The number of times an impact occurs across the relevant phase/lifetime of a project.
Generation Assets	The generation assets associated with the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm include the offshore wind turbines, inter-array cables, offshore substation platforms and platform link (interconnector) cables to connect offshore substations.
Habitats Regulations	The Conservation of Habitats and Species Regulations 2017 (as amended) and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended)
Impact	Change that is caused by an action/proposed development, e.g., land clearing (action) during construction which results in habitat loss (impact).
Impulsive sound	Impulsive sound consists of brief, discrete sounds with a sudden onset, such as acoustic pulses from example explosions, pile driving, or seismic airguns.
Inter-related Effects	Inter-related effects arise where an impact acts on a receptor repeatedly over time to produce a potential additive effect or where a number of separate impacts, such as sound and habitat loss, affect a single receptor.
Kurtosis	A measure of sharpness of the peak of a frequency-distribution curve.
Landfall	The area in which the offshore export cables make landfall (come on shore) and the transitional area between the offshore cabling and the onshore cabling. This term applies to the entire landfall area at Lytham St. Annes between Mean Low Water Springs and the transition joint bay inclusive of all construction works, including the offshore and onshore cable routes, intertidal working area and landfall compound(s).
Long term	A period of greater than five years.
Marine licence	The Marine and Coastal Access Act 2009 requires a marine licence to be obtained for licensable marine activities. Section 149A of the Planning Act 2008 allows an applicant for to apply for 'deemed marine licences' in English waters as part of the development consent process.
Maximum design scenario	The realistic worst case scenario, selected on a topic-specific and impact specific basis, from a range of potential parameters for the Transmission Assets
Medium term	A period of more than one year, up to five years.

Term	Meaning
Mitigation measures	This term is used interchangeably with Commitments. The purpose of such measures is to avoid, prevent, reduce or, if possible, offset significant adverse environmental effects.
Morecambe Offshore Windfarm: Generation Assets	The offshore generation assets and associated activities for the Morecambe Offshore Windfarm.
Morecambe Offshore Windfarm: Transmission Assets	The offshore export cables, landfall and onshore infrastructure required to connect the Morecambe Offshore Windfarm to the National Grid.
Morgan and Morecambe Offshore Wind Farms: Transmission Assets	The offshore and onshore infrastructure connecting the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm to the national grid. This includes the offshore export cables, landfall site, onshore export cables, onshore substations, 400 kV grid connection cables and associated grid connection infrastructure such as circuit breaker compounds. Also referred to in this report as the Transmission Assets, for ease of reading.
Morgan Offshore Wind Project: Generation Assets	The offshore generation assets and associated activities for the Morgan Offshore Wind Project.
Morgan Offshore Wind Project: Transmission Assets	The offshore export cables, landfall and onshore infrastructure required to connect the Morgan Offshore Wind Project to the National Grid.
National Policy Statement (s)	The current National policy statements for Energy published by the Department for Energy Security and Net Zero in 2023 and adopted in 2024.
Non-impulsive sound	Non-impulsive sound is continuous sound and is primarily generated by shipping.
Non-statutory consultee	Organisations that an applicant may choose to consult in relation to a project who are not designated in law but are likely to have an interest in the project.
Offshore export cables	The cables which would bring electricity from the Generation Assets to the landfall.
Offshore Order Limits	See Transmission Assets Order Limits: Offshore (below).
Offshore substation platform(s)	A fixed structure located within the wind farm sites, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable form for export to shore.
Planning Inspectorate	The agency responsible for operating the planning process for applications for development consent under the Planning Act 2008.
Preliminary Environmental Information Report	A report that provides preliminary environmental information in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. This is information that enables consultees to understand the likely significant environmental effects of a project and which helps to inform consultation responses.
Reversibility	A reversible impact is one where recovery is possible naturally in a relatively short time period, or where mitigation measures can be effective at reversing the impact. An irreversible impact may occur when recovery is

Term	Meaning
	not possible within a reasonable timescale, or there is no reasonable chance of action being taken to reverse it.
Scoping Opinion	Sets out the Planning Inspectorate's response (on behalf of the Secretary of State) to the Scoping Report prepared by the Applicants. The Scoping Opinion contains the range of issues that the Planning Inspectorate, in consultation with statutory stakeholders, has identified should be considered within the Environmental Impact Assessment process.
Short term	A period of months, up to one year.
Sound Exposure Levels	The representation of a sound event if all the energy were compressed into a one second period. This provides a uniform way to make comparisons between sound events of different durations.
Spatial extent	Geographical area over which the impact may occur.
Statutory consultee	Organisations that are required to be consulted by an applicant pursuant to section 42 of the Planning Act 2008 in relation to an application for development consent. Not all consultees will be statutory consultees (see non-statutory consultee definition).
Study area	This is an area which is defined for each environmental topic which includes the Transmission Assets Order Limits as well as potential spatial and temporal considerations of the impacts on relevant receptors. The study area for each topic is intended to cover the area within which an impact can be reasonably expected.
Substation	Part of an electrical transmission and distribution system. Substations transform voltage from high to low, or the reverse by means of electrical transformers.
Transboundary effects	Effects from a project within one state that affect the environment of another state(s).
Transmission Assets	See Morgan and Morecambe Offshore Wind Farms: Transmission Assets (above).
Transmission Assets Order Limits	The area within which all components of the Transmission Assets will be located, including areas required on a temporary basis during construction and/or decommissioning.
Transmission Assets Order Limits: Offshore	The area within which all components of the Transmission Assets seaward of Mean Low Water Springs will be located, including areas required on a temporary basis during construction and/or decommissioning. Also referred to in this report as the Offshore Order Limits, for ease of reading.
Vibrissae	Vibrissae are more generally called whiskers, are a type of stiff, functional hair used by mammals to sense their environment.
Zone of Influence	The zone for impacts associated with the project (e.g. potential injury and/or disturbance ranges of underwater sound as a result of construction activities during construction).

Acronyms

Acronym	Meaning
ADD	Acoustic Deterrent Device
AU	Assessment Unit
BEIS	Department for Business, Energy and Industrial Strategy
CEA	Cumulative Effects Assessment
CI	Confidence Interval
CIEEM	Chartered Institute of Ecology and Environmental Management
CIS MU	Celtic and Irish Seas Management Unit
CGNS MU	Celtic and Greater North Seas Management Unit
CPT	Cone Penetration Test
CSIP	UK Cetacean Stranding's Investigation Programme
CTV	Crew Transfer Vessel
CV	Coefficient of Variation
DAS	Digital Aerial Survey
DCO	Development Consent Order
Defra	Department for Environment, Food & Rural Affairs
DSM	Density Surface Models
EDR	Fixed Threshold Response
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EMP	Environmental Management Plan
EPP	Evidence Plan Process
EPS	European Protected Species
ES	Environmental Statement
EWG	Expert Working Group
GSRP	Grey Seal Reference Population
HF	High frequency
HSRP	Harbour Seal Reference Population
HRA	Habitats Regulations Assessment
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Sea
IMR	Institute of Marine Research
ISAA	Information to Support Appropriate Assessment

Acronym	Meaning
IS MU	Irish Sea Management Unit
IUCN	International Union for Conservation of Nature
JCP	Joint Cetatean Protocol
JNCC	Joint Nature Conservation Committee
LF	Low Frequency
MBES	Multi-beam Echo-sounder
MDS	Maximum Design Scenario
MHWS	Mean High Water Springs
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MMOb	Marine Mammal Observer
MNR	Marine Nature Reserve
MPCP	Marine Pollution Contingency Plan
MSFD	Marine Strategy Framework Directive
MU	Management Unit
MV	Marine Vibroseis
MWDW	Manx Whale and Dolphin Watch
NAMMCO	North Atlantic Marine Mammal Commission
NEQ	Net Explosive Quantity
NMFS	National Marine Fisheries Services
NOAA	National Oceanic and Atmospheric Administration
NPS	National Policy Statement
NRA	Navigational Risk Assessment
NRW	National Resources Wales
OSP	Offshore Substation Platforms
OSPAR	Oslo and Paris Conventions
PAM	Passive Acoustic Monitoring
PCB	PolyChlorinated Biphenyl
PCW	Phocid Carnivores in Water
PDV	Phocine Distemper Virus
PEIR	Preliminary Environmental Information Report
POP	Persistent Organic Pollutants
PTS	Permanent Threshold Shift

Acronym	Meaning
SAC	Special Area of Conservation
SCANS	Small Cetaceans in the European Atlantic and North Seas
SBES	Single-beam Echo-sounder
SBP	Sub-bottom Profiler
SCOS	Special Committee on Seals
SEL	Sound Exposure Level
SNCB	Statutory Nature Conservation Body
SMRU	Sea Mammal Research Unit
SMU	Seal Management Unit
SOV	Service Operation Vessels
SSC	Suspended Sediment Concentrations
SSS	Sidescan Sonar
TTS	Temporary Threshold Shift
TWT	The Wildlife Trust
UHRS	Ultra High Resolution Seismic
UK	United Kingdom
UXO	Unexploded Ordnance
VHF	Very High Frequency
VTMP	Vessel Traffic Management Plan
ZoI	Zone of Influence

Units

Unit	Description
%	Percentage
dB	Decibels
Hz	Hertz
kg	Kilogram
kHz	Kilohertz
km	Kilometre
km^2	Kilometre squared
Knots	Knot
m	Metre

Unit	Description
mg	Milligram
m/s	Metres per second
nm	Nautical mile
rms	Root mean square
SEL_{cum}	Cumulative Sound Exposure Level
SPL	Sound Pressure Level
SPL_{pk}	Peak Sound Pressure Level
μPa	Micro pascal
μPa^2	Micro-pascal squared

4 Marine mammals

4.1 Introduction

4.1.1.1 This chapter of the Environmental Statement (ES) presents the findings of the Environmental Impact Assessment (EIA) work undertaken for the Morgan and Morecambe Offshore Wind Farms: Transmission Assets. For ease of reference the Morgan and Morecambe Offshore Wind Farms Transmission Assets are referred to in this chapter as the 'Transmission Assets'. This ES accompanies the application to the Planning Inspectorate for development consent for the Transmission Assets.

4.1.1.2 The purpose of the Transmission Assets is to connect the Morgan Offshore Wind Project: Generation Assets and Morecambe Offshore Windfarm: Generation Assets (referred to collectively as the 'Generation Assets') to the National Grid. A description of the Transmission Assets can be found in Volume 1, Chapter 3: Project description of the ES.

4.1.1.3 This chapter considers the likely impacts and effects of the Transmission Assets on marine mammals during the construction, operation and maintenance, and decommissioning phases. Specifically, it relates to the offshore elements of the Transmission Assets seaward of Mean High Water Springs (MHWS).

4.1.1.4 This ES chapter:

- sets out the existing and future environmental baseline conditions, established from desk studies, surveys and consultation undertaken to date;
- presents the potential environmental impacts and effects on all aspects of marine mammals arising from the Transmission Assets, based on the information gathered and the analysis and assessments undertaken to date;
- identifies any assumptions and limitations encountered in compiling the environmental information; and
- highlights any necessary monitoring and/or mitigation measures that could prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

4.1.1.5 The assessment presented is informed by the following technical chapters and should be read in conjunction with:

- Volume 2, Chapter 3: Fish and shellfish ecology of the ES; and
- Volume 2, Chapter 7: Shipping and navigation chapter of the ES.

4.1.1.6 This chapter also draws upon additional information to support the assessment contained within:

- Volume 2, Annex 4.1: Marine mammals technical report of the ES; and

- Volume 1, Annex 5.2: Underwater sound technical report of the ES.

4.2 Legislation, policy and guidance

4.2.1 Legislation

4.2.1.1 The full legislative context for the Transmission Assets has been detailed in Volume 1, Chapter 2: Policy and legislation context of the ES, with the legislation outlined below being the most relevant to marine mammals.

Habitats Regulations

4.2.1.2 The objective of the Habitats Regulations is to conserve, at a Favourable Conservation Status, those qualifying habitats and species and supporting habitats of qualifying species listed under the Habitats Directive.

4.2.1.3 Before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which is likely to have a significant effect on a European offshore marine site or a European site (see designated sites relevant to marine mammals, as set out in **section 4.6.2** and in Volume 2, Annex 4.1: Marine mammals technical report of the ES) (either alone or in combination with other plans or projects), and is not directly connected with or necessary to the management of the site, the relevant competent authority must undertake an appropriate assessment of the implications for the site in view of that site's conservation objectives. If the potential for adverse effects on European site integrity cannot be discounted, the project could only proceed if imperative reasons of over-riding public interest are found to exist and if compensatory measures can be secured.

4.2.1.4 A person is guilty of an offence if they deliberately capture, injure, or kill any wild animal of a European Protected Species (EPS). In English inshore waters (within 12 nm of the coast), offences relating to the protection of marine EPS are provided for under the Habitats Regulations[1].

Marine and Coastal Access Act 2009

4.2.1.5 Parts three and four of the Marine and Coastal Access Act 2009 introduced a new marine planning and licensing system for overseeing the marine environment and a requirement to obtain a marine licence for certain activities and works at sea. Section 149A of the Planning Act 2008 allows applicants for development consent to apply for 'deemed marine licences' as part of the consenting process.

[1] The Conservation (Natural Habitats, &c.) Regulations (1994 implement the Habitats Directives in territorial waters out to 12 nautical miles (nm). The Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007 (as amended) (the Offshore Marine Regulations) transpose the provisions of the Habitats Directive in offshore waters, beyond 12 nm.

The Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS) 1994

4.2.1.6 The Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS) came into force in 1994. The aim of the Agreement is to promote close co-operation amongst Parties with a view to achieving and maintaining a favourable conservation status for small cetaceans.

OSPAR Convention 1992

4.2.1.7 The Convention for the Protection of the Marine Environment of the North-East Atlantic (referred to as the OSPAR (Convention) was signed at the ministerial meeting of the Oslo and Paris Commissions in Paris in 1992 and aims to protect the marine environment of the North-East Atlantic. As part of this work, the need for a network of Marine Protected Areas (MPAs) has been identified, and includes Special Areas of Conservation (SACs) with marine components, which is relevant to marine mammals.

Convention of the Conservation of European Wildlife and Natural Habitats (the Bern Convention, 1979)

4.2.1.8 The principal aims of the Convention are to ensure conservation and protection of wild plant and animal species and their natural habitats (listed in Appendices I and II of the Convention), to increase co-operation between contracting parties, and to regulate the exploitation of migratory species listed in Appendix III.

4.2.1.9 The United Kingdom (UK) Government ratified the Bern Convention in 1982. The obligations of the Convention are transposed into UK law by means of the Wildlife and Countryside Act 1981 Nature Conservation (Scotland) Act 2004, Wildlife (Northern Ireland) Order 1985, and the Nature Conservation and Amenity Lands (Northern Ireland) Order 1985.

Convention of the Conservation of Migratory Species of Wild Animals (the Bonn Convention, 1979)

4.2.1.10 The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention or CMS) was adopted in Bonn, Germany in 1979 and came into force in 1985. Contracting Parties work together to conserve migratory species and their habitats by providing strict protection for endangered migratory species, concluding multilateral Agreements for the conservation and management of migratory species which require or would benefit from international co-operation (listed in Appendix II), and by undertaking co-operative research activities.

The Conservation of Seals Act 1970

4.2.1.11 An Act to provide the protection and conservation of seals in England, Wales, Scotland and in adjacent territorial waters. The Conservation of Seals Act 1970 prohibits killing or taking seals. It is an offence to intentionally or recklessly kill, injure or take a seal. As of 1 March 2021, amendments made to the Conservation of Seals Act 1970 by Schedule 9 of the Fisheries Act 2020 come into force. Individual seals can no longer be controlled under the 'netsman's defence' as this defence was removed from the legislation as of 1 March 2021.

The UK Biodiversity Framework 2024

4.2.1.12 The UK Biodiversity Framework (UKBF), published in May 2024, has been developed in response to the Kunming-Montreal Global Biodiversity Framework (GBF), which was agreed at the Fifteen Conference of the Parties (COP15) of the Convention on Biological Diversity (CBD) in December 2022.

4.2.1.13 The Framework focuses on activities to provide opportunities for meeting the UK's commitments more efficiently at a UK scale, to add value to delivery in all countries of the UK, and to contribute to informing UK positions. Through the UKBF, the four countries will agree on activities where joint action between them is required to implement the Kunming-Montreal GBF. As a key initial activity, the four countries will develop and publish the UK's National Biodiversity Strategy and Action Plan, summarising how the countries of the UK will deliver/implement the GBF.

4.2.2 Planning policy context

4.2.2.1 The Transmission Assets will be located in English offshore waters (beyond 12 nautical miles (nm) from the English coast) and inshore waters, with the onshore infrastructure located wholly within England. As set out in Volume 2, Chapter 1: Introduction, of this ES, the Secretary of State for Energy Security and Net Zero (formerly Business, Energy and Industrial Strategy) has directed that the Transmission Assets and are to be treated as development for which development consent is required under the Planning Act 2008, as amended.

National Policy Statements

4.2.2.2 There are currently six energy National Policy Statements (NPS), two of which contain policy relevant to the Transmission Assets and marine mammals, specifically:

- overarching NPS for Energy (NPS EN-1) which sets out the UK Government's policy for the delivery of major energy infrastructure (Department for Energy Security & Net Zero 2023a); and
- NPS for Renewable Energy Infrastructure (NPS EN-3) (Department for Energy Security & Net Zero 2023b).

4.2.2.3 **Table 4.1** sets out a summary of the policies within the current adopted NPSs, relevant to marine mammals.

Table 4.1: Summary of the NPS EN-1, NPS EN-3 provisions relevant to marine mammals

Summary of NPS EN-1 and EN-3 provision	How and where considered in the ES
[EN-1 5.4.17-18] "Where the development is subject to EIA the applicant should ensure that the ES clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. The applicants should provide environmental information proportionate to the infrastructure where EIA is not required to help the Secretary of State consider thoroughly the potential effects of a proposed project."	The potential effects on internationally, nationally and locally designated sites for ecological or geological features of conservation importance have been assessed for the Transmission Assets (see **section 4.6.2**). The Habitats Regulations Assessment (HRA) Stage 1 Screening Report (document reference: E3) identifies direct or indirect effects on designated sites which could be affected, and those sites will be assessed in the HRA Stage 2 Information to Support Appropriate Assessment (ISAA) Part 2 (document reference: E2.2). Important protected areas for marine mammals are discussed in Volume 2, Annex 4.1: Marine mammals technical report of the ES and in **section 4.6.2** of this chapter and assessed in **section 4.11**.
[EN-1 5.4.19] "The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests."	Measures that will be adopted as part of the Transmission Assets to conserve marine mammal biodiversity are presented in **section 4.8** and the Marine enhancement statement (document reference: J12).
[EN-1 5.4.22] "The design of Energy NSIP proposals will need to consider the movement of mobile/migratory species such as birds, fish and marine and terrestrial mammals and their potential to interact with infrastructure. As energy infrastructure could occur anywhere within England and Wales, both inland and onshore and offshore, the potential to affect mobile and migratory species across the UK and more widely across Europe (transboundary effects) requires consideration, depending on the location of development."	The movement of mobile/migratory species such as marine mammals is considered in the assessment across the UK (**section 4.11**) and more widely across Europe in the cumulative (**section 4.13**) and transboundary assessment (**section 4.14**).
[EN-1 5.4.35] "Applicants should include appropriate avoidance, mitigation, compensation and enhancement measures as an integral part of the proposed development. In particular, the applicant should demonstrate that: • during construction, they will seek to ensure that activities will be confined to the minimum areas required for the works; • the timing of construction has been planned to avoid or limit disturbance; • during construction and operation best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised, including as a consequence of transport access arrangements;	Appropriate avoidance and mitigation measures (embedded measures) relevant for marine mammals will be adopted as part of the Transmission Assets are detailed in **section 4.8**. The Maximum Design Scenario (MDS) in **section 4.9.1**, represents the parameters that make up the realistic worst case scenario (i.e. the maximum project design parameters) and is selected on a topic-by-topic and impact-by-impact basis and assessed in **section 4.11**. The Applicants have also prepared an Outline Marine mammal mitigation protocol (MMMP) (CoT64) (**Table 4.12**) (document reference: J18) which is secured within the deemed marine licences in the draft Development Consent Order (DCO). The Outline MMMP (document

Summary of NPS EN-1 and EN-3 provision	How and where considered in the ES
• habitats will, where practicable, be restored after construction works have finished; • opportunities will be taken to enhance existing habitats rather than replace them, and where practicable, create new habitats of value within the site landscaping proposals. Where habitat creation is required as mitigation, compensation, or enhancement the location and quality will be of key importance. In this regard habitat creation should be focused on areas where the most ecological and ecosystems benefits can be realised; and • mitigations required as a result of legal protection of habitats or species will be complied with."	reference: J18) will be implemented during construction to reduce the risk of injury to marine mammals key receptors.
[EN-3 2.8.52-53] "Given the scale of offshore wind deployment required to meet 2030 and 2050 ambitions, applicants will need to give close consideration to impacts on MPAs, either alone or in combination, and employ the mitigation hierarchy and if necessary, provide compensation (both individually and in combination with other plans or projects) which may be needed to approve their projects. It is likely that mitigation may include proactive measures to reduce the impact of deployment (e.g. micrositing of offshore transmission routes to avoid vulnerable habitats, alternatives piling or trenching techniques, noise abatement technology, collision avoidance methods, or if necessary, compensation for habitat loss)."	Important marine protected areas, Special Areas of Conservation designated for marine mammals, and Marine Nature Reserves (MNR) in Manx waters are identified in Volume 2, Annex 4.1: Marine mammal technical report of the ES and in **section 4.6.2** of this chapter and assessed in **section 4.11**. Embedded mitigation measures relevant for marine mammals which will be adopted as part of the Transmissions Assets are detailed in **section 4.8**. The Applicants have also prepared an Outline MMMP (CoT64) (**Table 4.12**) (document reference: J18) which is secured within the deemed marine licences in the draft DCO. The Outline MMMP (document reference: J18) will be implemented during construction to reduce the risk of injury to marine mammals key receptors.
[EN-3 2.8.90-92] "As part of the Offshore Wind Environmental Improvement Package set out in the British Energy Security Strategy, Government committed to establishing Offshore Wind Environmental Standards (OWES; previously referred to as Nature Based Design Standards) to accelerate deployment whilst offering greater protection of the marine environment. OWES aim to support developers to take a more consistent approach to avoiding, reducing, and mitigating the impacts of an offshore wind farms and/or offshore transmission infrastructure. The measures could apply to the design, construction, operation and decommissioning of offshore wind farms and offshore transmission (as defined in EN-5 at section 2.12). Department for Environment, Food & Rural Affairs (Defra) will consult on a series of OWES before drafting clear OWES Guidance, which sets out where and how Defra expects each measure to be applied to a development. Once the OWES	The Applicants are aware of the requirements in NPS EN-3 to apply the guidance on environmental standards, once this final OWES guidance is issued. At the time of writing the draft OWES Guidance has not been produced. Once available, the Applicants will review any transitional provisions to confirm its applicability to the application.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the ES
Guidance is issued, the Secretary of State will expect applicants to have applied the relevant measures to their applications. Applicants should explain how their proposals comply with the guidance or, alternatively, the grounds on which a departure from them is justified. Any reasons for departure from the OWES should be fully detailed within the application documents, with details of any agreements made with statutory consultees."	
[EN-3 2.8.102-103] "Applicants need to consider environmental and biodiversity net gain as set out in Section 4.6 of EN-1 and the Environment Act 2021. Applicants should assess the potential of their proposed development to have net positive effects on marine ecology and biodiversity, as well as negative effects."	Both potential positive and negative effects for marine mammals have been considered for the Transmission Assets (see **section 4.11**). Further consideration can also be found in the Outline Marine enhancement statement (document reference: J12).
[EN-3 2.8.104-106] "Applicants should consult at an early stage of pre-application with relevant statutory consultees and energy not-for profit organisations/non-governmental organisations, as appropriate, on the assessment methodologies, baseline data collection, and potential avoidance, mitigation and compensation options should be undertaken. In developing proposals applicants must refer to the most recent best practice advice originally provided by Natural England under the Offshore Wind Enabling Action Programme and/or their relevant Statutory Nature Conservation Body (SNCB). Any relevant data that has been collected as part of post-construction ecological monitoring from existing, operational offshore wind farms should be referred to where appropriate."	Assessment methodologies and baseline data collection has been consulted on, through the Evidence Plan Process (EPP) (see **section 4.3**). Relevant data collected as part of post-construction ecological monitoring from existing operational offshore wind farms has been included where appropriate to inform the baseline (see **section 4.5**) with further detail given in Volume 2, Annex 4.1: Marine mammal technical report of the ES.
[EN-3 2.8.131-132] "Where necessary, assessment of the effects on marine mammals should include details of: • likely feeding areas and impacts on prey species and prey habitat; • known birthing areas/haul out sites for breeding and pupping; • migration routes; • protected sites; • baseline noise levels; • predicted construction and soft start noise levels in relation to mortality, Permanent Threshold Shift (PTS), Temporary Threshold Shift (TTS) and disturbance; • operational noise;	The potential for effects on marine mammals has been assessed in **section 4.11** and a detailed technical baseline, including likely feeding areas; known birthing areas/haul out sites; known migration or commuting routes has been presented within Volume 2, Annex 4.1: Marine mammal technical report of the ES and in this chapter (**section 4.6**). Relevant protected areas to the Transmission Assets are discussed in Volume 2, Annex 4.1: Marine mammal technical report of the ES and in this chapter (**section 4.6.2**). Baseline sound levels and predicted received sound levels in relation to PTS, TTS and disturbance have been considered within Volume 1, Annex 5.2: Underwater sound technical report of the ES.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the ES
• duration and spatial extent of the impacting activities including cumulative/in-combination effects with other plans or projects; • collision risk; • entanglement risk; and • barrier risk. The scope, effort and methods required for marine mammal surveys and impact assessments should be discussed with the relevant SNCB."	The duration and spatial extent of potentially disturbing activities, including cumulative effects with other plans or projects is presented in **section 4.13**. An assessment of in-combination effects is presented in the HRA Stage 2 ISAA Part 2 (document reference: E2.2). Collision risk has been considered within **section 4.11.4**. Where relevant, the potential for barrier effects has been considered. Entanglement risk is not a relevant risk for marine mammals for the Transmission Assets (see **Table 4.13** and Volume 1, Chapter 3: Project Description of the ES). Assessment methodologies and baseline data collection has been consulted on, through the Evidence Plan Process (EPP) (see **section 4.3**).
[EN-3 2.8.133-135] "The applicant should discuss any proposed noisy activities with the relevant statutory body and must reference the Joint Nature Conservation Committee (JNCC) and SNCB underwater noise guidance, and any successor of this guidance, in relation to noisy activities (alone and in-combination with other plans or projects) within SACs, SPAs and Ramsar sites, in addition to the JNCC mitigation guidelines to piling, explosive use, and geophysical surveys. Natural Resources Wales (NRW) has a position statement on assessing noisy activities which should also be referenced where relevant. Where the assessment identifies that noise from construction and Unexploded Ordnance (UXO) clearance may reach noise levels likely to lead to noise thresholds being exceeded (as detailed in the JNCC guidance) or an offence is committed, the applicant will be expected to look at possible alternatives or appropriate mitigation. The applicant should develop a Site Integrity Plan or alternative assessments for projects in English and Welsh waters to allow the cumulative impacts of underwater noise to be reviewed closer to the construction date, when there is more certainty in other plans and projects."	Potential sound as a result of UXO clearance activities has been discussed in **section 4.11.2**, with potential sound from vessels in discussed in **section 4.11.3** and potential sound as a result of geophysical and geotechnical surveys has been discussed in **section 4.11.6**. Potential sound as a result of piling has not been assessed - with the removal of the Morgan Offshore Substation Platform (OSP), the Morecambe OSPs and the Morgan Offshore Booster Station from the Project Design Envelope, the requirement to assess the potential for injury and disturbance from underwater sound generated from piling has also been removed (see **Table 4.5**). Appropriate measures adopted as part of the Transmission Assets to reduce the magnitude of impact such that any residual significant effects from the Transmission Assets are reduced to non-significant levels, along with those specific to construction, operations and maintenance and decommissioning are presented in **section 4.8**. The Applicants have also prepared an Outline MMMP (CoT64) (**Table 4.12**) (document reference: J18) which is secured within the deemed marine licences in the draft DCO. The Outline MMMP (document reference: J18) will be implemented during construction to reduce the risk of injury to marine mammals key receptors. A Site Integrity Plan is not proposed but the Outline MMMP (CoT64) (**Table 4.12**) (document reference: J18) establishes a process of investigating options to manage underwater sound levels, in consultation with the licensing authority and SNCBs with agreement prior to construction. This will allow the cumulative

Summary of NPS EN-1 and EN-3 provision	How and where considered in the ES
	impacts of underwater noise to be reviewed closer to the construction date. NRWs position statement (NRW, 2023b) has been reviewed and incorporated throughout the assessment. Guidelines on noisy activities have been referenced where relevant: • JNCC mitigation guidelines on explosive use have been considered in relevant sections of this chapter (**section 4.11**); • The SNCB guidance on underwater noise within SACs, SPAs and Ramsar sites, has been considered in the HRA Stage 2 Information to Support Appropriate Assessment (ISAA) Part 2 (document reference: E2.2). The ISAA Part 2 assesses the likely significance of effect of underwater noise (among other effects) on designated features, such as Annex II marine mammals, of European protected sites, whereas this chapter assesses the potential effects to marine mammal receptors directly.
[EN-3 3.8.237-239] "Monitoring of the surrounding area before and during the piling procedure can be undertaken by various methods including marine mammal observers and passive acoustic monitoring. Active displacement of marine mammals outside potential injury zones can be undertaken using equipment, such as acoustic deterrent devices. Soft start procedures during pile driving may be implemented. This enables marine mammals in the area disturbed by the sound levels to move away from the piling before physical or auditory injury is caused. Where noise impacts cannot be avoided, other mitigation should be considered, including alternative installation methods and noise abatement technology, spatial/ temporal restrictions on noisy activities, alternative foundation types. Applicants should undertake a review of up-to-date research and all potential mitigation presented as part of the application, having consulted the relevant JNCC mitigation guidelines ".	Potential sound as a result of UXO clearance activities has been discussed in **section 4.11.2**, with potential sound from vessels in discussed in **section 4.11.3** and potential sound as a result of geophysical and geotechnical surveys has been discussed in **section 4.11.6**. Potential sound as a result of piling has not been assessed - with the removal of the Morgan OSP, the Morecambe OSPs and the Morgan Offshore Booster Station from the Project Design Envelope, the requirement to assess the potential for injury and disturbance from underwater sound generated from piling has also been removed (see **Table 4.5**). Appropriate measures adopted as part of the Transmission Assets to reduce the magnitude of impact such that any residual significant effects from the Transmission Assets are reduced to non-significant levels, along with those specific to construction, operations and maintenance and decommissioning are presented in **section 4.8**. The Applicants have prepared an Outline MMMP (CoT64) (**Table 4.12**) (document reference: J18) which is secured within the deemed marine licences in the draft DCO. The Outline MMMP (document reference: J18) will be implemented during construction to reduce

Summary of NPS EN-1 and EN-3 provision	How and where considered in the ES
	the risk of injury to marine mammals key receptors, and includes measures in line with JNCC guidelines, including Marine Mammal Observers (MMOb), Passive Acoustic Monitoring (PAM) and soft starts for UXO clearance. The Outline MMMP (CoT64) (**Table 4.12**) (document reference: J18) establishes a process of investigating options to manage underwater sound levels, in consultation with the licensing authority and SNCBs with agreement prior to construction.
[EN-3 3.8.312-314] “The Secretary of State should be satisfied that the preferred methods of construction, in particular the construction method needed for the proposed foundations and the preferred foundation type, where known at the time of application, are designed reasonably to minimise significant impacts on marine mammals. Unless suitable noise mitigation measures can be imposed by requirements to any development consent the Secretary of State may refuse the application. The conservation status of cetaceans and seals are of relevance and the Secretary of State should be satisfied that cumulative and in-combination impacts on marine mammals have been considered."	Transmission Assets project parameters relevant to marine mammals have been set out in **Table 4.13** (Maximum Design Scenario considered for the assessment of potential impacts on marine mammals). Noting that no assessment has been undertaken for the construction of foundations as the OSPs and the Morgan Offshore Booster Station have been removed from the Project Design Envelope, the requirement to assess the potential for injury and disturbance from underwater sound generated from piling has also been removed (see **Table 4.5**). Measures adopted as part of the Transmission Assets are set out in **section 4.8**, which include a measure to develop and adhere to a detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18)which will be developed in accordance with the Outline MMMP (document reference: J18) and in line with the latest research and JNCC mitigation guidelines. The detailed MMMPs will be developed as part of a stepped strategy post consent and following the mitigation hierarchy - avoid, reduce, mitigate. An assessment of cumulative effects presented in **section 4.13** and an assessment of in-combination effects is presented in the HRA Stage 2 ISAA Part 2 (document reference: E2.2).

Marine policy

UK Marine Policy Statement

4.2.2.4 The assessment of potential changes to marine mammals has also been made with consideration to the specific policies set out in the UK Marine Policy Statement (HM Government, 2011). **Table 4.2** sets out a summary of the specific policies set out in the UK Marine Policy Statement (HM Government, 2011) relevant to this chapter.

Table 4.2: Summary of the UK Marine Policy Statement relevant to this chapter

Summary of relevant policy framework	How and where considered in the ES
Ensure a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets.	The magnitude of impacts and the sensitivity of marine mammal receptors are analysed in **section 4.11** to determine if the relevant impacts represent a significant effect on the marine mammal receptors.
The marine environment plays an important role in mitigating climate change.	The impact of climate change on the baseline environment and how this will influence the predictions made in the effects assessment is considered as part of the future baseline in **section 4.6**.
Biodiversity is protected, conserved and where appropriate recovered and loss has been halted.	**Section 4.11** presents an assessment of the significance of effect of the Transmission Assets on marine mammal receptors along with mitigation measures adopted to prevent, minimise, reduce or offset potential impacts (**Table 4.51** and **Table 4.52**) (Marine enhancement statement (document reference: J12)).
Marine businesses are acting in a way which respects environmental limits and is socially responsible.	**Section 4.11** presents an assessment of the significance of effect of the Transmission Assets on marine mammal receptors along with the measures adopted as part of the Transmission Assets to prevent, minimise, reduce or offset potential impacts.

The Marine Strategy Framework Directive

4.2.2.5 The Marine Strategy Framework Directive (MSFD) aims to protect more effectively the marine environment across Europe. **Table 4.3** sets out a summary of the MSFD descriptors relevant to marine mammals.

Table 4.3: Summary of the MSFD's high level descriptors of Good Environmental Status (GES) relevant to marine mammals and consideration in the Transmission Assets

MSFD Descriptor relevant to marine mammals	How and where considered in the Environmental Statement
Descriptor 1: Biological diversity: Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.	The potential effects on biological diversity has been described and considered within the assessment for Transmission Assets both alone (**section 4.11**) and in the Cumulative Effects Assessment (CEA) (**section 4.13**). A detailed baseline assessment which describes the distribution and abundance of marine mammal species in the study area has been undertaken in Volume 4, Annex 4.1: Marine mammal technical report of the ES, and a summary presented in **section 4.6**. Appropriate and precautionary densities to take forward to the assessment have been agreed in consultation with stakeholders.
Descriptor 4: Elements of marine food webs: All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long term abundance of the	The potential effects of prey species (see assessment of impacts on fish prey species in Volume 2, Chapter 3: Fish and shellfish ecology of the ES) on the abundance and distribution of marine mammal receptors within the regional marine

MSFD Descriptor relevant to marine mammals	How and where considered in the Environmental Statement
species and the retention of their full reproductive capacity.	mammal study area has been described and considered within the assessment for Transmission Assets both alone (**section 4.11**) and in the CEA (**section 4.13**).
Descriptor 6: Sea floor integrity: Seafloor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.	The potential effects on temporary and long term habitat loss and introduction of new habitat on benthic ecosystems and associated benthic species have been considered within Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the ES and Volume 2, Chapter 3: Fish and shellfish ecology of the ES. Subsequently, the potential indirect effects on marine mammals in relation to changes in prey species communities within the Transmission Assets marine mammal study area has been described and considered within the assessment for the Transmission Assets both alone (**section 4.11**) and in the CEA (**section 4.13**).
Descriptor 8: Contaminants: Concentrations of contaminants are at levels not giving rise to pollution effects.	The potential effects of contaminants on marine mammal receptors were scoped out as agreed in the Transmission Assets EIA Scoping Report and as agreed with NRW (**Table 4.5**).
Descriptor 10: Marine litter: Properties and quantities of marine litter do not cause harm to the coastal and marine environment.	An appropriate Offshore Environmental Management Plans EMP (CoT65) (**Table 4.12**) will be produced and implemented. The Offshore EMPs will also outline any procedures implemented during the operations and maintenance phase. A Decommissioning Programme (CoT) is required under the provisions of the Energy Act 2004. This must be approved by the Secretary of State for the Department for Energy Security and Net Zero before works commence.
Descriptor 11: Energy including underwater noise: Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.	The potential effects of underwater sound from UXO clearance, geophysical and geotechnical surveys, and vessels have been considered within the assessment for the Transmission Assets both alone (**section 4.11**) and in the CEA (**section 4.13**) .It is noted that the European Union recently adopted thresholds for maximum acceptable levels for impulsive (e.g. piling) and continuous sound (e.g. shipping). The new limits mean, that to be in tolerable status, no more than 20% of a given marine area can be exposed to continuous underwater sound over a year. Similarly, no more than 20% of a marine habitat can be exposed to impulsive sound over a given day, and no more than 10% over a year. Potential sound as a result of piling has not been assessed due to the removal of all infrastructure that would require piling from the Project Design Envelope (i.e. the removal of the OSPs and Morgan Offshore Booster Station) Project Design Envelope. (see **Table 4.5**).

MSFD Descriptor relevant to marine mammals	How and where considered in the Environmental Statement
	The Transmission Assets has committed to an to a detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18)which will consider further mitigation measures to reduce any residual significant effects from the Transmission Assets alone to a non-significant level, on the basis of a refined project design post consent, where more detailed information is available. Additionally, the Measures to minimise disturbance to marine mammals and rafting birds from transiting vessels are provided with the DCO application (document reference J16).

North West Inshore and North West Offshore Coast Marine Plans 2021

4.2.2.6 The assessment of potential changes to marine mammals has also been made with consideration to the specific policies set out in the North West Inshore and North West Offshore Marine Plan (Marine Management Organisation (MMO), 2021). **Table 4.4** sets out a summary of the specific policies set out in the North West Inshore and North West Offshore Marine Plan (HM Government, 2021) relevant to this chapter. A National Policy Statement Tracker (document reference J26) and Planning Statement (document reference J28) has been submitted alongside the application which collates compliance with relevant marine plans.

Table 4.4: Summary of inshore and offshore marine plan policies relevant to this chapter

Policy	Key provisions	How and where considered in the ES
NW-MPA-1	Proposals that support the objectives of marine protected areas and the ecological coherence of the marine protected area network will be supported. Proposals that may have adverse impacts on the objectives of marine protected areas must demonstrate that they will, in order of preference: a. avoid b. minimise c. mitigate; adverse impacts, with due regard given to statutory advice on an ecologically coherent network.	This chapter presents the spatial scale of potential effects in relation to sites protected for marine mammal features (e.g. SACs, MNRs). A detailed assessment of the spatial overlap with European nature conservation designations has been undertaken as part of the HRA (HRA Stage 2 ISAA Part 2 (document reference: E2.2). The mitigation hierarchy has been followed to reduce and mitigate effects where possible (**section 4.8**, **Table 4.12**). In addition, measures have been adopted as part of the Transmission Assets to reduce the spatial scale of potential effects and are described in **section 4.8**, **Table 4.12**. Further details on site selection and design process in regards to avoidance and minimisation of impacts is set out in Volume 1,

Policy	Key provisions	How and where considered in the ES
		Chapter 4: Site Selection and Consideration of Alternatives.
NW-BIO-2	NW-BIO-2 requires proposals to manage negative effects which may significantly adversely impact the functioning of healthy, resilient and adaptable marine ecosystems.	The Applicants will implement a range of measures adopted (embedded measures) as part of the Transmission Assets to mitigate potential negative effects which are detailed in **section 4.11**
NW-UWN-2	Proposals that result in the generation of impulsive or non-impulsive noise must demonstrate that they will, in order of preference: a. avoid b. minimise c. mitigate Adverse impacts on highly mobile species so they are no longer significant.	The potential impacts of underwater sound resulting from the construction, operations and maintenance, and decommissioning phases have been considered in the underwater sound impact assessment (**section 4.11**). The project design parameters have been reduced through project refinement post-PEIR. With the removal of the Morgan OSP, the Morecambe OSPs and the Morgan Offshore Booster Station from the Project Design Envelope, the requirement to assess the potential for injury and disturbance from underwater sound generated from piling has also been removed (see **Table 4.5**). In addition, to further reduce potential impacts, the mitigation hierarchy has been followed to reduce and mitigate effects where possible (**section 4.8, Table 4.12**), and the Applicants will implement a range of measures adopted (embedded measures) as part of the Transmission Assets to reduce the potential effects of sound, as detailed in **section 4.8**, **Table 4.12**. Further details on site selection and design process in regards to avoidance and minimisation of impacts is set out in Volume 1, Chapter 4: Site Selection and Consideration of Alternatives.
NW-CE-1	Proposals which may have adverse cumulative effects with other existing, authorised, or reasonably foreseeable proposals must demonstrate that they will avoid, minimise and mitigate.	Potential cumulative effects have been quantified and their significance assessed in **section 4.13**. A detailed MMMPs (developed in accordance with the Outline MMMP (CoT64) (**Table 4.12**) (document reference: J18)) will be developed post-consent subject to project refinements and will consider mitigation in order to reduce the potential effects for the Transmission Assets alone, which

Policy	Key provisions	How and where considered in the ES
		will reduce the contribution to potential cumulative effects. Additionally, the Measures to minimise disturbance to marine mammals and rafting birds from transiting vessels are provided with the DCO application (document reference J16).

4.2.3 Relevant guidance

4.1.1.1 The marine mammals assessment has followed the methodology set out in Volume 2, Chapter 5: Environmental assessment methodology of the ES. The following guidance documents, which are specific to marine mammals, have also been considered.

- Guidance for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine (Chartered Institute of Ecology and Environmental Management (CIEEM), 2018) - these guidelines combine the Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, second edition (2016) and the Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal (2010).
- Joint Nature Conservation Committee guidelines for minimising the risk of injury to marine mammals from using explosives (JNCC, 2010b).
- Joint Nature Conservation Committee guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017).
- Guidelines for distinguishing serious and non-serious injury of marine mammals provided by National Oceanic and Atmospheric Administration (NOAA) (National Marine Fisheries Service (NMFS), 2023).
- Guidance on Environmental Considerations for Offshore Wind Farm Development (Oslo and Paris Conventions (OSPAR), 2008).
- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Judd, 2012).

4.3 Consultation and engagement

4.3.1 Scoping

4.3.1.1 On 28 October 2022, the Applicants submitted a Scoping Report to the Planning Inspectorate, which described the scope and methodology for the technical studies being undertaken to provide an assessment of any likely significant effects for the construction, operation and maintenance, and decommissioning phases of the Transmission

Assets. It also described those topics or sub-topics which are proposed to be scoped out of the EIA process and provided justification as to why the Transmission Assets would not have the potential to give rise to significant environmental effects in these areas.

4.3.1.2 Following consultation with the appropriate statutory bodies, the Planning Inspectorate (on behalf of the Secretary of State) provided a Scoping Opinion (document reference: J25) on 8 December 2022. In the Scoping Opinion Natural England agreed with the receptors scoped in to the assessment (which includes marine mammals) (see **Table 4.5**).

4.3.2 Evidence plan process

4.3.2.1 Following scoping, consultation and engagement with interested parties specific to marine mammals has continued. An EPP has been developed for the Transmission Assets, seeking to ensure engagement with the relevant aspects of the EIA process throughout the pre-application phase. The development and monitoring of the Evidence Plan and its subsequent progress has been undertaken by the EPP Steering Group. The Steering Group comprises the Planning Inspectorate, the Applicants, the MMO, Natural England, Historic England, the Environment Agency and the Local Planning Authorities as the key regulatory bodies.

4.3.2.2 As part of the EPP, Expert Working Groups (EWG) were set up to discuss and agree topic specific matters with the relevant stakeholders. A Marine Mammals EWG is in place to agree the information needed to supply to the Secretary of State, as part of a DCO application for the Transmission Assets, and includes Natural England, the MMO, the Centre for Environment, Fisheries and Aquaculture Science (Cefas) and The Wildlife Trusts (TWT) (**Table 4.5**).

4.3.3 Section 42 responses

4.3.3.1 The preliminary findings of the EIA process were published in the Preliminary Environmental Information Report (PEIR) in October 2023. The PEIR was prepared to provide the basis for formal consultation under the Planning Act 2008. This included consultation with statutory bodies under section 42 of the Planning Act 2008 (**Table 4.5**).

4.3.4 Summary of consultation responses received

4.3.4.1 A summary of the key items raised specific to marine mammals during the aforementioned consultation is presented in **Table 4.5**, together with how these matters have been considered in the production of this chapter. It should however be noted that formal responses are provided for all consultation responses received and can be accessed in the Consultation Report (document reference E1).

Table 4.5: Summary of key consultation comments raised during consultation activities undertaken for the Transmission Assets relevant to marine mammals

Date	Consultee and type of response	Comments raised	How and where considered in the ES
December 2022	**Scoping Opinion** Planning Inspectorate	The Scoping Report does not specifically identify the potential impact of the effects of underwater sound on marine life due to jacket or monopile cutting and removal during decommissioning within the Fish and shellfish ecology, Marine mammals or Offshore ornithology sections. The outcomes of the assessment should be presented within the relevant ES chapters.	The removal of the OSPs and the Morgan Offshore Booster Station from the Project Design Envelope means that there are no foundation or piling associated with the Transmission Assets.
		The ES should identify and secure appropriate mitigation measures to reduce/avoid impacts from UXO clearance on marine mammals. Effort should be made to agree appropriate mitigation with the relevant consultation bodies.	The ES has identified and secured appropriate measures adopted as part of the Transmission Assets for impacts identified related to UXO clearance for relevant receptors. Within the ES, measures adopted as part of the Transmission Assets are presented in **Table 4.12** has been discussed with the EWG where appropriate.
		Vessel Management Plan should incorporate measures to avoid disturbance and/or collision to marine mammals where appropriate.as well as measures to minimise disturbance to rafting seabirds.	Measures to avoid disturbance and/or collision to marine mammals will be implemented, through an Offshore EMPs (CoT65) (**Table 4.12**) Additionally, measures to limit disturbance to marine mammals are provided within document reference J16 of the Transmission Assets DCO application.
		Where measures within the Vessel Management Plan (VMP), EMP and/or Marine Pollution Contingency Plan (MPCP) are being relied upon for the assessments in the ES they must be set out in the ES in detail, including how they are to be secured e.g. by a Development Consent Order DCO requirement (noting they may evolve as the EIA progresses).	Measures adopted as part of the Transmission Assets are presented in **Table 4.12** and includes how the measure will be secured.
		Offshore, the Scoping Report proposes to scope out accidental pollution resulting from construction, operation	Impacts that are not likely to result in significant effects have been scoped out of the assessment,

Date	Consultee and type of response	Comments raised	How and where considered in the ES
		and decommissioning of the Proposed Development. The Inspectorate agrees that such effects are capable of mitigation through standard management practices and can be scoped out of the assessment	including accidental pollution, as set out in **Table 4.11**.
	Scoping Opinion Natural England	Advise most recent evidence on foraging distances of grey and harbour seals is used to establish connectivity with SACs.	Foraging distances are presented in relevant species sections for grey seal (**paragraph 4.6.1.4**) and harbour seal (**paragraph 4.6.1.5**).
		Advise that a Vessel Management Plan should be added to the list of measures adopted as part of the project.	Measures adopted as part of the Transmission Assets are presented in **Table 4.12** and include a Vessel Traffic Management Plan (CoT69) (**Table 4.12**).
		Natural England agrees with the receptors and impacts scoped in and out of the assessment	The impacts scoped into the assessment (as agreed with by Natural England) are set out in **Table 4.10**, and the assessment of effects for these impacts is set out in **section 4.11** (for the Transmission Assets alone) and in **section 4.13** (cumulatively with other projects/plans). Impacts that are not likely to result in significant effects have been scoped out of the assessment (as agreed with by Natural England), as set out in **Table 4.11**.
	Scoping Opinion NRW	Requested clarification on which MUs are being proposed for grey seal and harbour seal. NRW presently utilise the large OSPAR Region III area as an interim MU for grey seal and advise as it adequately captures the connectivity between seal colonies and the range of grey seal movement. There is strong evidence (through photo-ID and tagging studies) that grey seals range among the three Welsh SACs and beyond throughout the regional seas (OSPAR Region III area: west coast of Great Britain and neighbouring areas).	For grey seal, the Management Units (MUs) proposed and taken forward to assessment are given in **Table 4.9**. These are based upon telemetry data presented in Volume 2, Annex 4.1: Marine mammals technical report of the ES. For grey seal the reference population combines four Seal Management Units (SMU) (12 Wales, 13 North West (NW) England, 14 Northern Ireland, one South West (SW) Scotland), and population estimates for the Isle of Man, east of Ireland and south east of Ireland regions. For

Date	Consultee and type of response	Comments raised	How and where considered in the ES
			grey seal, OSPAR Region III is also used as a separate reference population (**Table 4.9**). For harbour seal, three SMUs are applied: 12 Wales, 13 NW England and 14 Northern Ireland.
		Recommended scoping in accidental pollution and suspended sediment concentrations during the construction phase. This impact pathway has been scoped out based on the Environmental Management Plan, Pollution Prevention Guidelines and Marine Pollution Contingency Plans. However, a contingency plan is not enough to rule out the potential likely effect, thus the impact pathway should be scoped into the EIA. NRW Advisory (NRW (A)) disagree with the statement that turbid conditions in tidal areas are equivalent to sediment plumes generated by cable burial. Given the length of the transmission assets, NRW (A) recommend either scoping it in, or providing further detail on how the impact range is expected to be localised and dissipated over one tidal excursion.	Accidental pollution was scoped out due to the development of, and adherence to, Offshore EMPs (CoT65) (**Table 4.12**) which include a MPCP. As set out above in this table, both Natural England and the Planning Inspectorate agreed to the scoping out of accidental pollution. The MPCP ensures that the potential for release of pollutants during construction, operation and maintenance, and decommissioning phases is minimised. This may include designated areas for refuelling where spillages can be easily contained, storage of chemicals in secure designated areas in line with appropriate regulations and guidelines, double skinning of pipes and takes containing hazardous substances, and storage of these substances impenetrable bunds. The MPCP will ensure that in the unlikely event that a pollution event occurs, plans are in place to respond quickly and effectively to ensure any spillage is minimised and effects on the environment are ideally avoided or minimised. Implementation of these measures will ensure that accidental release of contaminants from vessels will be avoided or minimised, thus providing protection for marine mammals across all phases of the Transmission Assets. Whilst elevated levels of Suspended Sediment Concentrations (SSC) arising during construction, operation and decommissioning of

Date	Consultee and type of response	Comments raised	How and where considered in the ES
			the Transmission Assets may decrease light availability in the water column and produce turbid conditions, the maximum impact range is expected to be localised with sediments rapidly dissipating over one tidal excursion. In addition, there is a large natural variability in the SSC within the study area (see **section 4.4** and Figure 4.1, Volume 2, Figures), therefore marine mammals living here will be tolerant of any small scale increases, such as those associated with the construction activities.
April 2023	**Marine Mammals EWG 1 –** Natural England, MMO, TWT.	Approach to establishing a baseline environment for marine mammals was set out, including; • data sources; • key species; • study areas; • MU; and • Species-specific densities. No comments were raised by the EWG on the approach that was proposed.	The baseline methodology is set out in **section 4.5**. The baseline environment set out in **section 4.6** of this chapter and in Volume 2, Annex 4.1: Marine mammals technical report of the ES.
May 2023	**Post-EWG01 species-specific densities technical note –** provided to EWG	Provided clarifications on the species-specific densities to be taken forward to the assessment, following the EWG01. No comments were raised by the EWG in response to the technical note.	The baseline methodology is set out in **section 4.5**. Baseline environment set out in **section 4.6** of this chapter and in Volume 2, Annex 4.1: Marine mammals technical report of the ES.
August 2023	**Marine Mammals EWG 2 –** Natural England, MMO, TWT, Cefas.	Initial assessment outputs set out, including: • Maximum Design Scenario (MDS); • modelled injury and disturbance ranges for a dual metric approach; and	The MDS is set out in **section 4.9.1**. Modelled injury and disturbance ranges are set out in **sections 4.11.2**, **4.11.3** and **4.11.6** and in Volume 1, Annex 5.2: Underwater sound technical report of the ES. Measures

Date	Consultee and type of response	Comments raised	How and where considered in the ES
		• mitigation considerations. No comments were raised by the EWG on the approach that was proposed. Natural England and Cefas supported both the use of a dual metric approach for assessment, and the application of the largest predicted range on which to base mitigation	(commitments) adopted as part of the Transmission Assets are set out in **Table 4.12**.
November 2023	**S42**	A number of responses from Natural England, NRW and MMO (among others) directly relate to the assessment of injury and disturbance from underwater sound generated from piling, as presented at PEIR.	With the removal of the Morgan OSPs, the Morecambe OSPs and the Morgan Offshore Booster Station from the Project Design Envelope, there is no piling associated with the Transmission Assets, and no the need to assess the potential for injury and disturbance from underwater sound generated from piling.
		Natural England and NRW highlighted that multiple and substantially different densities were used for the different projects. Strong, ecological justification should be provided for this approach or a single density used instead.	A single density assessment for each species has been carried through to the assessment, as presented in **Table 4.9**.
		Natural England, NRW and the MMO highlighted that the marine mammals document is hard to follow and often confusing (given the extensive amount of detailed material to review) and recommend the structure of the chapter is revised in the submitted ES to make it more reader friendly.	The structure of this chapter has been re-structured to allow the content to be more easily read. In particular see the CEA (**section 4.13**), along with **paragraph 4.11.1.4** *et seq.* (Underwater sound and marine mammals).
		Natural England, NRW and the MMO highlighted that the submitted ES should base its assessment on the underwater noise modelling without ADDs and revise any assessments that are based on the predicted ranges with 30min ADDs.	The assessment of Injury and disturbance from elevated underwater sound during UXO clearance (**section 4.11.2**) presents impact ranges both without Acoustic Deterrent Devices (ADD) and with ADD, the latter providing evidence to demonstrate the potential efficacy of using ADD as a tool in the mitigation strategy. As set out in this table below, this issue was later raised at the Marine Mammals EWG 3. Natural England confirmed that while ADD are standard

Date	Consultee and type of response	Comments raised	How and where considered in the ES
			for every project their use is very specific per project and suggested that the language around ADDs in the ES should be sufficiently high level to allow for the detail of ADD implementation to be agreed. As such, the approach to mitigation for UXO clearance has been set out in **Table 4.12** (Measures adopted as part of the Transmission Assets). The Applicants have proposed that any identified UXO needing clearing will be preferentially using low order techniques. The use of mitigation measures (e.g. ADDs or soft start/scare charges), should a high order clearance be necessary, will be discussed and agreed as part of the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) with all relevant stakeholders, once project parameters have been refined.
	S42 Natural England (key responses)	Natural England advised that the consistent swimming speeds are used across the assessment to ensure consistency and requested that the Best Practice Phase III document is referenced.	Consistent swimming speeds have been applied to the assessment and are set out in **Table 4.17**.
		Natural England do not support use of scare charges for UXO clearance.	Natural England's position on scare charges is noted. The assessment of injury and disturbance from elevated underwater sound during UXO clearance has been set out in **section 4.11.2** and the approach to mitigation for UXO has been set out in **Table 4.12** (measures adopted as part of the Transmission Assets). As set out in **Table 4.12**, the Applicants have proposed that any identified UXO needing clearing will be preferentially cleared using low order techniques. The use of soft starts/ scare charges will therefore not be prioritised. Should a

Date	Consultee and type of response	Comments raised	How and where considered in the ES
			high order clearance be considered necessary, potential associated mitigation measures (including soft start/scare charges, ADDs), will be discussed and agreed with all relevant stakeholders, once relevant UXO parameters are known, and prior to pre-construction activities. Finalised and agreed details will be set out in the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18**.**
		The latest study on the effects of ADDs on harbour porpoise (Elmegaard *et al.,* 2023) states that "We conclude that AHD exposure at many km can evoke both startle, flight and cardiac responses which may impact blood-gas management, breath-hold capability, energy balance, stress level and risk of by- catch. We posit that current AHDs are too powerful for mitigation use to prevent hearing damage of porpoises from offshore construction. Therefore, the effect of ADDs on harbour porpoise should be fully assessed, and relying on the ADDs as the primary mitigation tool should be revaluated. Include the suggested reference, assess the impact of ADDs and revise the mitigation strategy in the submitted ES. Additionally, disturbance caused by ADDs should be included in the cumulative assessment.	The assessment of Injury and disturbance from elevated underwater sound during UXO clearance (**section 4.11.2**) presents impact ranges both without ADD and with ADD, the latter providing evidence to demonstrate the potential efficacy of using ADD as a tool in the mitigation strategy. As discussed at EWG03 and agreed with Natural England a qualitative review of the potential impact of ADDs has been presented in **paragraph 4.11.2.39** *et seq.* in lieu of a quantitative assessment of the impacts of ADDs themselves.
		Natural England stated that in order to assess the increase in vessel traffic and support the statement that the increase in the vessel activity will not differ greatly from the baseline, the current baseline needs to be quantified and presented for context and comparison. Natural England stated that the submitted ES should present the current vessel traffic baseline in the area.	Further quantification of the baseline levels of activity (as provided in Volume 2, Chapter 7: Shipping and navigation of the ES) has been included to demonstrate the potential elevation in sound above background levels in the Offshore Order Limits.
		Natural England stated that there is inconsistency in the approach when assigning the sensitivity score for effects	The sensitivity of receptors with respect to the assessment of effects on marine mammals due

Date	Consultee and type of response	Comments raised	How and where considered in the ES
		on marine mammals due to changes in prey availability. Minke whale has been assigned medium due to being particularly vulnerable to potential effects on herring. Natural England stated that due to the vulnerability of harbour porpoise and harbour seal to changes in prey availability, their sensitivity score should be assigned as medium in the submitted ES.	to changes in prey availability, has been reviewed for the ES. The conclusion of sensitivity of receptors and justification is presented in **section 4.11.5**, **paragraph 4.11.5.4** *et seq*.
		Natural England highlighted that disturbance ranges for cable trenching and survey/support vessels are quite large (18 km and 20 km respectively) thus these impacts need to be appropriately considered and addressed in the assessment.	Updated disturbance ranges for cable trenching and survey/support vessels are set out in the assessment of Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities (**Table 4.32**). These potential impacts have been appropriately assessed in the context of the assessment of Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities (**section 4.11.3**).
	S42 NRW (key responses)	NRW (A) noted the vessel noise assessment is poor. Given the weight of evidence showing the impacts of vessel noise on species such as harbour porpoise the applicant needs to assess this impact pathway adequately particularly given that there will be an estimated 700 vessels in the area from the development alone. NRW (A) No appreciable quantified assessment has been carried out on vessel noise. We disagree with the proposed magnitude of medium for disturbance for harbour porpoise, and advise that this should be set to high. We may be able to agree with the overall assessment of minor adverse as per 4.9.4.35 but would need to have sight of the final EMP.	A more detailed approach to assessing vessel sound has been included in **section 4.11.3** to give further quantification and confidence to the identified potential magnitude of impacts and associated significance of effects. Empirical data has been gathered from field studies to determine realistic impact ranges and a quantification of the number of animals potentially affected based on densities of key species has been provided. In addition, further quantification of the baseline levels of activity (as provided in Volume 2, Chapter 7: Shipping and navigation of the ES) has been included to demonstrate the potential elevation in sound above background levels in the Offshore Order Limits.

Date	Consultee and type of response	Comments raised	How and where considered in the ES
			The MDS for the impact of Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities is set out in **Table 4.13** and reflects reductions in vessel numbers based on a refined project description. The revised assessment of effects for this impact has been set out in **section 4.11.3**. Offshore EMPs will be developed and submitted post-application (see CoT65 and **Table 4.12**
February 2024	**Marine Mammals EWG 3 –** Natural England, MMO, TWT, Cefas.	Key S42 responses and response approach set out. Natural England highlighted that in the PEIR expert judgement was used to reach a conclusion of assessment. The terms used were short term, medium term, highly localised and small scale. These terms were not defined making it hard to agree. Natural England confirmed that the assessment matrix should be sound and logical, and that context should be followed from the start to conclusion to make it clear that conclusions are sound. Natural England confirmed that the reference Elmegaard *et al.,* 2023 should be included in the ES. Natural England highlighted that while ADD are standard for every project their use is very specific per project. Suggested that the language around ADDs in the ES should be sufficiently high level to allow for the detail of ADD implementation to be agreed. Natural England agreed that a qualitative review of the displacement effects arising from ADDs (including consideration of Elmegaard *et. al.* (2023)) was sufficient, in lieu of including a quantitative assessment of the impacts of ADDs themselves (as advised through S42 comments)	The assessment methodology is set out in **section 4.10**. Elmegaard *et al.,* 2023 has been reviewed and referenced (**paragraph 4.11.2.39** *et seq.*). Measures adopted as part of the Transmission Assets have been set out in **Table 4.12**.

4.4 Study area

4.4.1.1 For the purposes of the marine mammal baseline characterisation, two appropriate marine mammal study areas were defined.

- **Transmission Assets marine mammal study area (hereafter referred to as the study area):** this area is defined as the area encompassing the Transmission Assets Order Limits: Offshore (known as "Offshore Order Limits" from this point onwards plus a buffer of 10 to 14 km (see Figure 4.1, Volume 2, Figures). Following the PEIR, the size of the Offshore Order Limits has been reduced, so whilst the study area remains the same as for PEIR, the area of the buffer has increased (previously a 10 km buffer). This approach of a 10 km buffer was agreed by the SNCBs during the EPP. This buffer size was also considered appropriate as it provides greater coverage for marine mammals for the purpose of EIA and HRA baseline characterisation, than the existing best practice approach of a 4 km buffer (SNCBs, 2017) (which has been used for marine mammals for EIA for other projects, including the majority of commissioned windfarms in the UK).
- **Transmission Assets regional marine mammal study area (hereafter referred to as the regional study area):** Marine mammals are highly mobile and may range over large distances and therefore, to provide a wider context, the desktop review considered primarily the marine mammal ecology, distribution and density/abundance within the Irish Sea and wider Celtic Sea. In addition, species specific populations were considered over a regional scale, within the context of their relevant species MUs (see Figure 4.1, Volume 2, Figures).

4.4.1.2 The Inter-Agency Marine Mammal Working Group (IAMMWG, 2023) provided advice on cetacean MUs, and the Special Committee on Seals (SCOS) provided advice on SMUs (SCOS, 2020; SCOS 2021; SCOS, 2022).

4.5 Baseline methodology

4.5.1 Methodology for baseline studies

Desk studies

4.5.1.1 A comprehensive desk-based review was undertaken to inform the baseline for marine mammals. The existing studies and datasets referred to as part of the desk-based review are summarised in **Table 4.6** below.

Site-specific surveys

4.5.1.2 Two site-specific Digital Aerial Survey (DAS) campaigns that fall within the Order Limits have informed the baseline characterisation; one covered the Morgan Offshore Wind Project: Generation Assets plus a buffer of 10 km to 13.3 km, which commenced monthly in April 2021 and was completed in March 2023 (Appendix A of Volume 2, Annex 4.1: Marine mammal technical report of the ES) and one covered the Morecambe Offshore Windfarm: Generation Assets plus 4 km to 10 km buffer where monthly surveys commenced in March 2021 for 24 months (Appendix B of Volume 2: Annex 4.1, Marine mammal technical report of the ES).

4.6 Baseline environment

4.6.1 Desk study

4.6.1.1 Information on marine mammals within the study area was collected through a detailed review of existing studies and datasets. These are summarised at **Table 4.6**.

Table 4.6: Summary of desk study sources

Title	Source	Year	Author
Anglesey-based surveys	Various sources	2002 to 2018	Shucksmith *et al*. (2009), Jacobs (2018); Veneruso and Evans (2012); Pesante *et al*. (2008); Duckett (2018); Evans *et al*. (2015)
Atlas of the Marine Mammals of Wales (2012)	Countryside Council for Wales (CCW)	1990 to 2009	Baines and Evans (2012)
Awel y Môr Offshore Wind Farm surveys	APEM Ltd.	2019 to 2021	Sinclair *et al*. (2021)
Cardigan Bay surveys	CCW/Natural Resource Wales (NRW)	• 2005 to 2007 • 2011 • 2011 to 2013 • 2016 to 2018	Pesante *et al.* (2008); Veneruso and Evans (2012); Feingold and Evans (2014); Duckett (2018)

Title	Source	Year	Author
Distribution maps of cetacean and seabird populations in the north east Atlantic (North East Atlantic Distribution Maps)	Bangor University	1980 to 2018	Waggitt *et al.* (2020)
Gwynt y Môr Offshore Wind Farm surveys	Centre for Marine and Coastal Studies (CMACS)	2003 to 2005	CMACS Ltd. (2011; 2013); Goddard *et al*. (2017; 2018); Goulding *et al*. (2019)
Habitat-based predictions of at-sea distribution for grey and harbour seal in the British Isles	Report to Department for Business, Energy and Industrial Strategy (BEIS)	1996 to 2015	Carter *et al*. (2020; 2022)
IAMMWG MUs	IAMMWG	2015 to 2023	IAMMWG, 2015; 2022; 2023
JNCC Report 543: Persistent high occurrence and abundance of harbour porpoise and bottlenose dolphin	JNCC	1965 to 2014	Evans *et al.* (2015)
JNCC Report 544: The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area	JNCC	1994 to 2011	Heinänen and Skov (2015)
Joint Cetacean Data Programme (JCDP)	JNCC	2022 to 2024	JNCC, 2024
Joint Cetacean Protocol (JCP) - JCP Phase III, JCP Phase I	JCP	1994 to 2010	Paxton *et al*. (2016); Paxton and Thomas (2010)
Manx Marine Environmental Assessment (MMEA)	Isle of Man Government	2018	Howe (2018a; 2018b)
Manx Whale and Dolphin Watch (MWDW) surveys	MWDW	2006 to 2022	Manley (2021; 2020; 2019); Clark *et al.* (2019; 2018; 2017); Felce and Adams (2016); Felce, (2015); Adams (2017)
Manx Wildlife Trust (MWT) surveys. • Seal pup surveys on Calf of Man. • Opportunistic land sightings. • Seal haul-out survey data. Calf of Man Seal survey reports 2017 to 2021.	MWT	• 2017 to 2021 • 2016 to 2022 • 2017 2017 to 2021	Data provided by MWT

Title	Source	Year	Author
Modelled Distribution and Abundance of Cetaceans and Seabirds in Wales and Surrounding Waters (2023) (Welsh Marine Mammal Atlas)	NRW	1990 to 2020	Evans and Wagitt (2023)
Mona Offshore Wind Project surveys	Mona Offshore Wind Ltd.	2021 to 2023	Mona Offshore Wind Ltd., 2024
Morecambe Offshore Windfarm: Generation Assets Marine Mammal Information and Survey data (this includes HiDef DAS)	Morecambe Offshore Windfarm Ltd.	2023 DAS from March 2021 to February 2023	Morecambe Offshore Windfarm Ltd. (2023)
Morgan Offshore Wind Project: Generation assets Technical Report (this includes APEM DAS)	Morgan Offshore Wind Ltd.	2023 DAS from April 2021 to March 2023	Morgan Offshore Wind Ltd. (2024)
ObSERVE surveys	National Parks and Wildlife Service	2015 to 2017	Rogan *et al.* (2018)
Rhiannon Wind Farm surveys	Celtic Array Ltd.	2010 to 2013.	Celtic Array Ltd. (2014)
Small Cetaceans in the European Atlantic and North Seas (SCANS)-III Density Surface Models (DSM)	SCANS-III	Surveys conducted in 2016; modelling conducted in 2022	Lacey *et al*. (2022)
Seal Telemetry Data	Sea Mammal Research Unit (SMRU)	2004 to 2018	Wright and Sinclair (2022)
SCANS surveys	SCANS-I, SCANS-II, SCANS-III and SCANS-IV	1994; 2005; 2016; 2023	Hammond *et al.* (2002; 2017; 2021); Giles *et al.* (2023)
SCOS Reports	SMRU	1990 to 2022	SMRU
Walney Nature Reserve surveys	Cumbria Wildlife Trust	1981 to 2023	Data from Cumbria Wildlife Trust

4.6.1.2 The Transmission Assets lies within the east Irish Sea, an important area for marine mammals, with 24 species of cetacean (O'Brien *et al.*, 2009) and two species of pinniped having been sighted here to date. Seven marine mammal species are known to occur regularly in the region: harbour porpoise, bottlenose dolphin, short-beaked common dolphin *Delphinus delphis*, Risso's dolphin *Grampus griseus*, minke whale *Balaenoptera acutorostrata*, grey seal *Halichoerus grypus* and harbour seal *Phoca vitulina*. Other cetacean species are occasional or rare visitors.

4.6.1.3 The distribution of marine mammals in the Irish Sea is patchy. Cetaceans in particular are highly mobile, and their occurrence unpredictable. Harbour porpoise occur throughout the Irish Sea, whilst short-beaked common dolphin and Risso's dolphin are largely restricted to the south of the Irish Sea. Sightings of bottlenose dolphin are highest in the Cardigan Bay SAC compared to the rest of the Irish Sea. Minke whale are seasonal visitors to the Irish Sea, present in highest numbers in summer months. Sightings of minke whale are highest in deeper waters to the south of the Irish Sea but also northwards, particularly around the Isle of Man (Baines and Evans, 2012).

4.6.1.4 Grey seal use areas extensively across the south Irish Sea, the north of St George's Channel, and Liverpool Bay (Hammond *et al.*, 2005a). Several sites in Wales (such as the Marloes Peninsula, the Llŷn Peninsula, north Pembrokeshire coast and islands off the west coast of Pembrokeshire); south west England (especially Lundy and the Isles of Scilly); Northern Ireland (e.g. Strangford Lough); the Republic of Ireland (e.g. the Saltee Islands and Lambay Island); and Liverpool Bay (Solway Firth, Walney Island and Hilbre Island) support important haul-out sites. Genetic studies suggest that individuals here may form a distinct population from those found off west Scotland (SCOS, 2022). Telemetry studies have demonstrated adults and pups travel between Pembrokeshire Marine SAC, Llŷn Peninsula and the Sarnau SAC and the Saltee Islands SAC (Ireland) (SCOS, 2014). Grey seal have large maximum foraging ranges (up to 448 km reported in Carter *et al.*, 2022) however, tracking studies have shown that most foraging is likely to occur within 100 km of a haul-out site (SCOS, 2018).

4.6.1.5 Harbour seal are concentrated along the north east coast of Ireland, east coast of Northern Ireland and the Firth of Clyde. In Northern Ireland most harbour seal haul-outs are located in the south east of the country, with most harbour seal being counted at Carlingford Lough, Murlough SAC and Rathlin Island (Duck and Morris, 2019). Harbour seal have also been sighted in aerial surveys in the Maidens SAC and Strangford Lough SAC. It must be noted that harbour seal has a smaller maximum foraging range compared to grey seal and therefore levels of connectivity between SACs in the regional study area are likely less than for grey seal. Maximum foraging ranges of 273 km have been reported for harbour seal (Carter *et al.,* 2022), but other data suggests that harbour seal tend to stay within 50 km of the coast, and most foraging trips occur over shorter ranges (Russell and McConnell, 2014).

4.6.1.6 A summary of the marine mammal baseline characterisation within the study area, in the context of the regional study area, is presented in **Table 4.8** and in detail in Volume 2, Annex 4.1: Marine mammals technical report of the ES.

4.6.2 Designated sites

4.6.2.1 All designated sites within the regional study area and qualifying interest features that could be affected by the construction, operation and maintenance, and decommissioning phases of the Transmission Assets were identified using the three-step process described below.

- Step 1: All designated sites of international, national and local importance within the regional study area were identified using a number of sources. These sources included JNCC, SCOS, NMPI and European Nature Information System websites.
- Step 2: Information was compiled on the relevant marine mammal qualifying interests for each of these sites as follows.
  - The known occurrence of species within the regional study area was based on relevant desktop information (**Table 4.6** and in more detail in Volume 2, Annex 4.1: Marine mammals technical report of the ES).
- Step 3: Using the above information and expert judgement, sites were included for further consideration if:
  - a designated site directly overlaps with the Transmission Assets;
  - sites and associated features were located within the potential Zone of Influence (ZoI) for impacts associated with the Transmission Assets (e.g. potential effect ranges of underwater sound as a result of UXO clearance; see **section 4.11.2**); and
  - marine mammal features of a designated site were either recorded as present during historic surveys, or identified during the desktop study as having the potential to occur within the study area.

Legal status and designated sites

4.6.2.2 SACs and MNRs, designated for the protection of marine mammals within the regional study area (Figure 4.1, Volume 2, Figures), that could be affected by the construction, operation and maintenance, and decommissioning phases of the Transmission Assets are set out in **Table 4.7**.

Table 4.7: Designated sites and relevant qualifying interests

Designated Site	Distance to the Offshore Order Limits (km) (marine route)	Features
Langness MNR	16.8	Harbour seal *Phoca vitulina*
		Grey seal *Halichoerus grypus*
		Harbour porpoise *Phocoena phocoena*
		Risso's dolphin *Grampus griseus*
Little Ness MNR	20.5	Harbour porpoise *Phocoena phocoena*

Designated Site	Distance to the Offshore Order Limits (km) (marine route)	Features
		Bottlenose dolphin *Tursiops truncatus*
		Minke whale *Balaenoptera acutorostrata*
		Risso's dolphin *Grampus griseus*
Douglas Bay MNR	22.3	Bottlenose dolphin *Tursiops truncates*
		Risso's dolphin *Grampus griseus*
Laxey Bay MNR	22.4	Harbour porpoise *Phocoena phocoena*
		Minke whale *Balaenoptera acutorostrata*
		Bottlenose dolphin *Tursiops truncates*
Ramsey Bay MNR	26.5	Harbour seal *Phoca vitulina*
		Grey seal *Halichoerus grypus*
North Anglesey Marine/Gogledd Môn Forol SAC	28.5	Harbour porpoise *Phocoena phocoena*
Baie Ny Carrickey MNR	30.3	Risso's dolphin *Grampus griseus*
		Harbour porpoise *Phocoena phocoena*
		Bottlenose dolphin *Tursiops truncatus*
Calf and Wart Bank MNR	35.8	Risso's dolphin *Grampus griseus*
		Harbour porpoise *Phocoena phocoena*
Port Erin Bay MNR	40.2	Harbour porpoise *Phocoena phocoena*
Niarbyl MNR	45.0	Harbour porpoise *Phocoena phocoena*
		Grey seal *Halichoerus grypus*
West Coast MNR	50.2	Harbour porpoise *Phocoena phocoena*
		Harbour seal *Phoca vitulina*
		Grey seal *Halichoerus grypus*
North Channel SAC	62.8	Harbour porpoise *Phoocena phocoena*
Strangford Lough SAC	93.6	Harbour seal *Phoca vitulina*
Murlough SAC	98.5	Harbour seal *Phoca vitulina*
West Wales Marine/Gorllewin Cymru Forol SAC	110.9	Harbour porpoise *Phocoena phocoena*
Pen Llŷn a`r Sarnau/Llŷn Peninsula and the Sarnau SAC	119.4	Bottlenose dolphin *Tursiops truncatus*
		Grey seal *Halichoerus grypus*
Rockabill to Dalkey Island SAC	123.5	Harbour porpoise *Phocoena phocoena*

Designated Site	Distance to the Offshore Order Limits (km) (marine route)	Features
Lambay Island SAC	130.5	Harbour seal *Phoca vitulina*
		Grey seal *Halichoerus grypus*
Cardigan Bay/Bae Ceredigion SAC	188.4	Bottlenose dolphin *Tursiops truncatus*
		Grey seal *Halichoerus grypus*
Slaney River Valley SAC	234.1	Harbour seal *Phoca vitulina*
Pembrokeshire Marine/Sir Benfro Forol SAC	237.5	Grey seal *Halichoerus grypus*
Saltee Islands SAC	260.2	Grey seal *Halichoerus grypus*
Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC	301.3	Harbour porpoise *Phocoena phocoena*
Lundy SAC	336.0	Grey seal *Halichoerus grypus*

4.6.3 Key receptors

4.6.3.1 Key receptors are those marine mammals that have the potential to be affected by the Transmission Assets. The importance of receptors is dependent upon their biodiversity, social, and economic value within a geographic framework of appropriate reference (CIEEM, 2018). Marine mammal key receptors have been identified based on biodiversity importance, recognised through international or national legislation, conservation status/plans and on assessment of value according to the functional role of the species within the context of the regional study area (see **Table 4.8** and Volume 2, Annex 4.1: Marine mammals technical report of the ES). Relevant legislation/conservation plans for marine mammals would include, for example: Annex II species under the Habitats Directive; Annex IV(a) of the Habitats Directive as EPS; species listed as threatened and/or declining by OSPAR; International Union for Conservation of Nature (IUCN) Red List species; and UK Biodiversity Action Plan priority species either alone or under a grouped action plan.

Table 4.8: Summary of marine mammal key receptors baseline ecology

Species	Baseline summary	Conservation Importance
Harbour porpoise *Phocoena phocoena*	Widespread in cold and temperate north west European shelf waters, and abundant throughout the Irish Sea. Common inshore species found in high densities in the Irish Sea. Highest relative abundances in the west half of the central Irish Sea (Wall *et al.*, 2013). High predicted relative densities in both winter and summer in the Irish Sea (Waggitt *et al.,* 2020). Data from the DAS for the Generation Assets, show that harbour porpoise were recorded in all survey months (see Appendix A and Appendix B, respectively, of Volume 2, Annex 4.1: Marine mammals technical report of the ES). Wide-scale historical data collating heterogenous datasets from 1990 to 2009 confirms regular widespread sightings of harbour porpoise across the Irish Sea (Baines and Evans 2012). Estimates from the Morgan Offshore Wind Project: Generation Assets DAS indicated densities of 0.219 animals per km^2 in the summer bio-season, and 0.159 animals per km^2 in the winter bio-season (corrected for availability bias). Estimates from the Morecambe Offshore Windfarm: Generation Assets DAS indicated a density of 1.574 animals per km^2 (yearly average, corrected for availability bias). The differences across the Generation Assets are likely driven by the comparative proximity of the Morecambe Offshore Windfarm: Generation Assets to the coast (see Figure 4.1, Volume 2, Figures). SCANS-III data estimated densities of 0.239 animals per km^2 (Coefficient of Variation (CV) = 0.282) in Block E and 0.086 animals per km^2 (CV = 0.383) in Block F (Hammond *et al.,* 2021). Recently modelled density surfaces using the SCANS III data gave mean densities of 0.434 animals per km^2 and a maximum of 0.611 animals per km^2 for the study area (Lacey *et al.*, 2022). Heinänen and Skov (2015) divide the year into two bio-seasons based upon bimodal patterns of distribution: summer (April to September) and winter (October to March). In this study, which modelled predicted densities between 1997 and 2009, predicted densities reached >3.0 km^2 in the west region of the Irish Sea, between Anglesey and the Isle of Man in summer 2003, and north of the Isle of Man in winter 1997. Persistent high densities were identified in these areas, with lower densities towards the Transmission Assets. Waggitt *et al.* (2020) collated diverse survey data to generate predicted cetacean distribution maps at 10 km resolution, using Species Distribution Models (SDM). The predicted density for harbour porpoise for the study area derived from Waggitt *et al. (*2020) is 0.560 animals per km^2 (for August, as the highest monthly density). Most recent SCANS-IV data showed widespread sightings of harbour porpoise across the Irish Sea in summer 2022 (Gilles *et al.,* 2023). SCANS-IV data estimated densities of 0.515 animals per km^2 (CV = 0.25) in CS-E (where Transmission Assets is located) and 0.280 animals per km^2 (CV = 0.316) in the adjacent CS-D (Gilles *et al.,* 2023). The 2023 Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) density for harbour porpoise from the annual composite map for the	Annex II and Annex IV species protected under the European Council directive on the conservation of natural habitats and of wild fauna and flora (92/43/EEC) (Habitats Directive, European Protected Species (EPS), OSPAR protected species, International Union for Conservation of Nature (IUCN) Red List Least Concern.

Species	Baseline summary	Conservation Importance
	scoping boundary is 0.227 animals per km^2 (95% confidence intervals (CI) = 0.210 to 0.245) (Evans and Waggitt, 2023). The predicted estimate of mean densities for the study area and the Offshore Order Limits from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) are comparable to the SCANS III block E estimate (Hammond et al., 2021) in the west Irish Sea, but provide densities derived from higher resolution data than SCANS III surveys (2.5 km^2 resolution, compared to a single estimate over 34,870 km^2). Densities from the North East Atlantic Distribution Maps (Waggitt *et al.,* 2020) and SCANS-III DSM data (Lacey *et al.,* 2022) are derived from slightly lower resolution data (10 km resolution for both datasets) compared to the Welsh Marine Mammal Atlas data. In addition, the Welsh Marine Mammal Atlas data is specific to the Irish Sea, in which the Transmission Assets is located, whereas data from SCANS IV, SCANS III, the North East Atlantic Distribution Maps and SCANS-III DSM data cover far larger geographic areas. Furthermore, densities from the Welsh Marine Mammal Atlas are higher than absolute densities from Morgan DAS, but lower than absolute densities for the Morecambe DAS. Therefore, after the assessment of the above densities and as recommended from consultation with Natural England and the density of 0.227 animals per km^2 (Evans and Waggit, 2023) is taken forward to the impact assessment as a precautionary but proportionate density for the area. For the Celtic and Irish Seas (CIS) MU, the harbour porpoise abundance is estimated as 62,517 (CV = 0.13, 95% CI = 48,324 to 80,877) individuals (IAMMWG, 2023; 2021). This abundance estimate is applied to the assessment of effects for all impacts. Harbour porpoise is a qualifying interest of a number of SAC and MNRs (Isle of Man) within the regional study area (**Table 4.7**).	
Bottlenose dolphin *Tursiops truncatus*	Near-global distribution, widely distributed in the North Atlantic and occurs year-round throughout the Irish Sea near-shore. Predominately coastal distribution (though low densities have been recorded offshore). Concentrations of resident populations in Cardigan Bay and off the coast of Co. Wexford. Seasonal differences in dispersion have been noted (e.g. dolphins in summer occurring mainly in small groups near the coast, centred upon Cardigan Bay, dispersing more widely and generally northwards, where they may form very large groups in winter). Data from the DAS for the Morgan Offshore Wind Project: Generation Assets shows that nine bottlenose dolphin were sighted across the two years of surveys (April 2021 to March 2023), all recorded in June 2021 (see Appendix A of Volume 2, Annex 4.1: Marine mammals technical report of the ES). Data from the DAS for the Morecambe Offshore Windfarm: Generation Assets shows that two bottlenose dolphin were sighted across the two years of surveys (March 2021 to February 2023), both recorded in February 2023 (see Appendix B of Volume 2, Annex 4.1: Marine mammals technical report of the ES). SCANS-III surveys in 2016 estimated a density of 0.008 animals per km^2 (CV = 0.573) in Block E, with no animals sighted within Block F. The survey period was limited to 35 days in summer, so densities may vary in other months of the year, and in Manx waters, bottlenose dolphin do show a very clear temporal pattern, with	Annexes II and IV species protected under the Habitats Directive, EPS, IUCN Red List Least Concern.

Species	Baseline summary	Conservation Importance
	73% of sightings being reported between October and March (Howe, 2018). Recently modelled density surfaces using the SCANS III data gave a mean density of 0.016 animals per km^2 and a maximum of 0.050 animals per km^2 for the study area (Lacey *et al.*, 2022). There is suggestion of temporal movement between Manx waters for winter habitat and Cardigan Bay for calving (Howe, 2018; Pesante and Evans, 2008), as well as movement between UK and Irish waters (Robinson *et al.*, 2012). The predicted density for bottlenose dolphin for the study area derived from Waggitt *et al. (*2020) is 0.001 animals per km^2 (for August, as the highest monthly density). SCANS-IV data estimated densities of 0.0104 animals per km^2 (CV = 0.7) in CS-E (where Transmission Assets is located) and 0.235 animals per km^2 (CV = 0.353) in the adjacent CS-D (Gilles *et al.,* 2023).The 2023 Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) density for bottlenose dolphin from the annual composite map for the scoping boundary is 0.0012 animals per km^2 (95% CI = 0.0005 to 0.0026) (Evans and Waggitt, 2023). Predicted estimates of mean density for the study area from North East Atlantic Distribution Maps (Waggitt *et al.,* 2020) are very similar to those from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023), although Waggitt *et al.,* (2020) represents the offshore ecotype of bottlenose dolphin. Estimates are lower than the SCANS-III block E estimate, however the SCANS-III density is for a large-scale block that includes the Cardigan Bay population. The Transmission Assets lies in SCANS-III block F, within which no bottlenose dolphins were recorded. SCANS-IV block CS-E in which the Transmission Assets lies, also demonstrated a higher density value, but (as highlighted in Lacey *et al.,* 2022) large scale line transect surveys (such as SCANS) are not designed to collect data at a sufficiently small spatial scale necessary to generate estimates of abundance for small coastal populations, such as the bottlenose dolphin population in the Irish Sea. The SCANS III DSM density (Lacey *et al.,* 2022) for the Transmission Assets is higher than the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) but is a dataset based on UK-wide modelling of SCANS-III data, unlike the Welsh Marine Mammal Atlas which specifically accounts for the inshore ecotype of bottlenose dolphin in the Irish Sea MU (IS MU). Therefore, after the assessment of the above densities and as recommended from consultation with Natural England and the density of 0.0012 animals per km^2 (Evans and Waggit, 2023) is taken forward to the impact assessment as the most robust density estimate for the area. For the IS MU, the bottlenose dolphin abundance is estimated as 293 (CV = 0.54, 95% CI = 108 to 793) individuals (IAMMWG, 2023; 2021). This abundance estimate is applied to the assessment of effects for all impacts. Bottlenose dolphin is a qualifying interest of a number of SACs and three MNRs (Isle of Man) within the regional study area (**Table 4.7**).	
Risso's dolphin *Grampus griseus*	Worldwide distribution, and in north west Europe is a continental shelf species. Clusters regularly seen in the Irish Sea, with a relatively localised distribution, forming a wide band running south west to north east that encompasses west Pembrokeshire, the west end of the Llŷn Peninsula and Anglesey in Wales, the south east coast of Ireland in the west, and waters around the Isle of Man in the north (Evans *et al.*, 2003).	Annexxes II and IVspecies protected under the Habitats Directive, EPS, IUCN Red List Least Concern.

Species	Baseline summary	Conservation Importance
	No Risso's dolphin were recorded in the two years of DAS for the Morgan Offshore Wind Project: Generation Assets (April 2021 to March 2023) (see Appendix A of Volume 2, Annex 4.1: Marine mammals technical report of the ES) or the two years of DAS for the Morecambe Offshore Windfarm: Generation Assets (March 2021 to February 2023) (Appendix B of Volume 2, Annex 4.1: Marine mammals technical report of the ES). The Transmission Assets lies within Block F of the SCANS-III surveys, and although no Risso's dolphin were sighted within this block in 2016, they were recorded in the adjacent Block E with an estimated density of 0.0313 animals per km^2 (CV = 0.686) (Hammond *et al.,* 2021). In recent years, predicted distribution maps of Risso's dolphin at monthly scales by Waggitt *et al.* (2020) demonstrated Risso's dolphin densities to be lower in the Irish Sea from November to May, with increased densities in summer months between June to September. The predicted density for Risso's dolphin for the study area, derived from Waggitt *et al. (*2020) is 0.0009 animals per km^2 (for August, as the highest monthly density). No DSM was undertaken for Risso's dolphin in Lacey *et al.* (2022). Recent SCANS-IV data did not report any Risso's dolphin in block CS-E (in which the Transmission Assets lies) but reported a density of 0.0022 animals per km^2 (CV = 1.012) in adjacent block CS-D (Gilles et al., 2023). Modelled outputs from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) indicated Risso's dolphin occur at various locations across the Irish Sea with decadal maps showing the same principal areas for the species. The density estimates for Offshore Order Limits as calculated via the Welsh Marine Mammal Atlas data was 0.0003 animals per km^2. The estimated density of 0.0313 animals per km^2 taken from SCANS-III block E (Hammond *et al.,* 2021) is applied to the study area for the assessment of effects for all impacts.This is the most precautionary estimate when compared to estimated from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023), Waggitt et al. (2020) and SCANS IV block CS-D (Gilles *et al.,* 2023). For the Celtic and Greater North Seas (CGNS) MU, the Risso's dolphin abundance is estimated as 12,262 (CV = 0.46, 95% CI = 5,227 to 28,764) individuals (IAMMWG, 2023; 2021). This abundance estimate is applied to the assessment of effects for all impacts. Risso's dolphin is a feature of interest for four MNRs in the Isle of Man (**Table 4.7**).	
Short-beaked common dolphin *Delphinus delphis*	The most numerous offshore cetacean species in the temperate north east Atlantic. Widespread and abundant, centred on the Celtic Deep to the south of the Irish Sea, where water depths range from 50 to 150 m. A high-density area extends eastwards towards the coast and islands of west Pembrokeshire. Elsewhere in the Irish Sea, the species occurs at low densities mainly offshore, in a central band that extends north towards the Isle of Man. SCANS-III is a key baseline dataset, and the Transmission Assets lies within Block F of the 2016 SCANS-III surveys. No short-beaked common dolphin were sighted within block F or the adjacent Block E (Hammond *et al.,* 2021).	Annexxes II and IV species protected under the Habitats Directive, EPS, IUCN Red List Least Concern.

Species	Baseline summary	Conservation Importance
	Data from the DAS for the Morecambe Offshore Windfarm: Generation Assets shows that 32 short-beaked common dolphin were sighted across the two years of surveys (March 2021 to February 2023), all recorded in August 2022 (see Appendix B of Volume 2, Annex 4.1: Marine mammals technical report of the ES). No short-beaked common dolphin were recorded in the two years of DAS for the Morgan Offshore Wind Project: Generation Assets (April 2021 to March 2023) (see Appendix A of Volume 2, Annex 4.1: Marine mammals technical report of the ES). The predicted density from the SCANS-III data showed low short-beaked common dolphin densities (< 0.07 animals per km^2) in the Irish Sea, increasing towards the Celtic Sea (BEIS, 2022). The SCANS-II density estimate for Block O (corresponding to SCANS-III blocks E and F combined) is 0.018 animals per km^2 (CV = 0.78) (Hammond *et al.,* 2013). CANS-III DSM (Lacey *et al.* 2022) gave mean densities of 0.004 animals per km^2 for the study area with low densities across the east Irish Sea. The predicted density for short-beaked common dolphin for the study area, derived from Waggitt *et al. (*2020) is 0.047 animals per km^2 (for August, as the highest monthly density). Recent SCANS-IV data did not report any short-beaked common dolphin in block CS-E (in which the Transmission Assets lies) but reported a density of 0.027 animals per km^2 (CV = 0.814) in adjacent block CS D (Gilles et al., 2023). Lastly, modelled outputs from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) indicated short-beaked common dolphin are most abundant in the Celtic Deep within St. George's Channel but their distribution does extend northwards in deeper waters through the middle of the Irish Sea. The average density for both the study area, and the Offshore Order Limits, from the annual composite maps was 0.00025 animals per km^2 (95% Cls = 0.0001 to 0.0005) (Evans and Waggitt, 2023). The density taken forward to assessment is 0.00025 animals per km^2 from the most recent Welsh Marine Mammal Atlas data specific to the Irish Sea region (Evans and Waggitt, 2023) (as recommended by Natural England) for the study area. This was considered to be the most representative density for the region, when compared to the older SCANS II data (Hammond *et al.,* 2006) and broad scale block estimates from an adjacent SCANS-IV block (CS-D) (Gilles *et al.,* 2023). For the CGNS MU, the short-beaked common dolphin abundance is estimated as 102,656 (CV = 0.29, 95% CI = 58,932 to 178,822) individuals (IAMMWG, 2023; 2021). This abundance estimate is applied to the assessment of effects for all impacts.	
Minke whale *Balaenoptera acutorostrata*	Minke whale inhabit all major oceans of the world and are most abundant on the continental shelf, in relatively cool waters. Around the UK, minke whale are widely distributed and present year-round. In the Irish Sea they mainly occur in the south and west of the area (Hammond *et al.*, 2005), and are present from late April to early August (Wall, 2013). This is corroborated by Howe (2018) which shows minke whale to have a high degree of seasonality in Manx waters, with presence between June and November, and a clear spatial aspect to the distribution of minke whale sightings in Manx waters; the majority of summer sightings are on the west coast of the island, and most autumn sightings on the east coast (Howe, 2018).	Annexxes II and IV species protected under the Habitats Directive, EPS, IUCN Red List Least Concern.

Species	Baseline summary	Conservation Importance
	No minke whale were recorded in the two years of DAS for the Morgan Offshore Wind Project: Generation Assets (April 2021 to March 2023) (see Appendix A of Volume 2, Annex 4.1: Marine mammals technical report of the ES) or the two years of DAS for the Morecambe Offshore Windfarm: Generation Assets (March 2021 to February 2023) (Appendix B of Volume 2, Annex 4.1: Marine mammals technical report of the ES). No sightings were made within SCANS-III Block F (Hammond *et al.,* 2021), but an estimated density of 0.0173 animals per km^2 (CV = 0.618) were reported in Block E. SCANS-III data were also used to model density surfaces for minke whale in 2016, with high predicted densities around the Isle of Man (0.027 – 0.036 animals per km^2) and moderate densities across the entire Irish Sea (0.012 – 0.02 animals per km^2) (BEIS, 2022). SCANS-III density surface estimates identified densities of 0.021 animals per km^2 and a maximum of 0.040 animals per km^2 for the study area. JCP III (Paxton *et al.,* 2016) density surface modelling gave UK-wide mean densities of 0.022 animals per km^2, with areas of persistent high relative density around the Isle of Man (0.100 animals per km^2 in summer 2010). The predicted density for minke whale for the study area, derived from Waggitt *et al. (*2020) is 0.005 animals per km^2 (for August, as the highest monthly density). Recent SCANS-IV data reported densities of 0.0088 animals per km^2 (CV = 1.145) in block CS-E (in which the Transmission Assets lies) and 0.0137 animals per km^2 (CV = 0.632) in block CS-D (Gilles *et al.*, 2023), noting surveys for these blocks were carried out over a limited summer period (between 28 June and 15 August 2022). Lastly, modelled outputs from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) indicated minke whale density was highest across the west Irish Sea, with lower densities towards the east. The average density for the study area from the annual composite maps was 0.0029 animals per km^2 and the average density for the Offshore Order Limits was 0.0027 animals per km^2(Evans and Waggitt, 2023). Minke whale were sighted in block CS-E of SCANS-IV (in which the Transmission Assets lies) but the density given was lower in comparison to the density estimate derived for the study area from SCANS-III DSM (Lacey *et al.,* 2022). No minke whale were observed in SCANS-III block F (in which the Transmission Assets lies) but animals were observed in adjacent block E (Hammond *et al.,* 2021), which is similar to, but lower than the SCANS-III DSM density estimate. This SCANS-III DSM density estimate is also more conservative than densities for the study area derived from Waggitt *et al.,* 2020 and the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023). Therefore, the density taken forward to assessment is the SCANS-III DSM estimate of 0.021 animals per km^2 for the study area (Lacey *et al.,* 2022), as the most conservative estimate. For the CGNS MU, the minke whale abundance is estimated as 20,118 animals (CV = 0.18, 95% CI = 14,061 to 28,786) individuals (IAMMWG, 2023; 2021). This abundance estimate is applied to the assessment of effects for all impacts. Minke whale is a feature of interest for one MNR in the Isle of Man (**Table 4.7**).	
Grey seal	Approximately 38% of the world's grey seal population occurs in the UK (SCOS, 2014), where numbers have increased steadily over the past 60 years, in part due to its favourable conservation status. The main grey seal population centre in the UK is at the Scottish colonies, which account for approximately 77% of the UK	Annexes II and V species protected under Habitats

Species	Baseline summary	Conservation Importance
Halichoerus grypus	estimated population. The Irish Sea is also an important centre of grey seal abundance, being used by animals tagged at haul-out sites in south west Scotland, north west England and Wales Management Units. Data from the DAS for the Morgan Offshore Wind Project: Generation Assets shows that 34 grey seal were sighted across the two years of surveys (April 2021 to March 2023), with October and November being the only months in which animals were not sighted (see Appendix A of Volume 2, Annex 4.1: Marine mammals technical report of the ES). Data from the DAS for the Morecambe Offshore Windfarm: Generation Assets shows that grey seal were sighted in 19 of the 24 months across the two years of surveys (March 2021 to February 2023). 42 individuals were confirmed as grey seal and 59 unconfirmed individuals, which were likely to be grey seal (see Appendix B of Volume 2, Annex 4.1: Marine mammals technical report of the ES). Mean absolute density (i.e. density adjusted for availability bias) across the whole survey period for the Morgan Offshore Wind Project: Generation Assets was 0.099 animals per km^2, with a mean absolute density of 0.0184 animals per km^2 during the pupping season (August to November) and 0.0196 animals per km^2 during the non-pupping season (December to July). Morecambe Offshore Windfarm: Generation Assets generated an apportioned annual density of 0.0284 animals per km^2. UK-wide at-sea distribution for grey seals by Carter *et al.* (2022) demonstrated areas of high use around Liverpool Bay, the east coast of Ireland and to the north west of the Isle of Man. Finer scale seasonal movements were also identified, with seals transitioning between sites within the Irish Sea, but not leaving Wales. Average grey seal density for the study area is estimated at 0.108 animals per km^2 (Carter *et al.*, 2022). SMRU-tagged grey seals also showed presence throughout the regional study area, with highest density of tracks in the north west England and Wales SMUs (Wright and Sinclair, 2022) (see Figures 1.55 to 1.57 of Volume 2, Annex 4.1: Marine mammals technical report of the ES), A detailed overview of grey seal abundance is provided in Volume 2, Annex 4.1: Marine mammal technical report, based upon visual counts at haul-out sites. The density of 0.108 animals per km^2 (Carter *et al.,* 2022) is taken forward to the impact assessment, as it is based upon the most recent revised estimated at-sea distribution usage maps based on high-resolution tracking data and habitat association modelling. This is applied to all impact assessments within the Transmission Assets. For grey seal, abundance is considered at two scales; an abundance estimate of 60,780 for OSPAR Region III (NRW, 2022) and an abundance estimate of 13,283 (Grey Seal Reference Population (GSRP)) (SW Scotland SMU, NW England SMU, Wales SMU, Northern Ireland SMU (SCOS, 2021); east Ireland and south east Ireland regions (Duck and Morris, 2019), and Isle of Man region (Howe, 2018) combined). Grey seal is a qualifying interest of several SACs and three MNRs (Isle of Man) within the regional study area (**Table 4.7**). Designated haul-out sites located in the south west Scotland SMU are: Little Scares (SW-006);	Directive, IUCN Red List Least Concern.

Species	Baseline summary	Conservation Importance
	Solway Firth Outer Sandbank (SW-007); Sanda and Sheep Island (SW-001); Sound of Pladda Skerries (SW-002), and Lady Isle (SW-005).	
Harbour seal *Phoca vitulina*	Harbour seal are widely distributed, inhabiting temperate and subpolar seas throughout the Northern Hemisphere. The UK and Ireland represent an important population centre for harbour seal, with approximately 36% of the pup production for the east Atlantic subspecies of harbour seals (SCOS, 2020). Carter *et al.* (2022) suggests large centres of harbour seal abundance in Shetland, the Wash (in south east England) and west Scotland, with high density at-sea areas adjacent to those hotspots. The main harbour seal haul-outs are located to the north of the study area, in the south west Scotland and Northern Ireland SMUs. However, telemetry studies show no connectivity from the south west Scotland SMU to the study area (Wright and Sinclair, 2022) (see Figures 1.62 to 1.63 of Volume 2, Annex 4.1: Marine mammals technical report of the ES), The nearest designated haul-out sites for harbour seals in the vicinity of the study area are the Manx MNRs (Calf and Wart Bank, Langness, Ramsey and West Coast), and Murlough SAC, Strangford Lough SAC and The Maidens SAC. Harbour seal presence in the vicinity of the study area is low (Carter *et al.*, 2022), with mean at-sea usage estimated (via telemetry studies) at a density of 0.0002 animals per km^2. During the two years of DAS for the Morgan Offshore Wind Project: Generation Assets DAS (April 2021 to March 2023) (see Appendix A of Volume 2, Annex 4.1: Marine mammals technical report of the ES)and the two years of DAS for the Morecambe Offshore Windfarm: Generation Assets (March 2021 to February 2023) (see Appendix B of Volume 2, Annex 4.1: Marine mammals technical report of the ES) only a single harbour seal was observed for each. The density of 0.0002 animals per km^2 (Carter *et al.,* 2022) is taken forward to the impact assessment, as it is based upon the most recent revised estimated at-sea distribution usage maps based on high-resolution tracking data and habitat association modelling. This is applied to all impact assessments within the Transmission Assets. The harbour seal abundance is estimated as 1,156 individuals (Harbour Seal Reference Population (HSRP)) (NW England SMU, Wales SMU and Northern Ireland SMU (SCOS, 2021)). Harbour seal is a qualifying interest of several SACs and three MNRs (Isle of Man) within the regional study area (**Table 4.7**). Designated haul-out sites located in the south west Scotland SMU are: Sanda and Sheep Island (SW-001); Yellow Rock (SW-004); Sound of Pladda Skerries (SW-002); Rubha nan Sgarbh (SW-003); and Lady Isle (SW-005).	Annexxes II and V species protected under Habitats Directive, IUCN Red List Least Concern.

4.6.3.2 **Table 4.9** presents the importance that has been assigned to each receptor and a summary of the densities and the relevant MU populations carried forward to the assessment. All marine mammals with the potential to be affected by the Transmission Assets are protected under some form of international legislation and/or are important from a conservation perspective in an international/national context (**section 4.2.1**) and therefore the value of all marine mammal key receptors was determined to be international.

4.6.3.3 **Table 4.9** identifies the receptors taken forward into the assessment.

Table 4.9: Marine mammal key receptors taken forward to assessment, alongside densities, MU populations and their importance within the regional study area

Species	Density (animals per km^2)	Management Unit (MU)	MU population estimate	Importance
Harbour porpoise	0.227[1]	CIS	62,517[6]	International
Bottlenose dolphin	0.0012[1]	Irish Sea	293[6]	International
Short-beaked common dolphin	0.0003[1]	CGNS	102,656[6]	International
Risso's dolphin	0.0313[2]	CGNS	12,262[6]	International
Minke whale	0.0211[3]	CGNS	20,118[6]	International
Grey seal	0.108[4]	12 Wales 13 NW England 14 Northern Ireland 1 SW Scotland Isle of Man estimate east of Ireland south east of Ireland **(GSRP)**	3,579[7] 1,193[7] 2,183[7] 2,056[7] 400[8] 1,662[9] 2,211[9] **13,283**	International
		OSPAR Region III	60,780[10]	
Harbour seal	0.0002[4]	12 Wales 13 NW England 14 Northern Ireland Isle of Man **('Harbour Seal Reference Population' (HSRP))**	13[11] 7[11] 1,136[11] No estimate available **1,156**	International

[1] Density derived from Evans and Waggitt (2023) for the Transmission Assets Order Limits

[2] SCANS-III (Hammond *et al.,* 2021) for adjacent block E (none observed for block F).

[3] Density derived from SCANS-III Density Surface Modelling for the study area (Lacey *et al.,* 2022)

[4] Carter *et al.* (2022) values – average densities calculated to per km^2 from 25 km^2 cells for the Transmission Assets marine mammal study area

[5] All population estimates include the Isle of Man unless population estimate given separately.

[6] Population estimate from IAMMWG, 2023.

[7] Based upon counts presented in SCOS (2022) with scalar of 0.215

[8] Population estimate from Howe (2018b).

[9] Based upon counts in Morris and Duck (2019) with scalar of 0.215 from SCOS (2022)

[10] Estimate derived from the OSPAR Quality Status Report (QSR) 2023 (Banga, 2022) (n*min* applied as a precautionary estimate, rather than n*mean*).

[11] Population estimates from SCOS (2022).

4.6.4 Future baseline conditions

4.6.4.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 require that "an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge" is included within the ES. This section provides an outline of the likely future baseline conditions in the absence of the Transmission Assets.

4.6.4.2 The baseline environment is not static and will exhibit some degree of natural change over time, even if the Transmission Assets does not come forward, due to naturally occurring cycles and processes as well as any potential changes resulting from climate change and anthropogenic activity. Therefore, when undertaking impact assessments, it will be necessary to place any potential impacts within the context of the envelope of change that might occur over the timescale of the Transmission Assets.

4.6.4.3 Marine mammals are known to be impacted by various anthropogenic activities, including offshore developments but also fisheries, anthropogenic sound, and transportation. Avila *et al.* (2020) reported that between 1991 and 2016, globally almost all species of marine mammals (98%) were documented to be affected by at least one threat. Catch of marine mammals in active fishing gear (by-catch) was the most common threat category for odontocetes and mysticetes, followed by pollution (solid waste), commercial hunting and boat-collisions. Ghost-net entanglements, solid and liquid wastes, and infections were reported to be the main threats for pinnipeds.

4.6.4.4 In addition to anthropogenic impacts, marine mammals are also vulnerable to indirect impacts, including climate change which can result in increasing sea temperatures (see Volume 4, Chapter 1: Climate Change of the ES).

4.6.4.5 Shifts in spatial distribution is one of the most common responses to temperature changes by marine mammals and has the potential to modify the ranges of certain species. Furthermore, changes in water temperatures are likely to alter the life cycles of marine mammal prey species. This may result in predator-prey mismatch, where there is a discrepancy between the abundances of prey species and those of marine mammals, affecting migratory marine mammal species and species displaying some site fidelity. Additionally, climate change could affect survival rates of marine mammals by affecting reproductive success, increasing the stress of the animal and fostering the development of pathogens (Albouy *et al.*, 2020).

4.6.4.6 Given that anthropogenic pressures are now exacerbated by climatic changes, it is challenging to predict future trajectories of marine mammal populations in the absence of the Transmission Assets. In terms of data, for some species monitoring is not in place at the relevant temporal or spatial scales in order to assess the baseline dynamics of some marine mammal populations, especially for minke whale and Risso's dolphin. Therefore, a summary of current and future pressures and information about population dynamics is presented below, where data is available.

Harbour porpoise

4.6.4.7 As highlighted in **paragraph 4.6.4.3** marine mammals, including harbour porpoise, are known to be impacted by various anthropogenic activities, including offshore developments (and associated pollutants), fisheries, anthropogenic sound, and transportation, as well as indirect effects such as climate change, habitat and changes in prey availability.

4.6.4.8 Harbour porpoise are severely vulnerable to incidental entanglements in fishing gear, known as bycatch (Moan *et al.*, 2020). Harbour porpoise are most likely to die shortly after entanglement, as they cannot drag fishing gear to the surface to breathe, and this mortality can have large population-level effects, causing negative population trajectories of the species (Institute of Marine Research (IMR)/North Atlantic Marine Mammal Commission (NAMMCO), 2019). The CIS Assessment Units (AU, as defined in IMR/NAMMCO, 2019) have a higher bycatch level than other AUs, with bycatches constituting 852 animals or 2.42% of the abundance estimated for the AU (Moan *et al.*¸ 2020). The Celtic Sea region has known concern for harbour porpoise bycatch (Andersens, 2013). A study by Brown *et al.* (2015) on potential risk to cetaceans from static fishing gear demonstrated gillnets were considered to have high potential for capturing harbour porpoise and were likely to result in fatality from an interaction.

4.6.4.9 Prey availability also influences harbour porpoise abundance. Given that harbour porpoise has a high metabolic rate (Rojano-Doñate *et al.*, 2018) and therefore has to feed almost continuously, it is thought to be highly dependent on year-round proximity to food sources and harbour porpoise distribution and condition is considered likely to reflect the availability and energy density of prey (Santos and Pierce, 2003). Therefore, any changes in the abundance and density of prey species may have the potential to affect harbour porpoise foraging in an area (see **paragraph 4.6.4.13**).

4.6.4.10 Harbour porpoise have high parasitic exposure, with post-mortem examinations regularly revealing heavy parasitic worm burdens (Bull *et al.*, 2006). A causal immunotoxic relationship between Polychlorinated Biphenyl (PCB) exposure and infectious disease mortality has also been highlighted (Murphy *et al.*, 2015), with total PCB levels significantly higher in the infectious disease group compared to the physical trauma group in a study by Jepson *et al.* (2005), thus suggesting anthropogenic contaminants are having adverse effects on harbour porpoise. A toxicology database from harbour porpoise stranded and incidentally caught between 1990 and 2011 (Jepson 2005, Deaville and Jepson 2011, Law *et al.*, 2012) showed stable and often high levels of PCBs in harbour porpoise, but declining levels of organochlorine pesticides (e.g. Dichlorodiphenyltrichloroethane and dieldrin) (Law *et al.* 2012) and penta-mix brominated diphenyl ether congeners (Law *et al.* 2010), and only trace levels of butyltins (including Tributyltin) (Law *et al.* 2012b). These Persistent Organic Pollutants (POP) may have impacts on reproduction, as during pregnancy lipid-soluble contaminants, such as organochlorines, may be transferred from the mother to the foetus (in particular the firstborn calf) (Murphy *et al.*, 2013).

4.6.4.11 The impact of climate change on harbour porpoise remains poorly understood (Evans and Bjørge, 2013), with existing research limited and uneven in distribution. Impacts of climate change on marine mammals in general have included geographical range shifts (Kaschner *et al.*, 2011; Lambert *et al.*, 2011; Hazen *et al.*, 2013; Ramp *et al.*,2015; Nøttestad *et al.*, 2015; Vikingsson *et al.*, 2015; Silber *et al.*, 2017), food web changes (Ramp *et al.*, 2015; Nøttestad *et al.*, 2015; Vikingsson *et al.*, 2015), and increased susceptibility to disease and contaminants (Hall and Frame, 2010; Twiner *et al.*, 2011; Fire and Van Dolah, 2012; Jensen *et al.*, 2015; Haüssermann *et al.*, 2017; Mazzariol *et al.*, 2018).

4.6.4.12 Data from SCANS-II and SCANS-III and SCANS-IV suggested that the abundance of harbour porpoise in the North Sea (NS) MU is stable (IAMMWG, 2015; IAMMWG, 2021; Gilles *et al.* 2023). Comparison of the impact of climate change on the species range and distribution in van Weelden *et al.* (2021) suggested a northward shift and expansion of harbour porpoise range, similar to MacLeod *et al.* (2009), but no increase in maximum latitude – which may lead to range contraction and present a risk for north west European populations with their preference for sub-polar to temperate water temperature. There has been an increase in strandings of harbour porpoise (and short-beaked common dolphin) in north west Scotland (Haelters *et al.* 2011, Leeney *et al.* 2008, MacLeod *et al.* 2005), and decrease in cold-temperate water species (northern bottlenose whale *Hyperoodon ampullatus*, long-finned pilot whale *Globicephala melas*, Sowerby's beaked whale *Mesoplodon bidens* and white-beaked dolphin *Lagenorhynchus albirostris*) suggesting a shift in habitat in the region, favouring warm water species over cold water species.

4.6.4.13 Climate change may also affect prey distribution, having implications for predators such as harbour porpoise (as discussed in **paragraph 4.6.4.11**). Warming sea temperatures are predicted to cause changes in prey abundance and distribution, and enhanced stratification forcing earlier occurrence of the spring phytoplankton bloom and potential cascading effects through the food chain (Evans and Bjørge 2013). The impacts of climate change on marine predator-prey distributions in Sadykova *et al.* (2020) predicted a large future distribution shift in sandeel and porpoise habitat overlap (164 km) but a small shift (16 km) in overlap between herring and porpoise.

4.6.4.14 The results of the most recent UK assessment of favourable conservation status show that the current range of harbour porpoise covers all of the UK's continental shelf and there appears to have been no change in range since 1994 (Paxton *et al.*, 2016; JNCC, 2019a). The future trend in the range of this species has therefore been assessed as overall stable (good). Due to insufficient data the future trend in the population and consequently future prospects of harbour porpoise was assessed as unknown (JNCC, 2019a). Due to the establishment of SACs for this species in UK waters, the future prospects for the supporting habitat were assessed as good. The report on conservation status assessment for the species concluded that, assuming that conservation measures are maintained, and further measures are taken should other pressures emerge (or existing pressures change) then the future prospects for harbour porpoise in UK waters should remain favourable (JNCC, 2019a).

Bottlenose dolphin

4.6.4.15 As highlighted above for harbour porpoise (**paragraph 4.6.4.7**) marine mammals, including bottlenose dolphin, are known to be impacted by various anthropogenic activities, including offshore developments (and associated pollutants), fisheries, anthropogenic sound, and transportation, as well as indirect effects such as climate change, habitat disturbance and changes in prey availability.

4.6.4.16 Abundance estimates of bottlenose dolphin in the IS MU have declined in recent years (IAMMWG, 2021), with 379 animals in the MU in 2015 based upon Evans (2012), and 293 in 2021 based upon Hammond *et al.* (2021) and Rogan *et al.* (2018) estimates. Bottlenose dolphin have been monitored annually in Cardigan Bay since 2001 and increased in abundance until peaking in 2007 to 2008 but have generally declined since then, although numbers now are similar to those in 2001 (Lohrengel *et al.*, 2017).

4.6.4.17 The impacts of climate change for cetaceans are described in **paragraph 4.6.4.11**. For the Irish Sea, Evans and Waggitt (2020) suggested no obvious trends in bottlenose dolphins since 2005 (Hammond *et al.*, 2013, 2017).

4.6.4.18 Evans and Waggitt (2020) highlighted both the frequency and severity of toxic algal blooms are predicted to increase as a result of nutrient enrichment (via increased rainfall and freshwater runoff) and increased temperature (via climate change) and salinity. Mass die-offs due to fatal poisonings have also been reported in bottlenose dolphin (Fire *et al.*, 2007, 2008).

4.6.4.19 The results of the most recent UK assessment of favourable conservation status shown that the future trend in bottlenose dolphin range is, overall, stable (good) (JNCC, 2019b). The pressures impacting the bottlenose dolphin population and available habitat are not thought to be increasing and there are no threats identified which are likely to impact bottlenose dolphin in the next 12 years. However, due to insufficient data to establish current trends for this species, future trends and consequently future prospects for the population and habitat are unknown (JNCC, 2019b). Therefore, the overall assessment of future prospects and conservation status for bottlenose dolphin is unknown (JNCC, 2019b).

Short-beaked common dolphin

4.6.4.20 As highlighted above for harbour porpoise (**paragraph 4.6.4.7**) marine mammals, including short-beaked common dolphin, are known to be impacted by various anthropogenic activities, including offshore developments (and associated pollutants), fisheries, anthropogenic sound, and transportation, as well as indirect effects such as climate change, habitat disturbance and changes in prey availability.

4.6.4.21 In the Irish Sea and Celtic Sea, there appears to be no obvious trends in status for short-beaked common dolphin (Baines and Evans, 2012). In other areas such as the North Sea off north east Scotland, Orkney and Shetland, short-beaked common dolphin are more regularly observed, even in winter (Sea Watch Foundation, unpublished data in Evans and Waggitt 2020, Macleod *et al.* 2005). This may reflect the expanding range of fish species like anchovy and sardine that are warmer water species.

4.6.4.22 Climate change may impact these predator-prey dynamics, alongside other impacts of a warming climate. Short-beaked common dolphin are wide-ranging with a capacity for range expansion (Murphy *et al*., 2013). They are a typically warmer water species and appear to be extending their shelf sea range further north off west Britain and around the north North Sea (Evans *et al.*, 2003; MacLeod *et al*., 2005). Short-beaked common dolphin show a positive relationship with increasing temperature (Evans and Waggit, 2020), and thus warming waters may lead to a shift in the range of short-beaked common dolphin (MacLeod *et al.*, 2005).

4.6.4.23 Other pressures on short-beaked common dolphin include fisheries interactions, pollutants, sound pollution and habitat disturbance. In the International Council for the Exploration of the Sea (ICES) sub-division VII, which encompasses the Celtic Sea, the English Channel and the Irish Sea, 410 to 610 short-beaked common dolphin were killed in pelagic trawl and static net fisheries between 2005 and 2006 (Northridge *et al.*, 2007) and whilst these levels of bycatch were not of major conservation concern, when combined with gill or tangle nets impacts may be greater. Short-beaked common dolphin have been observed taking fish from the cod end and foraging on discarded fish (Svane, 2005) inside sea bass trawls in the English Channel (Northridge *et al.*, 2004), and off the south west coast of Ireland they have been observed targeting horse mackerel in the vicinity of pelagic trawl nets (Couperus *et al.*, 1997).

4.6.4.24 Short-beaked common dolphin, as with all marine mammal species, are susceptible to persistent organic pollutants (POPs) which may biomagnify (higher levels higher up the food chain) and bioaccumulate (increased concentration with age). As discussed in **paragraph 4.6.4.10**, trends in POPs in harbour porpoise are likely to be found in short-beaked common dolphin around the UK (Murphy *et al.*, 2013). A study on the potential impact of POPs on female short-beaked common dolphin which investigated strandings in the north east Atlantic from 2001 to 2003, found the threshold known to have adverse health effects (17 mg kg^{-1}) was frequently exceeded in short-beaked common dolphin (Pierce *et al.* 2008). Subsequent studies found existence of non-reproductive female short-beaked common dolphin stranding on the south west coast of the UK due to high contaminant burdens (Murphy *et al.*, 2010) which could have implications for future population trajectories.

4.6.4.25 The results of the most recent UK assessment of favourable conservation status show that the future trend of short-beaked common dolphin range was overall stable (good) (JNCC, 2019c). The pressures impacting the short-beaked common dolphin population and available habitat are not thought to be increasing and there are no threats identified which are likely to impact short-beaked common dolphin in the next 12 years. However, due to insufficient data to establish current trends for this species, future trends and consequently future prospects for the population and habitat are unknown (JNCC, 2019c). Therefore, the overall assessment of future prospects and conservation status for short-beaked common dolphin is unknown (JNCC, 2019c).

Risso's dolphin

4.6.4.26 As highlighted above for harbour porpoise (**paragraph 4.6.4.7**) marine mammals, including Risso's dolphin, are known to be impacted by various anthropogenic activities, including offshore developments (and associated pollutants), fisheries, anthropogenic sound, and transportation, as well as indirect effects such as climate change, habitat disturbance and changes in prey availability.

4.6.4.27 In the Irish Sea and Celtic Sea, there appears to be no obvious trends in status for Risso's dolphin (Baines and Evans, 2012). There has been an increase in abundance of squid in recent years in areas around the UK (Western Approaches, English Channel, North Sea) which may lead to an increased presence of squid predators such as Risso's dolphin (Evans and Bjørge, 2013). As a predominantly teuthophagous (feeding on cephalopods) species that feeds in continental slope waters, Risso's dolphin may be less vulnerable to the threat of overfishing, as the main cephalopod species are not commercially important, and most fishing occurs in shelf waters and targets bony fishes. There remains the risk that fisheries will target lower in the food web if populations of higher trophic level species are depleted (Pauly *et al.*, 1998; Sala *et al.*, 2004; Pauly and Palomares, 2005) which could reduce prey populations or disrupt food webs.

4.6.4.28 Known threats to Risso's dolphin include bycatch (e.g. pelagic drift nets), sound disturbance and ingestion of plastic debris (Bearzi *et al.*, 2011). Small numbers of Risso's dolphin have been observed entangled in pelagic drift gillnets, pelagic longlines, purse seines and pelagic pair trawls (Carretta *et al.*, 2008; Waring *et al.*, 2009), with high mortality for gillnets. Whilst studies of sound disturbance on Risso's dolphin is limited, there are some studies that demonstrate resting behaviour of Risso's dolphin was disrupted by whale watching boats in the Azores (Visser *et al.*, 2006).

4.6.4.29 In terms of climate change, there is little good quality information on the impact on Risso's dolphin, particularly at a population level (Bearzi *et al.*, 2011). There is some evidence of fluctuations in community structure and species composition, likely driven by climate change. For example, short-finned pilot whales were replaced by Risso's dolphin in an area of south California coinciding with El Niño events (Shane, 1994, 1995b); during El Niño (1997–1998) and La Niña (1999) events species such as Risso's dolphin that were virtually absent at the surface became more conspicuous (Benson *et al.*, 2002). As discussed in **paragraph 4.6.4.10** Risso's dolphin are also susceptible to POPs and PCBs.

4.6.4.30 The results of the most recent UK assessment of favourable conservation status show that the future trend in the range of Risso's dolphin is overall stable (good) (JNCC, 2019d). As the current conservation status for range is favourable for this species, the future prospects are considered good (JNCC, 2019d). However, the overall assessment of future prospects and conservation status for Risso's dolphin is unknown; this is due to there being insufficient data to establish current trends for these parameters (JNCC, 2019d).

Minke whale

4.6.4.31 As highlighted above for harbour porpoise (**paragraph 4.6.4.7**) marine mammals, including minke whale, are known to be impacted by various anthropogenic activities, including offshore developments (and associated pollutants), fisheries, anthropogenic sound, and transportation, as well as indirect effects such as climate change, habitat disturbance and changes in prey availability.

4.6.4.32 No obvious status changes have been observed in minke whale in the Irish Sea since 2005 (Evans and Waggitt, 2020; Baines and Evans, 2012), but there may have been increases in relative abundance since the 1980s (Evans *et al.*, 2003; Paxton and Thomas, 2010). Minke whale are regularly observed in the Irish Sea and Celtic Sea, but foraging behaviour is less well known. Volkenandt *et al.* (2015) found minke whale were predominantly observed in areas with herring *Clupea harengus* and sprat *Sprattus sprattus*, but less in areas with mackerel. Healy *et al.* (2007) also found a significant relationship between the presence of baleen whales with herring and sprat in the Celtic Sea, and the species had a preference for small schooling pelagic fish (similar to studies on minke whale stomach contents by Pierce *et al.*, 2004 in Scotland).

4.6.4.33 Howe *et al.* (2018) also highlighted minke whale appear to target two herring stocks in the Irish Sea; the Mourne stock and Manx stock, with minke appearing to mirror the Irish Sea herring in Manx waters. These prey species may be impacted by climate change and have knock-on effects on minke whale foraging. The results of analysis of minke whale stomach contents in Icelandic waters suggested minke whale may adapt their diet under changed environments (Víkingsson *et al.*, 2013). The study showed a decrease in the proportion of sandeel and cold water species in the diet and an increase in gadoids and herring, which may reflect responses of minke whale to a changed environment, possibly driven by climate change. Studies also suggest that minke whale are likely to shift their distribution as a response to the decrease in the abundance of the preferred prey species (Víkingsson *et al.*, 2015).

4.6.4.34 Major threats affecting minke whale in UK waters include direct and indirect interactions with fisheries. Entanglement is the primary source of anthropogenic mortality of minke in the north west Atlantic (Van der Hoop *et al.*, 2013). Gillnets and longlines and pots have high potential to entangle minke whale (Brown *et al.* 2015), but not necessarily lethal encounters. Other impacts include boat strikes, exposure to anthropogenic sound, ingestion of contaminants and debris and the loss or degradation of critical habitat (Gill *et* *al.*, 2000; Robinson and MacLeod 2009; Robinson *et al.*, 2009). Data from SCANS-II, SCANS-III and SCANS-IV suggested that the abundance of minke whale in the CGNS MU is stable (IAMMWG, 2015; IAMMWG, 2021; Gilles *et al.* 2023).

4.6.4.35 The results of the most recent UK assessment of favourable conservation status show that there is no evidence to suggest that minke whale range has changed since the last reported conservation status in 2013 and therefore it has been assessed as, overall, stable (good) (JNCC, 2019e). The OSPAR Intermediate Assessment (IA) suggest that minke whale abundance in the greater North Sea is stable (OSPAR IA, 2017; JNCC, 2019e). The pressures impacting the minke whale population and available habitat are not thought to be increasing and there are no threats identified which are likely to impact minke whale in the next 12 years. However, due to insufficient data to establish current trends for this species, future trends and consequently future prospects for the population and habitat are unknown (JNCC, 2019e). Therefore, the overall assessment of future prospects and conservation status for minke whale is unknown (JNCC, 2019e).

Grey seal

4.6.4.36 As highlighted above for harbour porpoise (**paragraph 4.6.4.7**) marine mammals, including grey seal, are known to be impacted by various anthropogenic activities, including offshore developments (and associated pollutants), fisheries, anthropogenic sound, and transportation, as well as indirect effects such as climate change, habitat disturbance and changes in prey availability.

4.6.4.37 UK grey seal numbers are currently stable or increasing throughout their monitored range (SCOS, 2021), suggesting that their population status is not under threat. The overall UK pup production increased by <1.5% per annum between 2016 and 2019, but growth was mainly limited to North Sea colonies. There has been evidence of increased haul-out counts of grey seal within all SMUs in the regional study area (Wright and Sinclair, 2022), but this could be due to an increase in species reporting (SCOS, 2021). The only sizeable breeding colony in Wales that is monitored annually is on Skomer Island, where following a period of little population growth (1993–2011), pup production has increased by an average of 10% per annum between 2011 and 2015 (Bull *et al.*, 2017).

4.6.4.38 Pinnipeds are vulnerable to impacts of climate change (Evans and Waggitt, 2022). The SMRU explored potential habitat shifts of grey seal and harbour seal in two scenarios of climate change (IPCC, 2014) in the north Atlantic. In the ‘low warming scenario’ overall compression of core habitat was observed for grey seal, with slight losses in the north end of distribution range, and extensive losses in the south end. In the ‘high warming scenario’ there was a northward shift in core habitat. Furthermore, pinnipeds such as grey seal that haul-out or breed on low lying coastal areas are vulnerable to sea level rise and increased storm surges. This could become an issue in particular for seals in the south North Sea (Evans and Bjørge, 2013; Zicos *et al.*, 2018).

4.6.4.39 Warming sea temperatures may also lead to increases in pathogen exposure or spread of novel infectious diseases (Evans and Waggitt, 2020). Climate change has the potential to increase pathogen development and survival rates, disease transmission, and host susceptibility (Harvel *et al.*, 2002), whilst higher temperatures may stress organisms, increasing their susceptibility to some diseases (Lafferty *et al.*, 2004). Furthermore, species such as seals that occupy near shore regions near human settlements and have a semi-aquatic lifestyle will likely be at increased risk of pathogen exposure or risk to both marine and terrestrial pathogens (Cohen *et al.*, 2018; Kroese *et al.*, 2018; Keroack *et al.* 2018; Lehnert *et al.*, 2017; Sanderson *et al.* 2020; Jensen *et al.*, 2010).

4.6.4.40 Impacts on the food chain, such as a reduction in prey availability, may also occur as a result of climate change. It has also been suggested that some effects of pollutants (e.g. disruption of the immune, reproductive or endocrine systems) could also be exacerbated by nutritional stress brought on by reduced food availability as a result of climate change (Jepson *et al.*, 2005). Additive effects of pollutants on predators who are already under stress from habitat changes (e.g. climate change) and prey availability are poorly understood, but there are suggestions that warming temperatures will alter pathways and concentrations of pollutants (Mazzariol *et al.*, 2018).

4.6.4.41 The results of the most recent UK assessment of favourable conservation status show that the future trend in the range of grey seal is, overall, stable (good) (JNCC, 2019f). Modelling of population size at the beginning of each breeding season between 1984 and 2017 demonstrated an increasing trend and although the rate of increase has declined, the abundance estimate is above historic estimates (JNCC, 2019f). As the current conservation status for range and population is favourable for this species, the future prospects for both parameters are considered good (JNCC, 2019f). The future trend of grey seal habitat has been assessed as overall stable (good) (JNCC, 2019f).

Harbour seal

4.6.4.42 As highlighted above for harbour porpoise (**paragraph 4.6.4.7**) marine mammals, including harbour seal, are known to be impacted by various anthropogenic activities, including offshore developments (and associated pollutants), fisheries, anthropogenic sound, and transportation, as well as indirect effects such as climate change, habitat disturbance and changes in prey availability.

4.6.4.43 UK harbour seal numbers have increased since the late 2000s and are close to the late 1990s level, prior to the 2002 Phocine Distemper Virus (PDV) epizootic (SCOS, 2021). Population dynamics however, vary significantly between regions. Populations in west Scotland are either stable or increasing, with the south west Scotland SMU (which is located in the regional study area) increasing since the 1990s. The main harbour seal haul-out locations are concentrated in the north region of the regional study area, in the south west Scotland SMU. Little information is available on the location of harbour seal hauled-out in the Wales and north west England SMUs (Wright and Sinclair, 2022). Most harbour seal haul-out locations in Northern Ireland are located in the south east of the country, with the majority of harbour seal identified at Carlingford Lough, Murlough SAC and Rathlin Island. Population estimates have increased since the 2011 to 2015 survey periods (SCOS, 2021), but remain lower than 2000 to 2006 and 2007 to 2009 estimates. Colonies on the east coast appear to have experienced more dramatic declines (Wilson *et al.* 2019, Robinson *et al.*, 2018).

4.6.4.44 Threats to harbour seal includes competition with grey seal, predation from killer whale *Orcinus orca* and exposure to toxins from harmful algal blooms (Blanchet *et al.*, 2021; Wilson *et al.*, 2019; Jones *et al.*, 2017; Jensen *et al.*, 2015). Harbour seal in declining colonies have been shown to be significantly more exposed to harmful algal toxin (e.g. domoic acid and saxitoxins) which may be contributing to observed declines (Jensen *et al.*, 2015). Harbour seal are also under threat from bycatch, however this is not monitored, and until recently seal shooting was still licenced for those seals observed interacting with fishing equipment (under the 'netsman's defence'). However, in March 2021, amendments made to the Conservation of Seals Act 1970 (applicable in England, Wales and Scotland) by Schedule 9 of the Fisheries Act 2020 came into force and individual seals can no longer be killed intentionally or recklessly.

4.6.4.45 Harbour seal range and haul-out patterns are influenced by water and air temperature and are therefore expected to be impacted by climate change (Simpkins *et al.* 2003). Changes in prey communities can also impact predator foraging patterns and diet composition, and whilst harbour seal have been shown to switch to alternative preys when required, these may come at a fitness cost (e.g. harbour seal showed signs of fish-induced anaemia when switching from herring to gadoid). As generalist top predators with a flexible and broad diet, harbour seal can shift between several trophic niches if needed. However, shifts in pathogen ranges and increased pathogen survival as a result of increased air and water temperatures (Fujii *et al.*, 2006) may affect harbour seal populations, through increasing risk of epidemic outbreaks. Past epizootic viral diseases have caused mass mortality of harbour seals in Europe; 60% of the North Sea harbour seal population died during an outbreak of PDV in 1988, which was followed by an additional outbreak in 2002 (Härkönen et al 2006; Stokholm *et al.* 2019). Several pinniped-related parasites have begun to expand their range, mainly northwards (Jensen *et al.* 2009; Gibson *et al.*, 2011). As discussed in **paragraph 4.6.4.39**, those species that occupy both terrestrial and marine habitats may be at a greater risk of exposure to pathogens.

4.6.4.46 The results of the most recent UK assessment of favourable conservation status show that the future trend in the range of harbour seal is, overall, stable (good) (JNCC, 2019g). Although the UK population of harbour seal has increased since 2000, the long-term trend indicates that the UK population is still below population levels documented in the late 1990s and declines were recorded at many sites, including the east of Scotland. Therefore, the current UK harbour seal population estimate has been considered as unfavourable-inadequate. Given that there is not predicted to be any increase in management which would outweigh threats to the species, future prospects of harbour seal population in the UK were assessed as poor (JNCC, 2019g). The pressures impacting the harbour seal population and available habitat are not thought to be increasing and there are no threats identified which are likely to impact harbour seal in the next 12 years. However, due to insufficient data to establish current trends for this species, future trends and consequently future prospects for the habitat are unknown (JNCC, 2019g).

4.7 Scope of the assessment

4.7.1.1 The scope of this ES has been developed in consultation with relevant statutory and non-statutory consultees as detailed in **Table 4.5**. This ES chapter covers the marine mammal species likely to be present within the study area and wider regional study area (see **section 4.4** and Figure 4.1, Volume 2, Figures) and the potential impacts to those species from the construction, operation and maintenance and decommissioning phases of the Transmission Assets.

4.7.1.2 Taking into account the scoping and consultation process, **Table 4.10** summarises the impacts considered as part of this assessment.

Table 4.10: Impacts considered within this assessment

Activity	Impacts scoped into the assessment
Construction phase	
Clearance of UXO	Injury and disturbance from elevated underwater sound during UXO clearance.
Vessel traffic and other sound-producing activities	• Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities. • Increased likelihood of injury due to collision with vessels.
Changes in prey availability resulting from Transmission Assets activities	Effects on marine mammals due to changes in prey availability.
Pre-construction geophysical and geotechnical surveys	Injury and disturbance from underwater sound generated from pre-construction survey sources.
Operation and maintenance	
Vessel traffic	• Injury and disturbance to marine mammal receptors as a result of underwater sound produced by vessel use. • Increased likelihood of injury due to collision with vessels.
Changes in prey availability resulting from Transmission Assets activities	Reduced access to prey for marine mammal receptors as a result of Transmission Assets activities.
Decommissioning	
Vessel traffic	• Injury and disturbance to marine mammals from elevated underwater sound due to vessel use. • Increased likelihood of injury due to collision with vessels.

Activity	Impacts scoped into the assessment
Changes in prey availability resulting from Transmission Assets activities	Effects on marine mammals due to changes in prey availability

4.7.1.3 Impacts that are not likely to result in significant effects have been scoped out of the assessment. A summary of the impacts scoped out, together with justification for scoping them out and whether the approach has been agreed with key stakeholders through either scoping or consultation, is presented in **Table 4.11**.

Table 4.11: Impacts scoped out of the assessment

Impacts	Justification
Accidental pollution during all phases.	There is a risk of pollution being accidentally released during the construction, operation and maintenance and decommissioning phases from sources including vessels/vehicles and equipment/machinery. This may lead to direct mortality of marine mammals or a reduction in prey availability, either of which may affect species' survival rates. However, the risk of such events is managed by the implementation of measures set out in standard post-consent plans (e.g. Offshore EMPs (CoT65) (**Table 4.12**), including MPCP). These plans include planning for accidental spills, address all potential contaminant releases and include key emergency contact details. It will also set out industry good practice and OSPAR (Oslo-Paris), International Maritime Organisation and International Convention for the Prevention of Pollution from Ships guidelines for preventing pollution at-sea. Specifically, the MPCP (CoT65) (**Table 4.12**) ensures that in the unlikely event that a pollution event occurs, that plans are in place to respond quickly and effectively to ensure any spillage is minimised and effects on the environment are ideally avoided or minimised. Implementation of these measures will ensure that accidental release of contaminants from vessels will be avoided or minimised, thus providing protection for marine mammals across all phases of the Transmission Assets. Therefore, the likelihood of an accidental spill occurring is very low and in the unlikely event that such events did occur, the magnitude of these will be minimised through development of, and adherence to, Offshore EMPs (CoT65) (**Table 4.12**), including MPCP. Measures adopted as part of the Transmission Assets are presented in **Table 4.12**, setting out how measures will be secured (e.g. secured as part of deemed marine licence (dML)/DCO). As such this is scoped out of further consideration within the assessment of effects for marine mammals, as agreed via scoping; the Planning Inspectorate and Natural England both agreed with the impacts scoped in and scoped out for marine mammals, as presented in the Scoping Report (see **section 4.3.1** and **Table 4.5**).
Increased SSC and associated sediment deposition during all phases.	Disturbance to water quality can have both direct and indirect impacts on marine mammals. Indirect impacts would include effects on prey species (which is scoped in). Direct impacts include the impairment of visibility and therefore foraging ability which might be expected to reduce foraging success. Marine mammals are well known to forage in tidal areas where water conditions are turbid and visibility conditions poor. For example, harbour porpoise and harbour seals in the UK have been documented foraging in areas with high tidal flows (e.g. Pierpoint, 2008; Marubini *et al.,* 2009; Hastie *et al.,* 2016); therefore, low light levels, turbid waters and suspended sediments are unlikely to negatively impact marine mammal foraging success. When the visual sensory systems of marine mammals are compromised, they are able to sense the environment in other ways, for example, seals can detect water movements and hydrodynamic trails with their mystacial

Impacts	Justification
	vibrissae; while odontocetes primarily use echolocation to navigate and find food in darkness. Whilst elevated levels of SSC arising during construction, operation and decommissioning of the Transmission Assets may decrease light availability in the water column and produce turbid conditions, the maximum impact range is expected to be localised with sediments rapidly dissipating over one tidal excursion. In addition, there is a large natural variability in the SSC within the study area (see **section 4.4** and Figure 4.1, Volume 2, Figures), so marine mammals living here will be tolerant of any small scale increases, such as those associated with the construction activities. As such this is scoped out of further consideration within the assessment of effects for marine mammals, as agreed via scoping; the Planning Inspectorate and Natural England both agreed with the impacts scoped in and scoped out for marine mammals, as presented in the Scoping Report (see **section 4.3.1** and **Table 4.5**).
Impact of Electromagnetic Fields (EMF) (from surface lain or offshore export cables) during the operation and maintenance phase.	Based on the data available to date, there is no evidence of EMF related to marine renewable devices having any impact (either positive or negative) on marine mammals (Copping, 2018). There is no evidence that seals can detect or respond to EMF, however, some species of cetaceans may be able to detect variations in magnetic fields (Normandeau *et al.,* 2011). To date, the only marine mammal known to show any response to EMF is the Guiana dolphin (*Sotalia guianensis*) which has been shown to possess an electroreceptive system, which uses the vibrissal crypts on their rostrum to detect electrical stimuli similar to those generated by small to medium sized fish (Czech-Damal *et al.,* 2013). However, this has not been shown in any other species of marine mammal and this species does not occur within the study area, as agreed via scoping; the Planning Inspectorate and Natural England both agreed with the impacts scoped in and scoped out for marine mammals, as presented in the Scoping Report (see **section 4.3.1** and **Table 4.5**). As such this is scoped out of further consideration within the assessment of effects for marine mammals, as agreed via scoping; the Planning Inspectorate and Natural England both agreed with the impacts scoped in and scoped out for marine mammals, as presented in the Scoping Report (see **section 4.3.1** and **Table 4.5**).

4.8 Measures adopted as part of the Transmission Assets (Commitments)

4.8.1.1 For the purposes of the EIA process, the term ‘measures adopted as part of the Transmission Assets’ is used to include the following two types of mitigation measures (adapted from IEMA, 2016). These measures are set out in the Volume 1, Annex 5.3: Commitments register of the ES).

- Embedded mitigation. This includes the following.
  - Primary (inherent) mitigation - measures included as part of the Transmission Assets design. IEMA describes these as ‘modifications to the location or design of the development made during the pre-application phase that are an inherent part of the Transmission Assets and do not require additional action to be taken’. This includes modifications arising through the iterative design process. These measures will be secured through the consent itself through the description of the Transmission Assets and the parameters secured in the DCO and/or marine licences. For example, a reduction in footprint or height.

   - Tertiary (inexorable) mitigation. IEMA describes these as '*actions that would occur with or without input from the EIA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effects*'. It may be helpful to secure such measures through a Code of Construction Practice or similar.
- Secondary (foreseeable) mitigation. IEMA describes these as '*actions that will require further activity in order to achieve the anticipated outcome'*. These include measures required to reduce the significance of environmental effects (such as lighting limits) and may be secured through environmental management plan.

4.8.1.2 In addition, where relevant, measures have been identified that may result in enhancement of environmental conditions. Such measures are clearly identified within Volume 1, Appendix 5.3: Commitments register of the ES. The measures relevant to this chapter are summarised in **Table 4.12**.

4.8.1.3 Embedded measures that will form part of the final design (and/or are established legislative requirements/good practice) have been taken into account as part of the initial assessment presented in **section 4.11** below (i.e., the initial determination of impact magnitude and significance of effects assumes implementation of these measures). This ensures that the measures to which the Applicants are committed are taken into account in the assessment of effects.

4.8.1.4 Where an assessment identifies likely significant adverse effects, further or secondary mitigation measures may be applied. These are measures that could further prevent, reduce and, where possible, offset these effects. They are defined by IEMA as actions that will require further activity in order to achieve the anticipated outcome and may be imposed as part of the planning consent, or through inclusion in the ES (referred to as secondary mitigation measures in IEMA, 2016).

Table 4.12: Measures (commitments) adopted as part of the Transmission Assets

Commitment number	Measure adopted	How the measure will be secured
Embedded measures		
CoT55	Offshore Decommissioning Programme(s) will be developed prior to decommissioning and will include information on the consideration of recycling of materials, where practicable, and if opportunities are available.	DCO Schedule 2A Requirement 21 (Offshore decommissioning) and DCO Schedule 2B Requirement 21 (Offshore decommissioning).
CoT64	Detailed Marine Mammal Mitigation Protocols (MMMPs) will be developed and implemented in accordance with the Outline MMMP, to reduce the risk of injury to marine mammals. The Detailed MMMP(s) will include measures to apply in advance of UXO clearance. The Detailed MMMP(s) will include for the use of low order techniques, where possible, as the primary mitigation measure alongside other measures. The detailed MMMP(s) will be approved by Marine Management Organisation, in consultation with Natural England.	DCO Schedule 14 (Marine Licence 1: Morgan Offshore Wind Project Transmission Assets) Part 2 – Condition 20(1)(b) (UXO clearance) and DCO Schedule 15 (Marine Licence 2: Morecambe Offshore Wind Farm Transmission Assets), Part 2 - Condition20(1)(b) (UXO clearance).
CoT65	Offshore Environmental Management Plan(s) (EMPs) will be developed and will include details of: • a marine pollution contingency plan to address the risks, methods and procedures to deal with any spills and collision incidents during construction and operation of the authorised scheme for activities carried out below MHWS; • a chemical risk review to include information regarding how and when chemicals are to be used, stored and transported in accordance with recognised best practice guidance; • waste management and disposal arrangements; • the appointment and responsibilities of a fisheries liaison officer; • a fisheries liaison and coexistence plan (which accords with the outline fisheries liaison and co-existence plan) to ensure relevant fishing fleets are notified of commencement of licensed activities	DCO Schedule 14 (Marine Licence 1: Morgan Offshore Wind Project Transmission Assets) Part 2 - Condition18(1)(f) (Pre-construction plans and documentation) and DCO Schedule 15 (Marine Licence 2: Morecambe Offshore Wind Farm Transmission Assets), Part 2 - Condition18(1)(f) (Pre-construction plans and documentation).

Commitment number	Measure adopted	How the measure will be secured
	pursuant to condition and to address the interaction of the licensed activities with fishing activities; • measures to minimise disturbance to marine mammals and rafting birds from vessels; and • a Marine Biosecurity Plan that includes measures to minimise the potential spread of invasive non-native species, including adherence to IMO ballast water management guidelines.	
CoT69	Detailed Vessel Traffic Management Plan(s) (VTMP) will be developed pre-construction in line with legislation, guidance and industry best practice which will: • determine vessel routing to and from construction areas and ports; • include vessel standards and a code of conduct for vessel operators; and • minimise, as far as reasonably practicable, encounters with marine mammals and basking sharks. These plans will be developed in accordance with the Outline VTMP prepared and submitted with the application for development consent.	DCO Schedule 14 (Marine Licence 1: Morgan Offshore Wind Project Transmission Assets) Part 2 - Condition18(1)(h) (Pre-construction plans and documentation) and DCO Schedule 15 (Marine Licence 2: Morecambe Offshore Wind Farm Transmission Assets), Part 2 - Condition18(1)(h) (Pre-construction plans and documentation).

4.9 Key parameters for assessment

4.9.1 Maximum design scenario

4.9.1.1 The MDS identified in **Table 4.13** have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the Project Design Envelope provided in Volume 1, Chapter 3: Project description of the ES. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Design Envelope (e.g., different infrastructure layout), to that assessed here be taken forward in the final design.

4.9.1.2 Where relevant, the MDS for each impact, set out in **Table 4.13** and assessed within the assessment of effects in **section 4.11** identifies the MDS for the construction of the Transmission Assets in line with either concurrent or sequential construction scenarios of the Transmission Assets, where relevant, as detailed in Volume 1, Chapter 3: Project description of the ES.

Table 4.13: Maximum design scenario considered for the assessment of impacts

Impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
Injury and disturbance from elevated underwater sound during UXO clearance	Yes	No	No	**Pre - Construction phase and site preparation** • Clearance of up to 25 UXOs within the Transmission Assets (22 UXO at Morgan Offshore Wind Project: Transmission Assets and three UXO at Morecambe Offshore Windfarm: Transmission Assets). • The assessment of Injury and disturbance from elevated underwater sound during UXO clearance for the Transmission Assets is based upon: – A range of UXO sizes assessed from 25 kg up to 907 kg with 130 kg the most likely maximum. – For high order detonation donor charges of 1.2 kg (most common) and 3.5 kg (single barracuda blast charge). – Up to 0.5 kg Net Explosive Quantities (NEQ) clearance shot for neutralisation of residual explosive material at each location. – Clearance during daylight hours only. The MDS for the Transmission Assets is for high order clearance but assessment also considered: • Low order clearance charge size of 0.08 kg • Low yield clearance configurations of 0.75 kg charges (up to 4x0.75 kg).	• Maximum number and maximum size of UXOs encountered within the Offshore Order Limits • Due to uncertainties in size of UXOs the assessment presents a range, highlighting the most likely size (common) to be encountered. • Most likely and maximum donor charges assessed for high order detonation. • Assumption of a clearance shot of up to 0.5 kg at all locations although noting that this may not always be required. • For low order/low yield clearance charges are based on the maximum required to initiate clearance event.
Injury and disturbance to marine mammals from elevated underwater sound due to vessel use	Yes	Yes	Yes	**Construction phase** • Maximum vessels within Offshore Order Limits: Offshore at any one time: – Morgan Offshore Wind Project: Transmission Assets: ○ Up to a total of 19 construction vessels on site at any one time (two tug/anchor handlers, six cable lay installation and support vessels, one	• The MDS considers the maximum number of vessels on site at any one time and greatest number of round trips during each phase of the Transmission Assets. This represents the broadest range of vessel types

Impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
and other sound-producing activities				guard vessel, two survey vessels, four seabed preparation vessels, two Crew Transfer Vessels (CTV) and two cable protection installation vessels). – Morecambe Offshore Windfarm: Transmission Assets: ○ Up to a total of 11 construction vessels on site at any one time (one tug/anchor handlers, four cable lay installation and support vessels, one guard vessel, one survey vessels, two seabed preparation vessels, one CTVs and one cable protection installation vessels). • Maximum movement of vessels within Offshore Order Limits: Offshore during construction phase: – Morgan Offshore Wind Project: Transmission Assets: ○ Up to 226 installation vessel movements (return trips) during construction (8 movements for tug/anchor handlers, 40 movements for cable lay installation and support vessels, 18 movements for guard vessels, four movements for survey vessels, 16 movements for seabed preparation vessels, 120 movements for CTVs and 20 movements for cable protection installation vessels). – Morecambe Offshore Windfarm: Transmission Assets: ○ Up to 60 installation vessel movements (return trips) during construction (four movements for tug/anchor handlers, eight movements for cable lay installation and support vessels, 12 movements for guard vessels, two movements for survey vessels, four movements for seabed preparation vessels, 28 movements for CTVs and two movements for cable protection installation vessels). **Other activities:** • Burial of up to 484 km of offshore export cables via trenching, jetting, ploughing (including prelay ploughing), and mechanical cutting (400 km for the Morgan Offshore Wind Project and 84 km for the Morecambe Offshore Windfarm) The MDS is represented by sequential site preparation and construction at the Transmission Assets, which would take place over a maximum of 30 months,	and therefore sound signatures within the marine environment to affect marine mammal receptors. • The MDS considers the maximum duration which activities could be conducted over.

Impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				noting that there is potential for a gap between the construction periods for Morgan and Morecambe. **Operation and maintenance phase** • Maximum vessels within Offshore Order Limits: Offshore at any one time: – Morgan Offshore Wind Project: Transmission Assets: ○ Up to eight operation and maintenance vessels on site at any one time (two CTVs/workboats, one jack-up vessels, one cable repair vessels, two Service Operation Vessels (SOV) or similar and two excavators/backhoe dredgers). – Morecambe Offshore Windfarm: Transmission Assets: ○ Up to six operation and maintenance vessels on site at any one time (two CTVs/workboats, one jack-up vessels, one cable repair vessels, one SOVs or similar and one excavators/backhoe dredgers). • Maximum movement of vessels within Offshore Order Limits during operation and maintenance phase: – Morgan Offshore Wind Project: Transmission Assets: ○ Up to 52 operation and maintenance vessel movements (return trips) each year (28 movements for CTVs/workboats, two movements for jack-up vessels, two movements for cable repair vessels, 16 movements for SOVs or similar and four movements for excavators/backhoe dredgers). – Morecambe Offshore Windfarm: Transmission Assets: ○ Up to 25 operation and maintenance vessels on site at any one time (14 movements for CTVs/workboats, one movement for jack-up vessels, two movements for cable repair vessels, four movements for SOVs or similar and four movements for excavators/backhoe dredgers).	

Impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				Decommissioning phase • Vessels used for a range of decommissioning activities such as removal of offshore export cable protection. • Sound from vessels assumed to be as per vessel activity described for construction phase above.	
Injury to marine mammals due to collision with vessels	Yes	Yes	Yes	**Construction phase** • As described for vessel disturbance above. **Operation and maintenance phase** • As described for vessel disturbance above. **Decommissioning phase** • As described for vessel disturbance above.	• The MDS considers the maximum number of vessels on site at any one time and largest numbers of round trips during each phase of the Transmission Assets. This represents the broadest range of vessel types and movements, and therefore greatest potential for collision risk.
Injury and disturbance from underwater sound generated from pre-construction survey sources.	Yes	No	No	**Pre - Construction phase** • Geophysical site investigation activities include: – Multi-Beam Echo-Sounder (MBES) - 200-500 kHz; 180-240 dB re 1 µPa re 1 m (rms); – Sidescan Sonar (SSS) - 200-700 kHz; 216-228 dB re 1 µPa re 1 m (rms); – Single Beam Echosounder (SBES) - 20-400 kHz; 180-240 dB re 1 µPa re 1 m (rms); – Sub-bottom Profiler (SBP) - 0.2-14 kHz chirp; 2-7 kHz pinger; 200-240 chirp dB re 1 µPa re 1 m (rms); 200-235 pinger dB re 1 µPa re 1 m (rms); and – Sparker (as an example of Ultra High Resolution Seismic (UHRS) (0.05-4 kHz; 182 dB re 1 µPa re 1 m (rms)). • Geotechnical site investigation activities include: – Cone Penetration Testing (CPT); and – Vibro-coring.	• Range of geophysical and geotechnical activities likely to be undertaken using equipment typically employed for these types of surveys. Parameters chosen resulted in the greatest range of effect (e.g. highest source sound level, fastest pulse rate, longest pulse duration) and as such were those that would lead to the greatest spatial extent for injury and disturbance effects.

Impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				Pre-construction site investigation surveys will involve the use of several geophysical/geotechnical survey vessels and will take place over a period of up to eight months.	
Effects on marine mammals due to changes in prey availability	Yes	Yes	Yes	**Construction phase** • As described in Volume 2, Chapter 3: Fish and shellfish ecology of the ES for: – temporary habitat loss/disturbance; – long term habitat loss; – underwater sound impacting fish and shellfish receptors; and – increased SSCs and associated sediment deposition. • Maximum duration of site preparation and construction activities = 30 months based on activities being conducted sequentially (noting that there is potential for a gap between the construction periods for Morgan and Morecambe). **Operation and maintenance phase** • As described in Volume 2, chapter 3: Fish and shellfish ecology of the ES for: – temporary habitat loss/disturbance; – long term habitat loss; – underwater sound impacting fish and shellfish receptors; – increased SSCs and associated sediment deposition; – EMF from subsea electrical cabling; and – colonisation of hard structures. **Decommissioning phase** • As described in Volume 2, Chapter 3: Fish and shellfish ecology of the ES for: – temporary habitat loss/disturbance;	• As described in Volume 2, Chapter 3: Fish and shellfish ecology of the ES

Impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				– long term habitat loss; – underwater sound impacting fish and shellfish receptors; and – increased SSCs and associated sediment deposition.	

[a] C=construction, O=operation and maintenance, D=decommissioning

4.10 Assessment methodology

4.10.1 Overview

4.10.1.1 The approach to determining the significance of effects is a two-stage process that involves defining the magnitude of the impact and the sensitivity of the receptor. This section describes the criteria applied in this chapter to assign values to the magnitude of impacts and the sensitivity of the receptors. The terms used to define magnitude and sensitivity are based on those which are described in further detail in Volume 1, Chapter 5: Environmental assessment methodology of the ES.

4.10.1.2 In addition, the marine mammals impact assessment has considered the legislative framework as defined by:

- the Infrastructure Planning (EIA) Regulations 2017 (as amended);
- the Marine and Coastal Access Act 2009; and
- the Planning Act 2008 (as amended).

4.10.1.3 Full descriptions of relevant legislation is described in Volume 2, Chapter 2: Policy and legislative context of the ES.

4.10.2 Receptor sensitivity/value

4.10.2.1 The criteria for defining sensitivity in this chapter are outlined in **Table 4.14** below. The sensitivity of marine mammal key receptors has been defined by an assessment of the ability of a receptor to adapt to a given impact, its resilience to that impact and its ability to recover back to pre-impact conditions.

4.10.2.2 Resilience is the ability to withstand a perturbation or disturbance by resisting damage. Recoverability is the ability of the same species to return to a state close to that which existed before the activity or event which caused change. It is dependent on the ability of the individuals to recover following cessation of the activity that causes the impact.

4.10.2.3 Information on these aspects of sensitivity of the marine mammal key receptors to given impacts has been informed by the best available evidence from scientific research on marine mammals (studies on captive animals as well as observations from field studies). In particular, evidence from field studies of marine mammals during the construction and operation of offshore wind farms (and analogous activities in the oil and gas sector, such as seismic surveys and vessel movements) has been used to inform this impact assessment. The review of resilience and recoverability of marine mammal key receptors has been combined to provide an overall evaluation of the sensitivity of a receptor to an impact as outlined in **Table 4.14**.

Table 4.14: Sensitivity criteria

Sensitivity	Definition
Very High	No ability to adapt behaviour so that survival and reproduction rates may be affected. No resilience; effect is very likely to cause a change in both reproduction and survival of individuals. No ability for the animal to recover from the effect. A receptor is of very high sensitivity where adverse effects on multiple key ecological functions (e.g. feeding, breeding, nursing) could occur, with no resilience and no potential for recovery such that reproduction and survival of individuals would be affected.
High	Limited ability to adapt behaviour so that survival and reproduction rates may be affected. Limited resilience; effect may cause a change in both reproduction and survival of individuals. Limited ability for the animal to recover from the effect. A receptor is of high sensitivity where adverse effects on multiple key ecological functions (e.g. feeding, breeding, nursing) could occur with limited resilience and limited potential for recovery such that reproduction or survival of individuals could be affected.
Medium	Ability to adapt behaviour so that reproduction rates may be affected but survival rates not likely to be affected. Some resilience; effect unlikely to cause a change in both reproduction and survival rates. Ability for the animal to recover from the effect. A receptor is of medium sensitivity where adverse effects on one or more key ecological functions (e.g. feeding, breeding, nursing) could be sustained beyond the duration of the impact (some resilience to the effect) but not at a level that would affect individual survival although reproductive success may be affected until the individual has recovered (ability to recover).
Low	Receptor is able to adapt behaviour so that survival and reproduction rates are not affected. Receptor is resilient to the effect without any impact on reproduction and survival rates. Receptor is able to return to previous behavioural states/activities once the impact has ceased. Low sensitivity is such that adverse effects on ecological functions (e.g. feeding, breeding, nursing) are likely to be very short term and would not affect reproductive success or individual survival.
Negligible	Very little or no effect on the behaviour of the receptor.

4.10.3 Magnitude of impact

4.1.1.2 Magnitude of impact quantifies the amount of change arising from an activity that could lead to alteration in the environment (e.g. UXO clearance could lead to an elevation in underwater sound) and the associated outcome or effect on sensitive ecological receptors. The duration of the activity and associated impact is considered, under the following definitions.

- Short term: a period of months, up to one year

- Medium term: a period of more than one year, up to five years
- Long term: a period of greater than five years.

4.10.3.1 The assessment describes the spatial extent over which potential impacts and potential effects could occur arising from a particular activity within the relevant geographic frame of reference (e.g. area of effect/number of animals in a MU population affected), how long animals are exposed to an activity that could cause an effect in the context of the life-history of a species (i.e. the duration), the frequency of the exposure that could lead to a change (i.e. continuous or intermittent), whether or not the resultant change in exposed animals is reversible and how long animals are exposed to an activity that could cause an effect in the context of the life-history of a species (i.e. the duration).

4.10.3.2 The criteria for defining magnitude in this chapter are outlined in **Table 4.15** below and provides guidance to assessing magnitude for all impacts. This is not a wholly prescriptive approach, as the assessment of magnitude is based upon expert judgement taking into account other factors such as the species life history, the wider population context and movement within the area to aid with defining magnitude.

Table 4.15: Magnitude of impact criteria

Magnitude	Definition
High	The magnitude of the impact would lead to large scale effects on the behaviour and distribution of the marine mammal key receptors, with sufficient severity to affect the long-term viability of the population over a generational scale. (Adverse).
	Long-term, large-scale increases in the population trajectory over a generational scale. (Beneficial).
Medium	The magnitude of the impact would lead to temporary changes in behaviour and/or distribution of individuals at a scale that would result in potential reductions to lifetime reproductive success to some individuals, although not enough to significantly affect the population trajectory over a generational scale; and/or the impact would lead to permanent effects on individuals that may influence individual survival but not at a level that would alter population trajectory over a generational scale. (Adverse).
	Benefit to the habitat influencing foraging efficiency resulting in increased reproductive potential and increased population health and size. (Beneficial).
Low	The magnitude of the impact would result in some measurable change in attributes, quality or vulnerability (e.g. a threshold shift in hearing), or minor loss, or detrimental alteration to, one (maybe more) key characteristics, features or elements of the species at an individual level (e.g. interruption of feeding or breeding) but is unlikely to be measurable at a population level. (Adverse).
	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute (e.g. enhance foraging opportunities) but is unlikely to be measurable at a population level, or a reduced risk of negative impact occurring. (Beneficial).
Negligible	The magnitude of the impact would result in a very minor, temporary loss or detrimental alteration to one or more characteristics, features or elements of the species at an individual level which would not affect the population. (Adverse).

Magnitude	Definition
	Very minor benefit to, or positive addition of one or more characteristics, features or elements of the species at an individual level but which would not benefit the species at a population level. (Beneficial).

4.10.4 Significance of effect

4.10.4.1 The assessment of significance relies on understanding the impacts arising from proposed activities and the effect that those impacts will have on ecological receptors. These are aligned to CIEEM Guidelines (CIEEM, 2018), and the following definitions are used for impact and effect throughout.

- 'Impact' – actions resulting in changes to an ecological feature. For example, elevated underwater sound from UXO clearance
- 'Effect' – outcome to an ecological feature from an impact. For example, the onset of auditory injury.

4.10.4.2 The significance of effect upon marine mammal key receptors is determined by correlating the magnitude of the impact and the sensitivity of the receptor by taking into account the sensitivity of the receptor and the magnitude of the impact. The particular method employed for this assessment is presented in **Table 4.16**. Where a range of significance of effect is presented in **Table 4.16**, the final assessment for each effect is based upon expert judgement. In all cases, the evaluation of receptor sensitivity, impact magnitude and significance of effect has been informed by professional judgement and is underpinned by narrative to explain the conclusions reached. As per Guidelines for Ecological Impact Assessment in the UK and Ireland (CIEEM, 2018), significant effects are considered with regard to impacts on the structure and function of defined sites, habitats or ecosystems and the conservation status of habitats and species (including extent, abundance and distribution), where for a species "the conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area" (CIEEM, 2018). The assessment of potential significant effects provided in **section 4.11** is quantified with reference to appropriate geographic scales (e.g. species-specific MUs).

4.10.4.3 In some cases the matrix suggests a range for the significance of effect (i.e. the range is given as minor to moderate) (**Table 4.16**). In such cases the final significance is based upon the expert's professional judgement as to which outcome delineates the most likely effect, with an explanation as to why this is the case.

4.10.4.4 For the purposes of this assessment, any potential effects with a significance level of minor or less have been concluded to be not significant in terms of The Infrastructure Planning (EIA) Regulations 2017. A level of effect of moderate or more will be considered significant in terms of the EIA Regulations.

Table 4.16: Assessment matrix

Sensitivity of Receptor	Magnitude of Impact			
	Negligible	Low	Medium	High
Negligible	Negligible	Negligible or Minor	Negligible or Minor	Minor
Low	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	Negligible or Minor	Minor	Moderate	Moderate or Major
High	Minor	Minor or Moderate	Moderate or Major	Major
Very High	Minor	Moderate or Major	Major	Major

4.10.4.5 The definitions for significance of effect levels are described as follows.

- Major: These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category. Effects upon human receptors may also be attributed this level of significance.
- Moderate: These beneficial or adverse effects have the potential to be important and may influence the key decision-making process. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse or beneficial effect on a particular resource or receptor.
- Minor: These beneficial or adverse effects are generally, but not exclusively, raised as local factors. They are unlikely to be critical in the decision-making process but are important in enhancing the subsequent design of the project.
- Negligible: No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.
- No change: No loss or alteration of characteristics, features or elements; no observable impact in either direction.

4.10.5 Assumptions and limitations of the assessment

4.10.5.1 The marine mammal impact assessment was developed on the basis of the best available information at the time of writing. Baseline data used to underpin the assessment was drawn from broadscale sources and desktop studies from key desk top sources. These data are subject to temporal and spatial variability and so are likely to influence assessments of marine mammal distribution, abundance and density. A summary of the limitations and uncertainties associated with the data is detailed in Volume 2, Annex 4.1: Marine mammal technical report of the ES.

4.10.5.2 The approach to the assessments of underwater sound on marine mammals was undertaken using an evidence-based approach based on a comprehensive review of the literature, including empirical data derived from field studies at other offshore wind farms. This makes the assumption that such data is applicable in a different region with a different environmental context. In addition, there is an assumption that responses may be similar across different species.

4.10.5.3 Whilst these data limitations and assumptions could lead to some level of uncertainty, this is overcome by adopting a precautionary approach at each stage of the assessment (see **paragraph 4.11.1.21**).

4.11 Assessment of effects

4.11.1 Introduction

4.11.1.1 The potential impacts of the construction, operation and maintenance, and decommissioning phases of the Transmission Assets were assessed. The impacts arising from the construction, operation and maintenance, and decommissioning phases of the Transmission Assets are listed in **4.16.1.2**, along with the MDS against which each impact has been assessed.

4.11.1.2 A description of the potential effect on receptors caused by each identified impact is given below.

4.11.1.3 Some of the potential effects on receptors assesses the interaction of marine mammals and anthropogenic underwater sound. An overview of underwater sound and marine mammals has been presented below to support the assessment of the following impacts.

- Injury and disturbance from elevated underwater sound during UXO clearance.
- Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities (e.g. offshore export cable trenching, offshore export cable laying).
- Injury and disturbance from underwater sound generated from pre-construction site-investigation survey sources.

Underwater sound and marine mammals

4.11.1.4 Marine mammals, in particular cetaceans, are capable of generating and detecting sound (Au *et al.*, 1974; Bailey *et al.*, 2010). They are dependent on sound for many aspects of their lives (i.e. prey identification; predator avoidance; communication and navigation). Increases in anthropogenic sound may consequently lead to a potential effect within the marine environment (Parsons *et al.*, 2008; Bailey *et al.*, 2010), and potential effects on marine mammals.

4.11.1.5 Four zones of influence have been described by Richardson *et al.* (1995), and these vary with the distance from the source, including: audibility (sound is detected); masking (interfere with detection of sounds and communication); responsiveness (behavioural or physiological response), and injury/hearing loss (tissue damage in the ear). This assessment considers the zones of injury (auditory) and disturbance (i.e.

responsiveness). There is insufficient scientific evidence to properly evaluate masking and no relevant threshold criteria to enable a quantitative assessment. The relevant thresholds for onset of potential effects, and the evidence base from which they are derived, are given below.

Injury

4.11.1.6 Auditory injury in marine mammals, which is often described in terms of a hearing threshold shift, can either be temporary (TTS), where an animal's auditory system can recover, or permanent (PTS), where there is no hearing recovery in the animal. The 'onset' of TTS is deemed to be where there is a temporary elevation in the hearing threshold by 6 dB and is 'the minimum threshold shift clearly larger than any day to day or session to session variation in a subject's normal hearing ability', and which "is typically the minimum amount of threshold shift that can be differentiated in most experimental conditions" (Southall *et al.*, 2007). Since it is considered unethical to conduct experiments measuring PTS in animals, the onset of PTS was extrapolated from early studies on TTS growth rates in chinchillas (Henderson and Hamernick, 1986) and is conservatively considered to occur where there is 40 dB of TTS (Southall *et al.*, 2007). Whether such shifts in hearing would lead to loss of fitness will depend on several factors including the frequency range of the shift and the duty cycle of impulsive sounds. For example, if a shift occurs within a frequency band that lays outside of the main hearing sensitivity of the receiving animal there may be a 'notch' in this band, but potentially no effect on the animal's ability to survive. Further discussion on the sensitivity of marine mammals to hearing shifts is provided later in this assessment.

4.11.1.7 Potential auditory injury is assessed in terms of PTS given the irreversible nature of the effect, unlike TTS which is temporary and reversible. Animals (particularly highly mobile species) exposed to sound levels that could induce TTS are likely to respond by moving away from ("fleeing") the ensonified area and therefore avoiding potential injury. It is considered there is a behavioural response (disturbance) that overlaps with potential TTS ranges. Since derived thresholds for the onset of TTS are based on the smallest measurable shift in hearing, TTS thresholds are likely to be very precautionary and could result in overestimates of TTS ranges.

4.11.1.8 The assumptions and limitations of underwater sound modelling (e.g. equal energy rule, reduced sound levels near the surface, conservative swim speeds, and use of impulsive sound thresholds at large ranges; see **paragraph 4.11.1.21** *et seq.*) may also lead to an overestimation of ranges. Due to a combination of factors impulsive sounds are unlikely to still be impulsive in character once they have propagated some distance (Hastie *et al.*, 2019; Martin *et al.*, 2020; Southall *et al.*, 2019; Southall, 2021). Hastie *et al*. (2019) found that during application of acoustic recordings of seismic air guns and pile-driving there were range dependent changes in signal characteristics with received sound losing its impulsive characteristics at ranges of several kilometres, especially beyond 10 km. As such, TTS is not considered a useful predictor of the potential effects of underwater sound on marine mammals where ranges exceed more than c. 10 km and therefore, where this is the case (i.e. UXO clearance), TTS is not included in the assessment of significance for injury. To support this reasoning a synthesis of the use of impulsive sound thresholds at large ranges is presented Volume 1, Annex 5.2: Underwater sound technical report of the ES. Ranges for TTS were, however, modelled and presented as a proxy for behavioural disturbance for UXO clearance, and were modelled for completeness for all other potential sound-related impacts. These are also presented in Volume 1, Annex 5.2: Underwater sound technical report of the ES.

4.11.1.9 For marine mammals, injury thresholds are based on both peak Sound Pressure Levels (SPL_{pk}) (i.e. un-weighted) and marine mammal hearing-weighted cumulative Sound Exposure Level (SEL_{cum}) as per the latest guidance (Southall *et al.*, 2019) (**Table 4.17**). The marine mammal hearing-weighted categories are based on the frequency characteristics (bandwidth and sound level) for each group within which acoustic signals can be perceived and therefore assumed to have potential auditory effects (**Table 4.17**).

4.11.1.10 To calculate distances using the SEL_{cum} metric the sound modelling assessment made a simplistic assumption that an animal would be exposed over the duration of the activity and that there would be no breaks in activity during this time. It was assumed that an animal would swim away from the sound source at the onset of activity at a constant rate and subsequently, conservative species-specific swim speeds were incorporated into the model summarised in **Table 4.18** (further detail is presented in Volume 1, Annex 5.2: Underwater sound technical report of the ES).

Table 4.17: Criteria for assessing injury to marine mammals from impulsive and non-impulsive sound based on different hearing groups.

Hearing Group	Species	Parameter	Impulsive	Non-impulsive
Low Frequency (LF) cetaceans	Baleen whales	SPL_{pk}, unweighted	219	-
		SEL_{cum}, LF weighted	183	199
High Frequency (HF) cetaceans	Dolphins, toothed whales and beaked whales	SPL_{pk}, unweighted	230	-
		SEL_{cum}, HF weighted	185	198
Very High Frequency (VHF) cetaceans	True porpoises, sperm whales and some oceanic dolphins	SPL_{pk}, unweighted	202	-
		SEL_{cum}, VHF weighted	155	173
Pinnipeds in water (PCW)	True seals	SPL_{pk}, unweighted	218	-
		SEL_{cum}, PCW weighted	185	201

Table 4.18: Assessment swim speeds of marine mammals that are likely to occur within the Irish Sea for the purpose of exposure modelling for the Transmission Assets.

Species	Hearing group	Swim speed (m/s)	Source reference
Harbour porpoise	VHF	1.5	Otani *et al.* (2000)
Bottlenose dolphin	HF	1.52	Bailey *et al.* (2010)
Short-beaked common dolphin			
Risso's dolphin			
Minke whale	LF	2.3	Boisseau *et al.* (2021)
Grey seal	PCW	1.8	Thompson *et al.* (2015)
Harbour seal			

Disturbance

4.11.1.11 Beyond the zone of injury, sound levels are such that auditory or physical injury is less likely to occur but can result in disturbance to marine mammal behaviour. A marine mammal's response to disturbance will depend on the individual and the context; previous experience and acclimatisation will affect whether an individual exhibits an aversive response to sound, particularly in an area with high sound levels related to human activities.

Fixed threshold approach

4.11.1.12 The US NMFS (NMFS, 2005) define strong disturbance in all marine mammals as Level B harassment and for impulsive sound suggests a threshold of 160 dB re 1 µPa (SPL_{rms}). This threshold meets the criteria defined by JNCC (2010a) as a 'non-trivial' (i.e. significant) disturbance and is equivalent to the Southall *et al*. (2007) severity score of five or more on the behavioural response scale. Beyond this threshold the behavioural responses are likely to become less severe (e.g. minor changes in speed, direction and/or dive profile, modification of vocal behaviour and minor changes in respiratory rate (Southall *et al*. 2007)). The NMFS guidelines suggest a precautionary level of 140 dB re 1 µPa (SPL_{rms}) to indicate the onset of low-level marine mammal disturbance effects for all mammal groups for impulsive sound (NMFS, 2005), although this is not considered likely to lead to a 'significant' disturbance response.

4.11.1.13 For non-impulsive sound sources (such as underwater sound from vessels, sonar, vibro-coring) NMFS provides a precautionary threshold of 120 dB re 1 µPa (SPL_{rms}) for disturbance, with no distinction made between 'strong' and 'mild' in this case (NMFS, 2005).

Summary of criteria for assessing behavioural disturbance

4.11.1.14 For underwater sound sources arising from pre-construction site investigation survey sources, vessel activity and offshore export cables burial activities, the assessment adopted the NMFS (2005) published guidance on impulsive and non-impulsive sound sources (**Table 4.19**). In the absence of published thresholds on potential behavioural effects of underwater sound arising from UXO clearance, the assessment adopted the use of the TTS threshold as a proxy for a disturbance as this is considered to correspond to an animal moving away or 'fleeing' (i.e. behaviourally displaced) (**Table 4.19**). Further detail is provided under each impact header in the following sections.

Table 4.19: Summary of criteria used in assessment of behavioural disturbance for different marine mammal species.

Sound source	Species	Approach	Source
UXO (impulsive)	All marine mammal species	Unweighted SPL_{pk} and hearing weighted SEL_{cum} for TTS as a proxy for disturbance ('fleeing' response).	Southall *et al.* (2019)
Vessel sound and offshore export cables burial activities (non-impulsive)	All marine mammal species	Unweighted threshold of 120 dB re 1 µPa (SPL_{rms})	NMFS (2005)
Site-investigation surveys (impulsive)	All marine mammal species	Unweighted threshold of 160 dB re 1 µPa (SPL_{rms}) (strong disturbance) Unweighted threshold of 140 dB re 1 µPa (SPL_{rms}) (mild disturbance)	NMFS (2005)
Site-investigation surveys (non-impulsive)	All marine mammal species	Unweighted threshold of 120 dB re 1 µPa (SPL_{rms})	NMFS (2005)

<u>Importance of context</u>

4.11.1.15 Southall *et al*. (2021) highlights that the challenges for developing a comprehensive set of empirically derived behavioural criteria for such a diverse group of animals are significant. Extensive data gaps have been identified (e.g. measurements of the potential effects of elevated sound on baleen whales) which means that extrapolation from other species has been necessary. Sounds that disturb one species may, however, be irrelevant or inaudible to other species since there are broad differences in hearing across the frequency spectrum for different marine mammal hearing groups. Variance in responses even within a species are well documented to be context and sound-type specific (Ellison *et al.,* 2012). In addition, the potential interacting and additive effects of multiple stressors (e.g. reduction in prey, sound and disturbance, contamination, etc.) is likely to influence the severity of responses (Lacy *et al.,* 2017).

4.11.1.16 For these reasons, a single step threshold approach was not provided in the original guidance (Southall et al., 2007) and subsequently the recent recommendations by Southall *et al.* (2021) also steer away from a single overarching approach. Instead, Southall et al. (2021) proposes a framework for developing probabilistic response functions for future studies. The paper suggests different contexts for characterising marine mammal responses for both free ranging and captive animals with distinctions made by sound sources (i.e. active sonar, seismic surveys and continuous/industrial). Three parallel categories have been proposed within which a severity score from an acute (discrete) exposure can be allocated. Survival – defence, resting, social interactions and navigation.

- Survival – defence, resting, social interactions and navigation.
- Reproduction – mating and parenting behaviours.
- Foraging – search, pursuit, capture and consumption.

4.11.1.17 Whilst the identification of individual responses to acute exposure has been presented in various studies, there is still limited understanding of how behavioural responses at the individual level to either short or longer term exposure could translate to biologically meaningful changes at the population level. To explore potential population-level effects, Southall *et al.* (2021) reported observations from long term whale watching studies and suggested that there were differences in the ability of marine mammals to compensate for long term disturbance which related to their breeding strategy. For example, mysticetes are 'capital breeders' - accumulating energy in their feeding grounds and transferring this to calves in their breeding ground, whilst other species such as harbour porpoise, bottlenose dolphin and harbour seal are 'income breeders' – they balance the costs of pregnancy and lactation by increased food intake, rather than depending on fat stores. Reproductive strategy can impact the energetic consequences of disturbance, and cause variation in an individual's vulnerability to disturbance based on both its reproductive strategy and stage (Harwood *et al.*, 2020). Furthermore, their ability to compensate for chronic exposure to sound will also depend on a range of ecological factors.

4.11.1.18 Ecological factors affecting the ability to compensate for chronic exposure to sound include the relative importance of the disturbed area and prey availability within their wider home range, the distance to and quality of other suitable sites, the relative risk of predation or competition in other areas, individual exposure history, and the presence of concurrent disturbances in other areas of their range (Gill *et al.*, 2001). Animals may be able to compensate for short term disturbances by feeding in other areas, for example, which would reduce the risk of longer-term population consequences. Booth (2020) highlighted foraging behaviour (intensity) and diet (largely target prey size) in harbour porpoise informs vulnerability to disturbance, and if animals can find suitable high energy-density prey they may be capable of recovering from some lost foraging opportunities due to disturbance. Christiansen and Lusseau (2015) studied the effect of whale watching on minke whale in Faxafoi Bay, Iceland and found no significant long-term effects on vital rates (i.e. the components of individual fitness that affect the probability of survival, production of offspring, growth rate and offspring survival), although years with low sandeel density led to increased exposure to whale watching as whales were forced to move into disturbed areas to forage. Odontocetes, however, may be more vulnerable to whale watching compared to mysticetes due to their more localised, and often, coastal home ranges. Bejder *et al.* (2006) documented a decrease in local abundance of bottlenose dolphin which was associated with an increase in whale watching in a tourist area compared to a control area. If, however, there is no suitable habitat nearby animals may be forced to remain in an area despite the disturbance regardless of whether or not it could affect survival or reproductive success (Gill *et al.* 2001).

4.11.1.19 The marine mammals considered in this assessment vary biologically and therefore have different ecological requirements that may affect their sensitivity to disturbance. This point is illustrated by the differences between the two seal species identified as key biological receptors in the baseline. Grey seal are capital breeders and often make long foraging trips from haul-outs. In contrast, harbour seal are income breeders (feeding throughout the pupping season) and make shorter foraging trips from haul-outs. Species-specific differences should therefore be considered in assessing the likelihood and severity of disturbance as a result of proposed activities at the Transmission Assets.

4.11.1.20 In summary, Southall *et al.* (2021) highlight the caveats associated with simple, one-size-fits-all, threshold approaches (i.e. a single step function based on hearing group) that could lead to errors in disturbance assessments. Recognising this inherent uncertainty in the quantification of effects the assessment has adopted a precautionary approach at all stages of assessment including:

- conservative assumptions in the marine mammal baseline (e.g. use of seasonal density peaks for harbour porpoise and grey seal, offshore and inshore densities for pinniped species);
- conservative assumptions in the MDS for the Transmission Assets parameters (**Table 4.13**); and
- conservative assumptions in the underwater sound modelling (see Volume 1, Annex 5.2: Underwater sound technical report of the ES for further details).
  - The modelling assessment assumed that animals swim directly away from the sound source at constant and conservative average speeds based on published values. Whilst this buffers the uncertainty with respect to the directionality of their movement, nonetheless it may lead to overestimates of the potential range of effect as animals are likely to exceed these speeds. For example, Otani *et al.* (2000) note that horizontal speed for harbour porpoise can be significantly faster than vertical speed and cite a maximum speed of 4.3 m/s. Similarly, Leatherwood *et al.* (1988) reported harbour porpoise swim speeds of approximately 6.2 m/s. For minke whale speeds of up to 4.2 m/s have been reported during acoustic deterrent exposure experiments on free ranging animals (McGarry *et al.*, 2017).
  - The use of the SEL_{cum} metric is described as an equal energy rule where exposures of equal energy are assumed to produce the same sound-induced threshold shift regardless of how the energy is distributed over time. This means that for intermittent sound, such as pre-construction survey sources, the equal-energy rule overestimates the effects since the quiet periods between sound exposures will allow some recovery of hearing compared to continuous sound.

– Due to a combination of factors (e.g. dispersion of the waveform, multiple reflections from sea surface and seafloor, and molecular absorption of high frequency energy), impulsive sounds are unlikely to still be impulsive in character once they have propagated some distance (Hastie *et al.*, 2019; Martin *et al.*, 2020; Southall *et al.*, 2019; Southall, 2021). Empirical evidence suggests such shifts in impulsivity could occur markedly within 10 km from the sound source (Hastie *et al.,* 2019, based on application of acoustic recordings of seismic air guns and pile-driving to quantify range dependency in impulsive characteristics) (Volume 1, Annex 5.2: Underwater sound technical report of the ES). Since the precise range at which this transition occurs is unknown (not least because the transition also depends on the response of the marine mammals' hearing) sound models still adopt the impulsive thresholds at all ranges and this is likely to lead to an overly precautionary estimate of injury ranges at larger distances (tens of kilometres) from the sound source. The transition cross-over point from impulsive to non-impulsive sound is discussed in detail in **paragraphs 1.4.6.12** to **1.4.6.15** of Volume 1, Annex 5.2: Underwater sound technical report of the ES), and defining this transition range is an active area of research and scientific debate, with a number of other potential methods being investigated (see **paragraph 1.4.6.14** of Volume 1, Annex 5.2: Underwater sound technical report of the ES).

4.11.1.21 Given these conservative assumptions, PTS and TTS range estimates (particularly the application of the SEL_{cum} threshold to TTS ranges) should be interpreted with caution, and presented in context. However, the application of injury onset ranges to the assessment of the impact of sound on marine mammal is widely accepted, as is the inherent precaution associated with using best available data for a robust assessment.

4.11.2 Injury and disturbance from elevated underwater sound during UXO clearance

4.11.2.1 The clearance of UXO prior to commencement of construction may result in detonation (high order techniques[2]) of a UXO. This activity has the potential to generate some of the highest peak sound pressures of all anthropogenic underwater sound sources (von Benda-Beckmann *et al.*, 2015), and is considered a high energy, impulsive sound source. The potential effects of this activity will depend on sound source characteristics, the receptor species, distance from the sound source and sound attenuation within the environment.

4.11.2.2 Further detail on sound modelling of UXO clearance is provided in Volume 1, Annex 5.2: Underwater sound technical report of the ES. For high order detonation, acoustic modelling was undertaken following the methodology described in Soloway and Dahl (2014). Estimates were conservative as the

[2] High order techniques refer to methods that include the detonation of the UXO using an explosive counter-charge placed next to the UXO on the seabed (see Volume 1, Chapter 3: Project description of the ES).

charge is assumed to be freely standing in mid-water, unlike a UXO which would be resting on or partially buried in the seabed and could potentially be buried, degraded or subject to other significant attenuation. In addition, the explosive material is likely to have deteriorated over time, so maximum sound levels are likely to be over-estimates of true sound level. Frequency dependent weighting functions were applied to allow comparison with marine mammal hearing weighted thresholds.

4.11.2.3 For low order techniques[3], according to Robinson *et al.* (2020), low order deflagration results in a much lower amplitude of peak sound pressure than high order detonations, and therefore acoustic modelling has been based on the methodology described in **paragraph 4.11.2.2** above but using a smaller donor charge size.

Construction Phase

Sensitivity of the receptor

Permanent Threshold Shift

4.11.2.4 The main feature of the acoustical properties of explosives is a short shock wave, comprising a sharp rise in pressure followed by an exponential decay with a time constant of a few hundred microseconds (Volume 1, Annex 5.2: Underwater sound technical report of the ES). The interactions of the shock and acoustic waves create a complex pattern in shallow water, and this was investigated further by Von Benda-Beckmann *et al.* (2015). Harbour porpoise are most often studied in scientific literature due to their high sensitivity to sound. The effects of explosives on harbour porpoise in the south North Sea was studied by Von Benda-Beckmann *et al.* (2015). The study measured SEL and peak overpressure (in kPa) at distances of up to 2 km from the explosions of seven aerial bombs (charge mass of 263 kg and 121 kg) detonated at approximately 26 m to 28 m depth, on a sandy substrate. The results suggested that the largest distance at which a risk of ear trauma could occur was at 500 m and that sound-induced PTS was likely to occur greater than the 2 km range that was measured during the study since the SEL recorded at this distance was 191 dB re 1 µPa^{2}s (i.e. 1 dB above the 'very likely to occur' threshold). Von Benda-Beckmann *et al.* (2015) also modelled possible ranges for 210 explosions that had been logged by the Royal Netherlands Navy and the Royal Netherlands Meteorological Institute over a two-year period (2010 to 2011). Applying the empirical measurements of SEL out to 2 km as a ground truth, the authors found that the impact distances ranged between hundreds of metres to just over 10 km (for charges ranging from 10 kg up to 1,000 kg). Near the surface, where porpoise are known to spend a large proportion of time (e.g. 55% based on Teilmann *et al.*, 2007) the SELs were predicted to be lower; with PTS ranges predicted out to just below 5 km from the source. Whilst the model provided a reasonable

[3] Low order techniques refer to methods that neutralise the UXO to be safe without detonation. This can include deflagration, which is the use of a small charge to 'burn out' the explosive material without detonation (see Volume 1, Chapter 3: Project description of the ES).

estimate of the SEL within 2 km (since the empirical measurements were made out to this point), estimates above this distance require further validation since the uncorrected model systematically overestimated SEL.

4.11.2.5 Estimating how individuals are exposed to sound over time depends on an animals' mobility. Aarts *et al.* (2016) demonstrated harbour porpoise movement strategy affects the cumulative number of animals acoustically exposed to underwater explosions. The study estimated the number of animals experiencing temporary or permanent hearing loss due to underwater detonations of recovered explosives (mostly World War II aerial bombs) and found that when porpoise remained in a small area, fewer animals would experience PTS and TTS than those free-roaming, but more individuals were subjected to repeated exposures.

4.11.2.6 Salomons *et al.* (2021) analysed the sound measurements performed near two detonations of UXO (charge masses of 140 kg and 325 kg) and derived a PTS effect distance at ranges of between 2.5 km and 4 km (using weighted SEL values and threshold levels from Southall *et al.* (2019)). When comparing the experimental data and model predictions, the same study concluded thar harbour porpoise are at risk of permanent hearing loss at distances of several kilometres, i.e. distances between 2 km and 6 km based on 140 kg and 325 kg charge masses, respectively.

4.11.2.7 Due to paucity of UXO studies on bottlenose dolphin, short-beaked common dolphin, Risso's dolphin and minke whale, less is known about the species' sensitivities to UXO detonation. During a clearance of relatively small explosive (35 kg charge) at an important feeding area for a resident population of bottlenose dolphin in Portugal, acoustic pressure levels in excess of 170 dB re 1 µPa (SPL_{rms}) were measured. Despite pressure levels being 60 dB re 1 µPa (SPL_{rms}) higher than ambient sound, no adverse effects were recorded in the behaviour or morphology of any individuals (Santos *et al.*, 2010). Nonetheless, other studies reported that although dolphins experienced external injuries consistent with inner ear damage due to explosives, they expressed little change in surface behaviour near detonation areas (Ketten, 1993).

4.11.2.8 Robinson *et al.* (2020) found that using low order UXO disposal methods offers a substantial reduction in acoustic output over traditional high-order detonations, with the SPL_{pk} and SEL_{cum} observed being typically >20 dB lower for the deflagration of the same sized munition (a reduction factor of just over ten in SPL_{pk} and 100 in acoustic energy). The study reported that the acoustic output depends on the size of the shaped charge, rather than the size of the UXO itself. Considering the above, compared to high-order methods, Robinson *et al.* (2020) provided the evidence that low order techniques offer the potential for greatly reduced acoustic sound exposure to marine mammals.

4.11.2.9 All marine mammals are deemed to have limited resilience to PTS (i.e. are highly susceptible to PTS), exhibit low recoverability and are considered of international value. The sensitivity of the receptors to PTS is therefore, considered to be **high**.

Behavioural Disturbance (Temporary Threshold Shift as a proxy)

4.11.2.10 Although underwater sound as a result of UXO clearance has the potential to produce behavioural disturbance, there are no agreed thresholds for the onset of a behavioural response generated as a result of explosion. Thresholds for the onset of behavioural disturbance from detonation of explosives exist (Finneran and Jenkins, 2012) following the proposed approach by Southall *et al.* (2007), but these are intended for repeated impulsive events (detonations) over a 24 hour period and therefore not suitable for single detonations of a UXO. Finneran and Jenkins (2012) states for these single detonations, behavioural disturbance is likely to be limited to 'a short-lived startle reaction' and therefore does not use any unique behavioural disturbance thresholds for marine mammals exposed to single explosive events.

4.11.2.11 Southall *et al.* (2007) recommended the use of TTS as the most appropriate proxy disturbance from single pulses (such as UXO detonation) and therefore this has been applied to inform the assessment.

4.11.2.12 Given that TTS is a temporary and reversible hearing impairment, it is anticipated that any animals experiencing this shift in hearing would recover after they have moved beyond the injury zone when no longer exposed to elevated sound levels. The implication of animals experiencing TTS, leading to potential displacement, is not fully understood, but it is likely that aversive responses to anthropogenic sound could temporarily affect life functions as described for PTS. Therefore, in this respect animals exposed to sound levels that could induce TTS have similar susceptibility as those exposed to sound levels that could induce PTS. There is an important distinction, however, given that TTS is only temporary hearing impairment, it is less likely to lead to acute effects and will largely depend on recoverability. The degree and speed of hearing recovery will depend on the characteristics of the sound the animal is exposed to, and on the degree of shift in hearing experienced.

Harbour porpoise

4.11.2.13 SEAMARCO (2011) measured recovery rates of harbour porpoise following exposure to a piling playback sound source of 175 dB re 1 $\mu Pa^2 s$ (SEL) over 120 minutes and found that recovery to the pre-exposure threshold was estimated to be complete within 48 minutes following exposure (the higher the hearing threshold shift, the longer the recovery). Whilst this evidence relates to piling, which is not assessed for the Transmission Assets, the elevation in sound is similarly intermittent and short-term in nature, compared to UXO clearance, but is likely to occur over longer time scales than the very short-term nature of UXO clearance.

4.11.2.14 Kastelein *et al.* (2021) found that the susceptibility to TTS depends on the frequency of the fatiguing sound causing the shift, and the greatest TTS depends on the SPL (and related SEL). In a series of studies measuring TTS occurrence in harbour porpoise in response to a digitized playback of a continuous fatiguing sound at a range of frequencies typical of high amplitude anthropogenic sounds, the greatest shift in mean TTS occurred at 0.5 kHz with hearing recovery within 60 minutes after the fatiguing sound stopped.

Scientific understanding of the biological effects of TTS is limited to the results of controlled exposure studies on small numbers of captive animals (reviewed in Finneran, 2015). Extrapolating these results to how animals may respond in the natural environment should be treated with caution as it is not possible to exactly replicate natural environmental conditions, and the small number of test subjects would not account for intraspecific differences (i.e. differences between individuals) or interspecific differences (i.e. extrapolating to other species) in response.

Bottlenose dolphin, short-beaked common dolphin and Risso's dolphin

4.11.2.15 Finneran *et al.* (2000) investigated the behavioural and auditory responses of two captive bottlenose dolphins to sounds that simulated distant underwater explosions. The animals were exposed to an intense sound once per day and no auditory shift (i.e. TTS) greater than 6 dB in response to levels up to 221 dB re 1 µPa p-p (peak-peak) was observed. Behavioural shifts, such as delaying approach to the test station and avoiding the 'start' station, were recorded at 196 dB and 209 dB re 1 µPa p-p for the two dolphins and continued at higher levels. There are several caveats to this study (discussed in Nowacek *et al.* (2007)), (i.e. the signals used in this study were distant and the study measured masked-hearing signals). The animals used in the experiment were also trained and rewarded for tolerating high levels of sound and subsequently, it can be anticipated that behavioural disruption would likely be observed at lower levels in other contexts.

4.11.2.16 Whilst there are no available species-specific recovery rates for high-frequency cetaceans to TTS, there is no evidence to suggest that recovery will be significantly different to harbour porpoise recovery rates therefore animals can recover their hearing after they are no longer exposed to elevated sound levels. It can be anticipated that bottlenose dolphin, short-beaked common dolphin and Risso's dolphin would be able to tolerate TTS without any impact on reproduction or survival rates with ability to return to previous behavioural states or activities once the activity had ceased.

Minke whale

4.11.2.17 Few studies are available on reactions of minke whales to impulsive sounds; however, several studies indicate that mysticetes in general may react to pile driving sound at considerable distances (Tougaard *et al.,* 2021). Sivle *et al.* (2015) exposed a single minke whale to simulated sonar sounds between 1 and 2 kHz. At received sound levels equivalent to 146 dB re 1 µPa^{2}s SEL, the minke whale responded by swimming away. Boisseau *et al*. (2021) observed minke whale showing clear avoidance behaviour to an operational 15 kHz ADD, at signals at the likely upper limit of their hearing sensitivity. Tougaard et al. (2021) noted that it is difficult to extract robust response thresholds for minke whale, however, sound levels at which responses occur appear to be considerably higher than for harbour porpoise (by some 40 to 50 dB re 1µPa (SPL_{pk}))) indicating a lower sensitivity to the sound.

4.11.2.18 There is no species-specific recovery rate for minke whale to TTS. However, there is no evidence to suggest that recovery will be significantly different to harbour porpoise recovery rates as studies report that minke whale avoid a 15 kHz ADD and clearly react to signals at the likely upper limit of their hearing sensitivity (Boisseau *et al.*, 2021). It is anticipated that minke whale would be able to tolerate effects without any impact on reproduction or survival rates and are expected to return to previous behavioural states or activities once the activity had ceased.

Harbour seal and grey seal

4.11.2.19 Kastelein *et al.* (2018) measured recovery rates of harbour seal following exposure to playbacks of broadband pile-driving sounds of 193 dB re 1 μPa^{2}s (SEL_{cum}) over 360 minutes and found that recovery from TTS to the pre-exposure baseline was estimated to be complete within 72 minutes following exposure. These results are in line with findings reported in SEAMARCO (2011), which showed that for small TTS values, recovery in seals was very fast (around 30 minutes) and the higher the hearing threshold shift, the longer the recovery. Kastelein *et al.* (2019a) also reported relatively fast recovery, with full hearing recovery within two hours following exposure.

4.11.2.20 Considering the above, in most cases, impaired hearing for a short time is anticipated to have little effect on the total foraging period of a seal. If hearing is impaired for longer periods (hours or days) the impact has the potential to be ecologically significant (SEAMARCO, 2011). Nevertheless, the findings of studies presented in this section indicate that seal species are less vulnerable to TTS than harbour porpoise for the sound bands tested. It is also expected that animals would move beyond the injury range prior to the onset of TTS. The assessment considered that both grey seal and harbour seal are likely to be able to tolerate the effect without any impact on either reproduction or survival rates and would be able to return to previous behavioural states or activities once the activity had ceased.

4.11.2.21 All marine mammals are deemed to have some resilience to TTS, exhibit high recoverability and are considered of international value. The sensitivity of the receptor to TTS is therefore, considered to be **low**.

Magnitude of impact

4.11.2.22 Potential effects of underwater sound from high order UXO clearance on marine mammals include mortality, physical injury or auditory injury. The duration of impact (elevated sound) for each UXO detonation is very short (seconds) and therefore behavioural effects are considered to be **negligible** in this context. TTS is presented as a temporary reduction in hearing sensitivity but also represents a threshold for the onset of a moving away response. Specific sound modelling for the Transmission Assets was carried out using published and peer-reviewed criteria to determine PTS and TTS ranges for marine mammal receptors (see Volume 1, Annex 5.2: Underwater sound technical report of the ES). A Transmission Assets specific detailed MMMPs (developed in accordance with the Outline MMMP (CoT64) (**Table 4.12**) (document reference: J18)) will be developed in order to reduce the potential for injury as a result of UXO detonation.

4.11.2.23 It is anticipated that up to 25 UXO within the Offshore Order Limits are to be cleared. The absolute maximum UXO size is assumed to be 907 kg (representing the MDS), the most common size is 130 kg and the smallest UXO size is 25 kg (**Table 4.13**), thus all sizes have been assessed. A low order clearance donor charge of 0.08 kg is assumed whilst low-yield donor charges are multiples of 0.75 kg (up to four required for the largest UXO). For donor charges for high-order clearance activities, charge weights of 1.2 kg (the most common) and 3.5 kg (single barracuda blast charge) have been included.

4.11.2.24 UXO clearance activities will be tide and weather dependant. The aim is to enable clearance of at least one UXO per tide, during the hours of daylight and good visibility. There is an assumption of up to 0.5 kg NEQ clearance shot for neutralisation of residual explosive material at each location.

Permanent threshold shift (PTS)

4.11.2.25 PTS ranges for low order and low yield UXO clearance activities are presented in **Table 4.20**, PTS ranges for donor charges used in high order UXO clearance are presented in **Table 4.21**, and PTS ranges for high order clearance of UXO are presented in **Table 4.22**. The number of animals predicted to experience PTS due to low order and low yield UXO clearance activities are presented in **Table 4.23**, The number of animals predicted to experience PTS due to donor charges used in high order UXO clearance are presented in **Table 4.24** and the number of animals predicted to experience PTS due to high order clearance of UXO in **Table 4.25**.

4.11.2.26 It is considered that there is a small risk that a low order clearance could result in high order detonation of UXO, and the assessment considered both high order and low order techniques. With regard to UXO detonation (low order techniques as well as high order events), due to a combination of physical properties of high frequency energy, the sound is unlikely to still be impulsive in character once it has propagated more than a few kilometres (see Volume 1, Annex 5.2: Underwater sound technical report of the ES). The NMFS (2018) guidance suggested an estimate of 3 km for transition from impulsive to continuous (although this was not subsequently presented in later guidance (Southall *et al.*, 2019)). Therefore, in applying this empirical evidence to the impulsive characteristics of UXO clearance, caution should be used when interpreting any results with predicted injury ranges in the order of tens of kilometres as the PTS ranges are likely to be lower than predicted (see **paragraph 4.11.1.7**).

4.11.2.27 An explosive mass of 907 kg (absolute maximum high order explosion) yielded the largest PTS ranges for all species, with the greatest injury range (15,370 m) seen for harbour porpoise (SPL_{pk}) (**Table 4.22**). However, the most likely (common) 130 kg charge yielded injury ranges of 8,045 m for harbour porpoise (SPL_{pk}). Conservatively, the number of harbour porpoise that could be potentially injured, based on the Welsh Marine Mammal Atlas density of 0.227 animals per km^2 (**Table 4.9**) was estimated as 169 animals for 907 kg UXO high order explosion equating to 0.27% of the CIS MU. Predicted numbers were much smaller for the most likely (common) 130 kg and 25 kg UXO with up to 47 animals and 16 animals potentially experiencing PTS respectively (applying the SPL_{pk} metric). For low order techniques, the largest range of 2,290 m was predicted from the 4 x 0.75 kg low-yield charges, which has the potential to injure up to four harbour porpoise within this range.

4.11.2.28 The underwater sound assessment (Volume 1, Annex 5.2: Underwater sound technical report of the ES) found that the maximum injury (PTS) range estimated for bottlenose dolphin, short-beaked common dolphin and Risso's dolphin using the SPL_{pk} metric is 890 m for the detonation of charge size of 907 kg, but 464 m for 130 kg and 268 m for 25 kg. Therefore conservatively, during high order detonation of any size of UXO the maximum number of individuals that could potentially be injured for any of these species (based on densities presented in **Table 4.9**) was estimated as less than one animal. With reference to wider populations, this equated to small proportions of the relevant MUs (0.34% for bottlenose dolphin, 0.001% for short-beaked common dolphin and 0.008% for Risso's dolphin). For low order techniques, the injury ranges were considerably lower with a maximum of 133 m from the 4 x 0.75 kg low-yield charges estimated as less than one animal of any species likely to be present within this range.

4.11.2.29 The underwater sound assessment (Volume 1, Annex 5.2: Underwater sound technical report of the ES) found that the maximum injury (PTS) range estimated for minke whale using the SEL_{cum} metric is 4,215 m for the detonation of charge size of 907 kg, but 1,705 m for 130 kg and 775 m for 25 kg. Therefore conservatively, during high order detonation of any size of UXO the maximum number of individuals that could potentially be injured (based on densities presented in **Table 4.9**) was estimated as up to two animals for 907kg and less than one animal for 130 kg and 775 kg. This equates to a maximum of 0.01% of the CGNS MU. For low order techniques, the maximum range predicted was up to 406 m and there would be less than one animal potentially within this range.

4.11.2.30 The underwater sound assessment found that the maximum injury (PTS) range estimated for grey seal and harbour seal using the SPL_{pk} metric was 3,015 m for the detonation of charge size of 907 kg, but 1,580 m for 130 kg and 910 m for 25 kg. Therefore conservatively, the number of individuals that could be potentially injured, (based on densities presented in **Table 4.9**), was estimated as up to four grey seal for 907 kg UXO high order explosion, which equates to a maximum of 0.03% of the GSRP, or 0.007% of the OSPAR Region III reference population and less than one animal for both 130 kg and 25 kg UXO. For harbour seal, for all UXO weights, less than one animal was predicted to experience PTS, equating to less than 0.087% of the reference population (based on densities presented in **Table 4.9**). For low order techniques, the maximum range predicted was up to 449 m and there would be less than one animal of each species potentially within this range.

Table 4.20: Potential PTS ranges for low order and low yield UXO clearance activities

Charge size	PTS range (m)				
	Threshold	VHF	HF	LF	PCW
0.08 kg low-order donor charge	SPL_{pk}	685	40	122	135
	SEL_{cum}	190	2	47	9
0.5 kg clearing shot	SPL_{pk}	1,265	73	223	247
	SEL_{cum}	421	4	115	22
2 x 0.75 kg low-yield charge	SPL_{pk}	1,820	105	322	357
	SEL_{cum}	650	7	196	38
4 x 0.75 kg low-yield charge	SPL_{pk}	2,290	133	406	449
	SEL_{cum}	840	10	275	53

Table 4.21: Potential PTS ranges for donor charges used in high order UXO clearance activities

Charge size	PTS range (m)				
	Threshold	VHF	HF	LF	PCW
1.2 kg	SPL_{pk}	1,690	98	299	331
	SEL_{cum}	596	6	176	34
3.5 kg	SPL_{pk}	2,415	140	427	473
	SEL_{cum}	885	10	297	57

Table 4.22: Potential PTS ranges for high order UXO clearance activities

Charge size	PTS range (m)				
	Threshold	VHF	HF	LF	PCW
25 kg UXO – high order explosion	SPL_{pk}	4,645	268	825	910
	SEL_{cum}	1,645	27	775	147
130 kg UXO – high order explosion	SPL_{pk}	8,045	464	1,425	1,580
	SEL_{cum}	2,520	61	1,705	323
907 kg UXO – high order explosion	SPL_{pk}	15,370	890	2,720	3,015
	SEL_{cum}	3,820	151	4,215	800

Table 4.23: Number of animals with the potential to experience PTS due to low order and low yield UXO clearance activities

Threshold	Number of animals						
	Harbour porpoise	Bottlenose dolphin	Short-beaked common dolphin	Risso's dolphin	Minke whale	Grey seal	Harbour seal
0.08 kg low-order donor charge							
SPL_{pk}	<1	<1	<1	<1	<1	<1	<1
SEL_{cum}	<1	<1	<1	<1	<1	<1	<1
0.5 kg clearing shot							
SPL_{pk}	2	<1	<1	<1	<1	<1	<1
SEL_{cum}	<1	<1	<1	<1	<1	<1	<1
2 x 0.75 kg low-yield charge							
SPL_{pk}	3	<1	<1	<1	<1	<1	<1
SEL_{cum}	<1	<1	<1	<1	<1	<1	<1
4 x 0.75 kg low-yield charge							
SPL_{pk}	4	<1	<1	<1	<1	<1	<1
SEL_{cum}	<1	<1	<1	<1	<1	<1	<1

Table 4.24: Number of animals with the potential to experience PTS due to donor charges used in high order UXO clearance activities

Threshold	Number of animals						
	Harbour porpoise	Bottlenose dolphin	Short-beaked common dolphin	Risso's dolphin	Minke whale	Grey seal	Harbour seal
1.2 kg donor charge							
SPL_{pk}	3	<1	<1	<1	<1	<1	<1
SEL_{cum}	<1	<1	<1	<1	<1	<1	<1
3.5 kg donor blast-fragmentation charge							
SPL_{pk}	5	<1	<1	<1	<1	<1	<1
SEL_{cum}	<1	<1	<1	<1	<1	<1	<1

Table 4.25: Number of animals with the potential to experience PTS due to high order UXO clearance activities

Threshold	Number of animals						
	Harbour porpoise	Bottlenose dolphin	Short-beaked common dolphin	Risso's dolphin	Minke whale	Grey seal	Harbour seal
25 kg UXO – high order explosion							
SPL_{pk}	16	<1	<1	<1	<1	<1	<1
SEL_{cum}	2	<1	<1	<1	<1	<1	<1
130 kg UXO – high order explosion							
SPL_{pk}	47	<1	<1	<1	<1	<1	<1
SEL_{cum}	5	<1	<1	<1	<1	<1	<1
907 kg UXO – high order explosion							
SPL_{pk}	169	<1	<1	<1	<1	4	<1
SEL_{cum}	11	11	<1	<1	2	<1	<1

4.11.2.31 For the purposes of this assessment, it has been assumed that the MDS will be clearance of UXO with a NEQ of 907 kg (absolute maximum) cleared by either low order or high order techniques, although clearance of UXO with an NEQ of 130 kg is considered the more likely (common) scenario (**Table 4.13**). Embedded mitigation can be employed to reduce the risk of injury by using low order techniques (CoT64) (**Table 4.12**) to clear UXOs where possible, noting however, that low order techniques are not always possible and are dependent upon the individual situations surrounding each UXO, therefore both low order and higher order techniques are included in the assessment.

4.11.2.32 With embedded mitigation in place (i.e. using low order technique, where possible (CoT64) (**Table 4.12**)) the assessment found (based upon the absolute maximum 907 kg UXO) that there would be a residual risk of injury over a range of 2,290 m (for harbour porpoise using the SPLpk metric) that would require further mitigation (**Table 4.20**). Where low order/low yield measures are not possible there is a maximum risk of injury (predicted for harbour porpoise) out to ~15 km for a 907 kg UXO (absolute maximum) and ~8 km for a 130 kg UXO (most likely (common) scenario. Therefore, adopting standard industry practice (JNCC, 2010b), embedded mitigation measures will applied as part of a MMMP (CoT64) (**Table 4.12**) (which will be developed in accordance with the Outline MMMP (document reference: J18)) (**Table 4.12**).

4.11.2.33 The injury ranges (for both low order and high order clearance) are considerably larger than the standard 1,000 m mitigation zone recommended for UXO clearance (JNCC, 2010b) and there are often difficulties in detecting marine mammals (particularly harbour porpoise) over such large ranges (McGarry *et al.*, 2017). Visual surveys note that there is often a significant decline in detection rate with increasing sea state (Embling *et al.*, 2010;

Leaper *et al.*, 2015). Embedded mitigation (CoT64) (**Table 4.12**) includes for the preparation of MMMP (document reference: J18) with measures to apply in advance of and during surveys and UXO clearance. This may include the use of ADDs and potentially scare charges to deter animals from the injury zone . The efficacy of such deterrence will depend upon the device selected and reported ranges of effective deterrence vary. One of the loudest devices available, the Lofitech ADD, operates at a range of frequencies and may be suitable as multi-species deterrent. Brandt *et al.* (2012) reported effective deterrence of harbour porpoise out to 7.5 km whilst Dähne *et al.* (2017) suggests detectable deterrence to 12 km. Olesiuk *et al.* (2002) report a displacement range of 3.5 km for the Airmar dB plus II ADD whilst Kyhn *et al.* (2015) report effective deterrence to 2.5 km for harbour porpoise. A full review of available devices is provided in McGarry *et al. (*2020).

4.11.2.34 In addition to ADDs, deterrence can also be achieved through the use of soft start charges, the application of which will be discussed and agreed with consultees post-submission, once more information on the size and type of UXOs are known. Details of appropriate embedded mitigation measures as set out in the detailed MMMPs (CoT64) (**Table 4.12**) (which will be developed in accordance with the Outline MMMP (document reference: J18)) will be discussed and agreed with consultees post-consent. To illustrate what this may entail for high order clearance of the most likely scenario (130 kg NEQ), based on a swim speed of 1.5 m/s for harbour porpoise, a total of 89 minutes of deterrence activities would be required for animals to clear the 8 km risk zone (as per the Outline MMMP, document reference: J18).

4.11.2.35 Adopting a precautionary approach, and assuming application of embedded mitigation (CoT64) (**Table 4.12**) as part of the Transmission Assets, the assessment considered the magnitude for a high order detonation (the absolute maximum 907 kg UXO). The magnitude of impact is predicted to be of local to regional spatial extent (depending on species), very short-term duration, intermittent and, although the impact itself is reversible (i.e. the elevation in underwater sound only occurs during detonation event), the effect of injury on sensitive receptors is permanent. It is predicted that the impact will affect the receptor directly. With embedded mitigation (CoT64) (**Table 4.12**) applied, it is anticipated that, for most species, animals would be deterred from the injury zone and therefore the risk of PTS would be removed.

4.11.2.36 The magnitude is therefore considered to be **negligible** (for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal).

4.11.2.37 For harbour porpoise the ranges of effect are large for high order clearance, and there is considered to be a residual risk of PTS to a number of individuals. Whilst it is difficult to quantify this residual risk (due to uncertainties over the predicted ranges of effect and the potential ranges over which deterrence measures are effective, alongside assessing on the MDS of high order clearance which may be refined following site-investigation surveys), it is anticipated that there would be some measurable changes at an individual level but that this would not manifest to population level effects due to the small proportion of the CIS MU potentially affected.

4.11.2.38 The magnitude is therefore conservatively (based upon the absolute maximum 907 kg UXO) considered to be **medium** for harbour porpoise.

Consideration of the potential effect of ADDs on marine mammal receptors

4.11.2.39 Given that the geographic ranges of efficacy for ADDs have the potential to exceed that required for mitigation, the potential effect of ADDs themselves should not be overlooked, and the reliance on ADDs as a primary mitigation tool should be considered carefully, and on a case by case basis. The use of some types of ADD has led to reduced detection rates of cetaceans (namely, harbour porpoise) at greater distances than are generally required to mitigate auditory injury (Thompson *et al.,* 2020; Voss *et al.,* 2023), raising questions on whether some devices currently in use (particularly those manufactured to deter seals from fish farms) may be too powerful (i.e. operating at too high a source level) as a tool for mitigation to prevent potential hearing damage from offshore construction (Elmegaard *et al.,* 2023). Recently, Elmegaard *et al.* (2023), investigated the physiological and behavioural responses of harbour porpoise to a commercial ADD in Danish waters. Six harbour porpoise were tagged with suction-cup-attached DTAGs (sound and movement recording tags), recording sound, 3D-movement, and GPS (n = 3) or electrocardiogram (n = 2) and were then exposed to ADDs for 15 minutes. All animals reacted by displaying a mixture of acoustic startle responses, swimming away responses, altered echolocation behaviour, and by demonstrating unusual tachycardia (increased heart rate) while diving. The results however showed that of the six harbour porpoise, five were shown to return to feeding within 16 to 42 minutes after exposure to the ADD (the tag fell off the sixth harbour porpoise, shortly after exposure). The study placed importance on the large distances at which harbour porpoise reacted to the ADDs; harbour porpoise reacted to ADDs more than 7 km from the ADD, which is consistent with identified 7.5 to 12 km ranges posited by other similar studies (Brandt *et al.,* 2013; Dähne *et al.,* 2013). Therefore, the study highlighted that whilst deterrence devices need to be effective to avoid auditory injury from construction activities, the risk and effect caused by the deterrence should not exceed the risk and effect of the activity the animals are deterred from. A such, the sound level of an ADD and time of operational activation must be considered to strike an appropriate balance between successfully deterring individuals from an injury zone and avoiding large-scale, unnecessary habitat exclusion (Elmegaard *et al.,* 2023).

4.11.2.40 There is also some evidence that suggests ADDs themselves have the capacity to cause hearing damage (Hiley *et al.,* 2021). For instance, modelling of devices at aquaculture sites indicated that (assuming continuous 24-hour operation) there is the potential for TTS, and PTS (at much smaller ranges than TTS), to be induced in harbour porpoise (and other cetacean and seal species). Similarly, Todd *et al.* (2021) found that TTS could occur in VHF cetaceans ranges out to ranges of 4 to 31 km (Todd *et al.*, 2021). However, Boisseau *et al.* (2021) found no prediction of auditory injury to LF cetaceans from ADDs. However, the overarching conclusion from peer-reviewed literature and industry reporting has been that whilst ADDs have the potential to induce auditory injury in marine mammals, this is predominantly through the continuous activation of devices over long periods of time, rather than as a result of instantaneous auditory injury. Auditory injury in marine mammals as a result of ADD activation may therefore be avoided by the judicious and proportionate use of ADDs (Boisseau *et al.*, 2021, Schaffeld *et al.*, 2019, Thompson *et al.*, 2020).

4.11.2.41 Elmegaard *et al.* (2023) highlighted that if harbour porpoise consistently swim away from an ADD at a received level of more than 100 dB re 1 µPa (SPL_{rms}), the sound level of an ADD could be reduced by 26 dB from (e.g.) 190 to 164 dB re 1 µPa (SPL_{rms}) and still deter animals out to a 1 km radius from the sound source. Furthermore, the study pointed out that the number of animals affected behaviourally and physiologically by the ADD would on average be reduced to < 5% compared to a sound level of 190 dB re 1 µPa (SPL_{rms}).

4.11.2.42 The evidence shows the need for proportionate and judiciary application of ADDs, and the significance of using only the minimum level of sound required the deter animals from the ZoI, over the smallest possible amount of time. As such the application of ADDs as a mitigation measure will be discussed and agreed with consultees post-submission, once more information on the size and type of UXOs are known (CoT64) (**Table 4.12**).

Behavioural displacement (Temporary threshold shift (TTS) as a proxy)

4.11.2.43 A second threshold assessed was the onset of TTS where the resulting effect would be a potential temporary loss in hearing. This is assumed that whilst similar ecological functions would be inhibited in the short term due to TTS, these are reversible on recovery of the animal's hearing and therefore not considered likely to lead to any long-term effects on the individual. However, the onset of TTS also corresponds to a moving away or 'fleeing response' as this is the threshold at which animals experience disturbance and are likely to move away from the ensonified area. This, the onset of TTS also reflects the threshold at which strong disturbance could occur (it represents the boundary between the most severe disturbance levels and the start of physical auditory impacts on animals).

4.11.2.44 As previously described in **paragraph 4.11.2.22**, the sound is unlikely to be impulsive in character once it has propagated more than a few kilometres (detailed discussion in paragraphs 1.4.6.12 to 1.4.6.15 of Volume 1, Annex 5.2: Underwater sound technical report of the ES). This is particularly important when interpreting results for TTS thresholds at ranges of up to ~35 km as these are likely to be substantially lower than predicted.

4.11.2.45 As before, the assessment of TTS considered low order and low yield UXO clearance activities (**Table 4.26**), donor charges for high order UXO disposal **Table** 4.27) and high order explosions (**Table 4.28**). The largest ranges sing SPL_{pk} were predicted for 907 kg UXO (absolute maximum) with potential strong disturbance (TTS)/moving away response over a distance of up to 28.32 km for harbour porpoise (**Table 4.28**). The greatest predicted range for the SEL_{cum} metric was 34.37 km (minke whale) and the greatest predicted range for the SPL_{pk} metric was 28.32 km (harbour porpoise) (**Table 4.28**). Predicted ranges using SPLpk were smaller for all other species.

Table 4.26: Potential TTS ranges for low order and low yield UXO clearance activities

Charge size	TTS range (m)				
	Threshold	VHF	HF	LF	PCW
0.08 kg low-order donor charge	SPL_{pk}	1,265	73	224	247
	SEL_{cum}	1,500	23	655	124
0.5 kg clearing shot	SPL_{pk}	2,325	134	411	455
	SEL_{cum}	2,435	56	1,585	301
2 x 0.75 kg low-yield charge	SPL_{pk}	3,350	194	593	660
	SEL_{cum}	3,120	95	2,665	504
4 x 0.75 kg low-yield charge	SPL_{pk}	4,220	244	750	830
	SEL_{cum}	3,600	131	3,670	695

Table 4.27: Potential TTS ranges for donor charges used in high order UXO clearance activities

Charge size	TTS range (m)				
	Threshold	VHF	HF	LF	PCW
1.2 kg	SPL_{pk}	3,110	180	551	610
	SEL_{cum}	2,975	85	2,400	454
3.5 kg	SPL_{pk}	4,445	257	790	875
	SEL_{cum}	3,715	141	3,940	745

Table 4.28: Potential TTS ranges for high order UXO clearance activities

Charge size	TTS range (m)				
	Threshold	VHF	HF	LF	PCW
25 kg UXO – high order explosion	SPL_{pk}	8,555	494	1,515	1,680
	SEL_{cum}	5,290	343	9,325	1,760
130 kg UXO – high order explosion	SPL_{pk}	14,825	855	2,625	2,905
	SEL_{cum}	6,830	680	17,755	3,360
907 kg UXO – high order explosion	SPL_{pk}	28,320	1,635	5,015	5,550
	SEL_{cum}	8,925	1,380	34,365	6,470

4.11.2.46 The number of animals that would potentially experience TTS due to low order and low yield UXO clearance activities is presented in **Table 4.29**, donor charges for high order UXO disposal in **Table 4.30** and high order explosions in **Table 4.31**.

4.11.2.47 As seen for PTS the highest number of animals affected, based on high order detonation of a 907 kg UXO (absolute maximum), was found for harbour porpoise where up to 572 animals could experience TTS within the 28.32 km range equating to 0.915% of the MU population (based on SPL_{pk}). Based on

SEL_{cum} the number of grey seal within a predicted ~6.4 km TTS range was estimated as 15 animals (0.11% of the GSRP, or 0.024% of the OSPAR Region III reference population). For minke whale up to 79 animals may occur within the 34.37 km TTS range (0.392% of the MU population, based on the SEL_{cum} metric). For all other species the number of animals predicted to be disturbed was very small with less than one animal within the predicted effect zones.

4.11.2.48 Behavioural effects are reversible and therefore animals are anticipated to fully recover following cessation of the activity. It is, however, recognised that where embedded mitigation is applied to reduce the risk of PTS, deterrence measures (i.e. ADD and soft start charges (CoT64) (**Table 4.12**)) by their nature would contribute to, rather than reduce, the moving away response.

Table 4.29: Number of animals with the potential to experience TTS due to low order UXO clearance activities

Threshold	Estimated number of animals						
	Harbour Porpoise	Bottlenose Dolphin	Short-beaked common dolphin	Risso's dolphin	Minke whale	Grey seal	Harbour seal
0.08 kg low-order donor charge							
SPL_{pk}	2	<1	<1	<1	<1	<1	<1
SEL	2	<1	<1	<1	<1	<1	<1
0.5 kg clearing shot							
SPL_{pk}	4	<1	<1	<1	<1	<1	<1
SEL	5	<1	<1	<1	<1	<1	<1
2 x 0.75 kg low-yield charge							
SPL_{pk}	8	<1	<1	<1	<1	1	<1
SEL	7	<1	<1	<1	<1	<1	<1
4 x 0.75 kg low-yield charge							
SPL_{pk}	13	<1	<1	<1	<1	<1	<1
SEL	10	<1	<1	<1	<1	<1	<1

Table 4.30: Number of animals with the potential to experience TTS due to donor charges high order UXO

Threshold	Estimated number of animals						
	Harbour Porpoise	Bottlenose Dolphin	Short-beaked common dolphin	Risso's dolphin	Minke whale	Grey seal	Harbour seal
1.2 kg donor charge							
SPL_{pk}	7	<1	<1	<1	<1	<1	<1
SEL	7	<1	<1	<1	2	<1	<1

Threshold	Estimated number of animals						
	Harbour Porpoise	Bottlenose Dolphin	Short-beaked common dolphin	Risso's dolphin	Minke whale	Grey seal	Harbour seal
3.5 kg donor blast-fragmentation charge							
SPL_{pk}	15	<1	<1	<1	<1	1	<1
SEL	10	<1	<1	<1	2	1	<1

Table 4.31: Number of animals with the potential to experience TTS due to high order clearance of UXO

Threshold	Estimated number of animals						
	Harbour Porpoise	Bottlenose Dolphin	Short - beaked common dolphin	Risso's dolphin	Minke whale	Grey seal	Harbour seal
25 kg UXO – high order explosion							
SPL_{pk}	53	<1	<1	<1	<1	1	<1
SEL	20	<1	<1	<1	6	2	<1
130 kg UXO – high order explosion							
SPL_{pk}	157	<1	<1	<1	<1	3	<1
SEL	34	<1	<1	<1	21	4	<1
907 kg UXO – high order explosion							
SPL_{pk}	572	<1	<1	<1	2	11	<1
SEL	57	<1	<1	<1	79	15	<1

4.11.2.49 Adopting a precautionary approach, and with embedded mitigation (CoT64) (**Table 4.12**) adopted, the assessment considered the magnitude for a high order detonation. The magnitude of TTS resulting from a high order detonation is predicted to be of regional spatial extent, short-term duration, intermittent and both the impact itself (i.e. the elevation in underwater sound only occurs during detonation event) and effect of TTS are reversible. It is predicted that the impact will affect the receptor directly.

4.11.2.50 The magnitude is therefore considered to be **low** for all species.

Significance of effect

4.11.2.51 In the case that a low order technique is not possible, or results in a high order detonation (as per **paragraph 4.11.2.23**,) conclusions presented in **paragraph 4.11.2.52** onwards are based on the assessment for high order clearance.

Auditory injury

4.11.2.52 Overall, with embedded mitigation applied (CoT64) (**Table 4.12**), for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal, the magnitude of the impact is deemed to be **negligible** and the sensitivity of the receptors is considered to be **high**. There is not anticipated to be any effect on the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

4.11.2.53 Overall, with embedded mitigation applied (CoT64) (**Table 4.12**), for harbour porpoise, the magnitude of the impact is deemed to be **medium**, and the sensitivity of the receptor is considered to be **high**. The effect could be concluded to be of either minor adverse or moderate adverse significance, in line with the matrix approach set out in **Table 4.16**. Whilst there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS, based on expert judgement it is considered that this would not manifest to population level effects, and is unlikely to affect the international value of the species. The effect will, therefore, be of **moderate adverse** significance, which is significant in EIA terms This conclusion is based on the assumption that embedded mitigation measures (CoT64) (**Table 4.12**) may not be sufficient to reduce the risk of injury. The Transmission Assets will, where practically possible and safe to do so, use alternative clearance methods, such as low order techniques (discussed below). Where alternative clearance methods can be employed, it is considered that there would be no significant effect on any marine mammal species.

4.11.2.54 Mitigation measures via the detailed MMMPs (secured as a requirement within the draft DCO), will be developed in accordance with the Outline MMMP (CoT64) (**Table 4.12**) (document reference: J18) included as part of the application) to reduce the residual risk of injury to harbour porpoise. The details of which will be agreed post-consent when further information is available regarding the type/size of UXO to be cleared. There is a general hierarchy of preferred mitigation with regard to UXO (as detailed in **Table 4.12**), with a preference to avoid UXO, and then clear with low order techniques if possible. Where detonation of UXO using low order techniques occurs this, is considered to be embedded mitigation (noting, however, that it is not possible to fully commit to this measure at this stage due to the unknown nature of UXO that is present) and would reduce the risk to negligible, therefore not significant. However, if low order/low yield clearance is not possible, and measures adopted as part of the Transmission Assets do not fully mitigate the impact, further measures are considered in the detailed MMMPs, which will be developed in accordance with the Outline MMMP(CoT64) (**Table 4.12**) (document reference: J18), discussed below. A more detailed assessment of mitigation will be undertaken post-consent as further information on the number, condition, and type of UXOs becomes available to inform the detailed MMMPs and will be developed in consultation with the licensing authority and SNCBs.

Behavioural disturbance (TTS used as proxy)

4.11.2.55 Overall, with embedded mitigation applied (CoT64) (**Table 4.12**), the magnitude of the impact for all species is deemed to be low and the sensitivity of the receptor is considered to be low. There is not anticipated to be any effect on the international value of any marine mammal species. The effect could be concluded to be of either negligible or minor adverse significance. The effect is concluded to be of minor adverse significance rather than negligible, as there is evidence of an effect. This is not significant in EIA terms.

Further mitigation measures

4.11.2.56 The Transmission Assets alone assessment of injury from elevated underwater sound during UXO clearance concludes a significant effect in EIA terms, for harbour porpoise only. The Transmission Assets alone assessment of disturbance from elevated underwater sound during UXO clearance concludes no significant effect in EIA terms, for all marine mammal receptors. The Applicants have committed to the development of detailed MMMPs (which will be developed and implemented in accordance with the Outline MMMP (document reference: J18) (CoT64) (**Table 4.12**) to manage underwater sound levels associated with significant impacts from the Transmission Assets alone, to reduce the magnitude of impacts such that there will be no residual significant effect.

4.11.2.57 The detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) will present relevant further mitigation options (such as noise abatement systems, temporal and spatial restrictions, low order clearance methods, soft start) in order to manage underwater sound levels so as to reduce the magnitude of underwater sound levels associated with residual significant impacts from the Transmission Assets alone. The Applicants have prepared an Outline MMMP (document reference: J18) which is secured as a requirement within the draft DCO, which establishes a process of investigating options to manage underwater sound levels, in consultation with the licensing authority and SNCBs and agreeing prior to construction, mitigation measures that will be implemented to reduce the magnitude of impacts such that there will be no residual significant effect from the Transmission Assets (in this case, on harbour porpoise). These further measures would also reduce impacts associated with underwater sound for other marine mammal receptors.

4.11.3 Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities

4.11.3.1 Increased vessel movements during the construction, operation and maintenance, and decommissioning phases, and offshore export cable burial activities during the construction phase, have the potential to result in a range of effects in marine mammals such as avoidance behaviour or displacement and masking of vocalisations or changes in vocalisation rate.

4.11.3.2 The assessment of injury and disturbance from elevated underwater sound due to vessel use and other sound producing activities is based on a vessel and/or offshore export cable burial basis and considers the maximum injury/disturbance range as assessed in Volume 1, Annex 5.2: Underwater sound technical report of the ES. However, several activities could be potentially occurring at the same time and therefore ranges of effect may extend from several vessels/locations where the activity is carried out therefore have the potential to overlap.

Construction Phase

Sensitivity of the receptor

4.11.3.3 Increased vessel movements during all phases of the Transmission Assets have the potential to result in a range of effects on marine mammals including injury as a result of elevated underwater sound; avoidance behaviour or displacement; and masking of vocalisations or changes in vocalisation rate.

Auditory injury

4.11.3.4 All marine mammals are deemed to have limited resilience to auditory injury (i.e. are highly susceptible to auditory injury) exhibit low recoverability and are considered of international value. The sensitivity of the receptor is therefore, considered to be **high**.

Behavioural disturbance

4.11.3.5 Disturbance levels for marine mammal receptors will be dependent on individual hearing ranges and background sound levels within the vicinity. Sensitivity to vessel sound is most likely related to the marine mammal activity at the time of disturbance (IWC, 2006; Senior *et al.*, 2008), and the level of response dependent upon vessel type and behaviour (e.g., heading, speed) (Oakley *et al.*, 2017; Hermannsen *et al.*, 2019).

4.11.3.6 Cetaceans can both be attracted to and disturbed by vessels. For example, resting dolphins are likely to avoid vessels, foraging dolphins will ignore them, and socialising dolphins may approach vessels (Richardson *et al.*, 1995). Anderwald *et al.* (2013) showed within their study that bottlenose dolphin were positively correlated with total number of boats and number of utility vessels, but minke whale and grey seal were displaced by high levels of vessel traffic.

4.11.3.7 Harbour porpoise are particularly sensitive to high frequency sound and likely to avoid vessels. Wisniewska *et al.* (2018) studied the change in foraging rates of harbour porpoise in response to vessel sound in coastal waters with high traffic rates. The results show that occasional high-sound 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). Heinänen and Skov (2015) found that the occurrence of harbour porpoise declines significantly when the number of vessels in a 5 km^2 area exceeds

20,000 ships per year (approximately 80 ships per day or 18 ships per km^2). A recent study by Benhemma-Le Gall *et al.* (2021) suggested increased vessel activity (and other construction activities) led to a decrease in porpoise acoustic detections and activity at distances of up to 4 km, when comparing occurrence and foraging activity between two offshore windfarms in the Moray Firth.

4.11.3.8 Other species of dolphin (e.g. short-beaked common dolphin) are regularly sighted near vessels and may also approach vessels (e.g. bow-riding). However, dolphins are also known to show aversive behaviours to vessel presence, including increased swimming speed, greater time travelling, less time resting or socialising, avoidance, increased group cohesion and longer dive duration (Toro *et al.*, 2020; Marley *et al.*, 2017; Miller *et al.*, 2008). Meza *et al.* (2020) found increased foraging in bottlenose and short-beaked common dolphin behavioural budgets, but a decrease in time spent foraging by harbour porpoise when exposed to purse seine vessels in the Istanbul Strait, which has high levels of human pressure with many vessels in a narrow space.

4.11.3.9 A study on concurrent ambient sound levels on social whistle calls produced by bottlenose dolphins in the west North Atlantic (Fouda *et al.,* 2018), demonstrated increases in ship sounds (both within and below the dolphins' call bandwidth) resulted in simplified vocal calls, with higher dolphin whistle frequencies and a reduction in whistle contour complexity. This sound-induced simplification of whistles may reduce the information content in these acoustic signals and decrease effective communication, parent–offspring proximity or group cohesion. This upward shift in whistle frequency has also been observed in bottlenose dolphin related to vessel presence in Walvis Bay, Namibia (Heiler, 2016).

4.11.3.10 Reactions of marine mammals to vessel sound are often linked to changes in the engine and propeller speed (Richardson *et al.*, 1995). Watkins (1986) reported avoidance behaviour in baleen whales from loud or rapidly changing sound sources, particularly where a boat approached an animal. Disturbance in dolphins and porpoises is likely to be associated with the presence of small, fast-moving vessels as they are more sensitive to high frequency sound, whilst baleen whales, such as minke whale, are likely to be more sensitive to slower moving vessels emitting lower frequency sound. Pirotta *et al.* (2015) found that transit of vessels (moving motorised boats) in the Moray Firth resulted in a reduction (by almost half) of the likelihood of recording bottlenose dolphin prey capture buzzes. They also suggest that vessel presence, not just vessel sound, resulted in disturbance.

4.11.3.11 Anderwald *et al.* (2013) suggested that in the study of displacement responses to construction-related vessel traffic, minke whale and grey seal were avoiding the area due to sound rather than vessel presence. In the same study, the presence of bottlenose dolphin was positively correlated with overall vessel numbers, as well as the number of construction vessels. It was, however, unclear whether dolphins were attracted to the vessels themselves or to particularly high prey concentrations within the study area at the time. Richardson (2012) investigated the effect of disturbance on bottlenose dolphin community structure in Cardigan Bay and found that group size was significantly smaller in areas of high vessel traffic.

4.11.3.12 Common reactions of pinnipeds to approaching vessels includes increased alertness (Henry and Hammill, 2001), head raising (Niemi, *et al.*, 2013) and flushing off haul-out sited into the sea (Jansen *et al.*, 2010; Anderson *et al.*, 2012; Blundell and Pendleton, 2015; Johnson and Acevedo-Gutiérrez, 2007), but studies focused on presence of vessel rather than vessel sound. In a recent study, monitoring of responses of grey and harbour seal to ship sound showed that a tagged grey seal changed its diving behaviour, switching rapidly from a dive ascent to descent (Mikkelsen *et al.*, 2019). Pérez Tadeo *et al.* (2021) assessed the responses of grey seal to ecotourism during breeding and pupping seasons at White Strand Beach in south west Ireland and found vessels approaching within 500 m of the beach showed strong influence on the proportion of grey seals entering the water and increase in vigilance and decrease in resting behaviour. This is similar to a previous study on harbour seal which showed avoidance behaviour or alert reactions in harbour seal when vessels approach within 100 m of a haul-out (Richardson *et al.*, 2005). This disturbance to seal haul-outs could have negative consequences in pupping season, due to trade-offs between feeding and nursing (see **paragraph 4.11.3.12**). Harbour seal have been shown to move away from approaching boats (Anderson *et al.*, 2012; Blundell and Pendleton, 2015), but this response varies by season. For example, harbour seal exhibit shorter responses during the breeding season, appearing more reluctant to move away and return to haul-out site after being disturbed (Andersen *et al.*, 2012). This is presumed to be attributed to a trade-off between moving away and nursing, rather than habituation. In a study of harbour seal in Alaska, haul-out probability was negatively affected by vessels, with cruise ships having the strongest effect (Blundell and Pendleton, 2015).

4.11.3.13 The presence of vessels in foraging grounds could also result in reduced foraging success. Christiansen *et al.* (2013b) found that the presence of whale-watching boats within an important feeding ground for minke whale led to a reduction in foraging activity. As a capital breeder such a reduction could lead to reduced reproductive success, given that female body condition is known to affect foetal growth (Christiansen *et al.*, 2014). However, it is worth noting that the study was conducted in Faxafloi Bay in Iceland where baseline sound levels (compared to the Irish Sea) are very low (McGarry *et al.*, 2017). In addition, a subsequent study conducted by Christiansen and Lusseau (2015) in the same study area found no significant long-term effects of disturbance from whale watching on vital rates since whales moved into disturbed areas when sandeel numbers were lower across their wider foraging area. However, a study on grey seals by Hastie *et al.* (2021) demonstrated how foraging context is important when interpreting avoidance behaviour and should be considered when predicting the effects of anthropogenic activities; avoidance rates depend on both the perceived risk (e.g. silence, pile driving sound, operational sound from tidal turbines) and the quality of the prey patch. It highlights that sound exposure in different prey patch qualities may result in markedly different avoidance behaviour and should be considered when predicting impacts in EIAs. Given the existing levels of vessel activity in the shipping and navigation study area it is expected that marine mammals could tolerate the effects of disturbance without any impact on reproduction and survival rates and would return to previous activities once the impact had ceased (Figure 4.2 – Figure 4.4, Volume 2, Figures).

4.11.3.14 Whilst, there is some evidence of tolerance to boat traffic (Antichi *et al.,* 2022), and anthropogenic sounds and activities in general (Vella *et al.,* 2002), and therefore a slight increase from the existing levels of traffic in the vicinity of the Transmission Assets may not result in high levels of disturbance, there is also evidence to suggest that reactions to boat noise occur, with no evidence of habituation. Dyndo *et al.* (2015) for example, via an exposure study, observed strong, stereotyped behavioural responses in harbour porpoise to low levels of high frequency components, found in vessel noise. In line with Dyndo *et al.* (2015) Wisniewska *et al.* (2018) suggested that continued strong responses to high-level vessel noise (greater than 90 dB re 1 µPa SPL_{rms}) indicate that harbour porpoise did not habituate to the noise. However, the Liverpool Bay area already has a high level of anthropogenic activity as a baseline. Seal bulls have been known to approach fishing vessels in Liverpool Bay (Dobson, 2002, pers. comm.). In a national scale assessment of seals and shipping in the UK, high co-occurrence of seals and shipping traffic within 50 km of the coastline near to haul-out sites was observed (Jones *et al*, 2017).

4.11.3.15 Regarding cetaceans, Thompson *et al.* (2011) (Scottish Natural Heritage commissioned report) undertook a modelling study which predicted that increased vessel movements associated with offshore wind development in the Moray Firth did not have a negative effect on the local population of bottlenose dolphin, although it did note that foraging may be disrupted by disturbance from vessels, which was also suggested by Benhemma-Le Gall *et al.* (2021) (see **paragraph 4.11.3.7**). Potlock *et al.* (2023) used C-POD detections of sonar activity as a proxy for vessel disturbance during construction of wind turbines foundations off Blyth, Northumberland. The vessel sonar variable was significant in both the dolphin (potentially bottlenose dolphin and/or white-beaked dolphin) and harbour porpoise models. The effect size was substantial in both species, with around eight minutes of sonar occurrence per hour leading to a 50% decline in harbour porpoise occurrence and around 13 minutes of sonar occurrence per hour leading to a 50% decline in dolphin occurrence. Despite this, dolphin occurrence during and after construction were not significantly different to the occurrence before the construction phase. Similarly, the increase in harbour porpoise occurrence across this study suggests that construction and post-construction vessel activity did not result in any overall decline in area usage (Potlock *et al.,* 2023).

4.11.3.16 Bottlenose dolphin have been found to both increase and decrease whistle frequencies in noisy environments, avoiding acoustic masking and improving signal transmission (Heiler *et al.,* 2016; May-Collado and Wartzok, 2008; La Manna *et al.,* 2013; Rako Gospić and Picciulin, 2016; Peters, 2018). These findings suggest that if marine mammals depend on specific areas to maintain their activities and the benefits exceed the cost of disturbance, animals show tolerance instead of site avoidance (Antichi *et al.,* 2022). As such, marine mammals could continue to regularly visit the areas where they may be affected by the vessel presence (Rako Gospić and Picciulin, 2016; Antichi *et al.,* 2022). For example, Wisniewska *et al.* (2018) found tagged porpoises did not appear to avoid highly trafficked areas (where large ship traffic concentrates in deeper channels that allow access to ports or open water) perhaps because these overlapped with important foraging habitats (deep waters which may aggregate important prey items).

4.11.3.17 Furthermore, Joy *et al.* (2019) conducted a voluntary commercial vessel slowdown trial through 16 nm of shipping lanes which overlapped with critical habitat of at-risk southern resident killer whales. Disturbance metrics were simplified to a "lost foraging time" measure and demonstrated (when compared to baseline sound levels in the region) the slowdown trial achieved 22% reduction in 'potential lost foraging time' for killer whales (with 40% reductions when 100% of vessels were under the 11 knot speed limit). Vessels involved in the construction phase are likely to be travelling at a speed slower than 14 knots. With the exception of CTVs, most vessels involved in the construction phase are likely to be travelling considerably slower than this (Laist, 2001), and all vessels will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from vessels (document reference: J16) (**Table 4.12**).

4.11.3.18 All marine mammals are deemed to have some resilience to disturbance, exhibit high recoverability and are considered of international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Magnitude of impact

Auditory injury

4.11.3.19 During the construction phase of the Transmission Assets, the increased levels of vessel activity, in association with construction activities, and offshore export cableburial activities, in the Offshore Order Limits, will contribute to the total underwater sound levels.

4.11.3.20 As per **section 4.9.1** the MDS for construction activities associated with site preparation and inter-array cable for Morgan Offshore Wind Project: Transmission Assets is up to a total of 19 construction vessels on site at any one time carrying out 226 trips. Two tug/anchor handlers will carry out eight return trips. Six cable lay installation and support vessels will carry out 40 return trips across the construction period. One guard vessels will carry out 18 return trips. Two survey vessels will carry out four return trips. A maximum of four seabed preparation vessels for boulder removal, grapnel, pre-sweep and levelling will carry out 16 return trips. Two CTV will carry out 120 return trips. Two cable protection installation vessels will carry out 20 return trips.

4.11.3.21 For construction activities associated with site preparation and inter-array cable for Morecambe Offshore Windfarm: Transmission Assets is up to a total of 11 construction vessels on site at any one time carrying out 60 trips. One tug/anchor handlers will carry out four return trips. Four cable lay installation and support vessels will carry out eight return trips across the construction period. One guard vessels will carry out 12 return trips. One survey vessels will carry out two return trips. A maximum of two seabed preparation vessels for boulder removal, grapnel, pre-sweep and levelling will carry out four return trips. One CTV will carry out 28 return trips. one cable protection installation vessels will carry out two return trips. Finally, burial of up to 484 km of offshore export cables will occur, via trenching, jetting, ploughing (including prelay ploughing), and mechanical cutting.

4.11.3.22 If concurrent construction at the Transmission Assets takes place, construction would occur over a maximum of 21 months, however if sequential construction at the Transmission Assets takes place, construction would occur over 30 months. The maximum vessel numbers and movements, as described in **paragraph 4.11.3.20**, would remain the same, regardless of approach to construction and therefore concurrent construction represents a scenario where vessel movements will occur over a shorter time period, but more vessels are likely to be present within the Offshore Order Limits at any one time, whereas sequential construction represents a scenario where vessel movements will occur over a greater time period, with fewer vessels likely to be present within the Offshore Order Limits at any one time.

4.11.3.23 Whilst this will lead to an uplift in vessel activity, the movements will be limited to within the Offshore Order Limits and are likely to follow existing shipping routes to/from the ports. Approximately 8,590 vessels in total pass through the Offshore Order Limits per year (Volume 2, Annex 7.1: Navigational Risk Assessment (NRA) of the ES). Vessel traffic activity shows a seasonal trend that peaks over the summer months (May to August) and decreases in the winter months (November to February) (see Figure 4.2 and Figure 4.3, Volume 2, Figures). Within the Offshore Order Limits, this is primarily due to an increase in ferry service operations and recreational activity. The NRA demonstrated that much of the shipping and navigation study area experienced over 17,596 vessel trips per year (see Figure 4.4, Volume 2, Figures). The majority of vessels crossing the shipping and navigation study area are tug and service boats for oil and gas platforms as well as passenger vessels. Density of commercial vessel traffic and recreational vessel transits remain low (Volume 2, Annex 7.1: Navigational Risk Assessment of the ES).

4.11.3.24 The main drivers influencing the magnitude of the impact are vessel type, speed and ambient sound levels (Wilson *et al.*, 2007). Baseline levels of vessel traffic in the study area are at a high level, largely due to ferry routes. For example, in 2022, commercial ferry routes based on annual data from 2022 (see Volume 2 Chapter 7: Shipping and navigation of the ES) 14.6 ferry transits occur per day through the shipping and navigation study area, with a total of 5,314 in 2022. Within Offshore Order Limits, 4,019 of these ferry transits passed through with approximately 11 per day. Four principal operators have been identified in the east Irish Sea. The Isle of Man Steam Packet Company operate between Douglas, Liverpool and Heysham. Seatruck operate between Heysham, Liverpool, Warrenpoint and Dublin. Stena operate between Liverpool, Heysham and Belfast. Finally, P&O operate between Liverpool and Dublin, however these vessels do not enter the shipping and navigation study area.

4.11.3.25 Other sound-generating activities for the Transmission Assets will include burial of up to 484 km of offshore export cables via trenching, jetting, ploughing and mechanical cutting (**Table 4.13**). See Volume 1, Annex 5.2: Underwater sound technical report of the ES for more information about SELs associated with above construction activities.

4.11.3.26 A detailed underwater sound modelling assessment has been carried out to investigate the potential for injurious and behavioural effects on marine mammals resulting from elevated underwater sound (non-impulsive sound), using the latest criteria (Volume 1, Annex 5.2: Underwater sound technical report of the ES). A conservative assumption has been made that all individual marine mammals will respond aversively to increases in vessel sound (i.e. that there is no intra or inter-specific variation or context-dependent differences). The distance over which effects may occur will, however, vary according to the species, the ambient sound levels, hearing ability, vertical space use and behavioural response differences. Underwater sound modelling was also conducted for the Morgan Offshore Wind Project: Generation Assets (Appendix B of Volume 2, Annex 4.1: Marine mammal technical report of the ES) and the Morecambe Offshore Windfarm: Generation Assets (Appendix C of Volume 2, Annex 4.1: Marine mammal technical report of the ES).

4.11.3.27 SELs were estimated for vessels based on 24 hours continuous operation, although it is important to note that it is highly unlikely that any marine mammal would stay at a stationary location or within a fixed radius of a vessel for 24 hours. Therefore, acoustic modelling has been undertaken based on an animal swimming away from the source (or the source moving away from an animal) (**Table 4.18**).

4.11.3.28 The sound modelling results indicate that the threshold for PTS was not exceeded for any species for all vessels or for all offshore export cable burial activities. Therefore, there is no risk of PTS occurring to marine mammals as a result of elevated underwater sound due to vessel use or offshore export cable burial activities. Acoustic modelling was conducted for TTS for completeness (see Volume 1, Annex 5.2: Underwater sound technical report of the ES); however, ranges indicated are likely to be overestimates given that, for continuous sources such as vessel sound, thresholds do not take into account any ambient sound levels in the region (which already has high levels of shipping activity, see **paragraph 4.11.3.23**).

4.11.3.29 Ranges for TTS (SEL_{cum} weighted) were only exceeded for VHF cetaceans (harbour porpoise) for the three tug/anchor handlers, nine cable lay installation and support vessels, two guard vessel, three survey vessels, six seabed preparation vessels, three CTVs and three cable protection installation vessels with ranges predicted out to less than 60 m. Whilst the likelihood of auditory injury to animals is considered unlikely, the maximum duration of the construction phase is up to four years (48 months).

4.11.3.30 The impact is predicted to be of limited spatial extent, medium term duration, intermittent and, although the impact itself is reversible (i.e. the elevation in underwater sound only occurs during the activities), the effect of PTS is permanent. It is predicted that the impact will affect the receptor directly.

Since the PTS threshold was not predicted to be exceeded for any activities or species, the magnitude is considered to be **negligible**.

Behavioural disturbance

4.11.3.31 Disturbance from vessel sound is likely to occur only where vessel sound associated with the construction of the Transmission Assets exceeds the background ambient sound level. As discussed in **paragraph 4.11.3.20** to **4.11.3.24**, the Transmission Assets is located in a relatively busy shipping area and therefore background sound levels are likely to be relatively high. For impulsive sound sources there is an understanding of the difference between strong and mild disturbance, whereas for non-impulsive (continuous) sound sources such as from vessels, there is only a single available threshold (see **paragraph 4.11.3.35**) , which is proposed as the basis for the onset of a strong behavioural reaction. JNCC *et al.* (2010) state that 'it is most unlikely that a passing vessel would cause more than trivial disturbance. It is the repeated or chronic exposure to vessel noise that could cause disturbance'. Therefore, it is important to consider when viewing these potential disturbance radii that the 120 dB re 1 µPa SPL_{rms}) criterion is highly precautionary, does not consider background sound levels, and that ambient sound levels in the area could well exceed this value (Xodus, 2014). As such, an understanding of background underwater sound level is valuable when assessing potential effects from elevated underwater sound due to vessel use.

4.11.3.32 Furthermore, NMFS (2005) highlights that it is possible that sound pressure levels in the local environment will already be as high as the continuous behavioural disturbance threshold of 120 dB re 1 µPa SPL_{rms} for marine mammals much of the time, and therefore represents an over-precautionary assessment and therefore may not necessarily result in strong displacement of animals. In their maps of shipping sound of the north east Atlantic, Farcas *et al.* (2020) showed areas of high shipping densities often exceeded 120 dB re 1 µPa (SPL_{rms}), with total underwater sound exceeding 121 dB re 1 µPa (SPL_{rms}) in areas of the east Irish Sea and annual median ship sound surpassing 20 dB excess (sound above modelled natural background sound) in the Irish Sea. This combined with worst case assumptions made in the modelling can mean ranges are highly over-precautionary.

4.11.3.33 A detailed underwater sound modelling assessment has been carried out to investigate the potential for behavioural effects on marine mammals resulting from increased vessel sound and other activities (Volume 1, Annex 5.2: Underwater sound technical report of the ES). The estimated ranges within which there is a potential for disturbance to marine mammals are presented in **Table 4.32**.

4.11.3.34 The greatest modelled disturbance range (as presented in Volume 1, Annex 5.2: Underwater sound technical report of the ES) was for survey and support vessels, crew transfer vessels, cable protection and seabed preparation, at 4.02 km, for all marine mammal species. Sandwave clearance, rock placement and cable installation vessels, had disturbance ranges out to 2.34 km. Cable laying also had disturbance ranges of 2.34 km, and tug/anchor handlers had a disturbance range of 1.44 km (**Table 4.32**). In comparison, boulder clearance has the potential to result in a disturbance range of 0.37 km; jack-up rigs had a disturbance range of less than 10 m (**Table 4.32**).

Table 4.32: Estimated disturbance ranges for marine mammals as a result of vessels and other activities based on the NMFS sound threshold value for continuous sound (120 dB re 1 µPa SPL_{rms})

Threshold	Disturbance Range (km)
Sandwave clearance, rock placement vessel and cable installation vessels	2.34
Boulder clearance	0.37
Tug/anchor handlers, guard vessels	1.44
Survey vessel and support vessels, Crew Transfer Vessel (CTV), cable protection/seabed preparation	4.02
Jack-up rig	<0.01

4.11.3.35 As per **paragraph 4.11.3.31** for non-impulsive (continuous) sound sources, there is only a single available threshold (120 dB re 1 µPa (rms)), which is classed as the distance beyond which no animals would be disturbed (the Level B harassment threshold[4]) (NMFS, 2005). Given that ranges for disturbance for vessels are presented up to the 120 dB re 1 µPa (rms) threshold, and there is no distinction between mild and strong disturbance, it can be assumed that not all animals found within those ranges (**Table 4.32**) would be disturbed. Moreover, for those animals disturbed, there is likely to be a proportional response (i.e. not all animals will be disturbed to the same extent), although there is no dose-response curve available to apply in the context of non-impulsive sound sources for key species in the Irish Sea. Dose-response curves for vessels have been created for killer whales (Joy *et al*., 2019), thus indicating there is evidence of proportional response to vessel sound.

4.11.3.36 It must be noted that thresholds that relate to single exposure parameters (e.g. received sound level) for behavioural responses across species and sound types may lead to over-simplification in prediction effects. Ideally differences between species, situational context, spatial scales and interacting effects of multiple stressors would be quantified to predict effects, but Southall *et al.* (2021) highlights few studies report this critical data in a systematic structured way. Tyrack and Thomas (2019) demonstrated using the RLp50 step function can lead to underestimates of animals impacted (e.g. number affected was underestimated by a factor of 280), but highlighted their approach was far more complex to apply than the single threshold approach preferred by regulators (it requires combining dose response

[4] Level B harassment is defined as “any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioural patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioural patterns are abandoned or significantly altered” NMFS (2005).

function with animal and stressor distribution). Furthermore, the dose-response function used was derived from experiments performed on free-swimming killer whales exposed to a steadily increasing level of sonar sounds (Miller *et al*., 2014) and therefore a dose-response specifically for continuous sound (such as those in Joy *et al.* 2019) would be more appropriate.

4.11.3.37 Furthermore, animals in areas of high shipping are frequently exposed to vessel sound, and it has been suggested vessel type and speed rather than presence are relevant factors (e.g. 75% of all negative reactions of harbour porpoise in south west Wales were in response to high-speed planing-hulled vessels, with the remainder being neutral responses (Oakley *et al.*, 2017)) and reactions are different dependent on vessel type, distance and speed (Wisniewska *et al.,* 2018) (see **paragraph 4.11.3.7** for further discussion). It is important to note that the life history of an individual and the context will also influence the likelihood of an individual to exhibit an aversive response to sound, and it must be highlighted that these impacts will not be continuous over the four-year construction programme. Therefore, given the limited quantitative information available, as described above, any simplified calculation would likely lead to an unrealistic overestimation of the number of animals likely to be disturbed. As such, this value has not been quantified.

4.11.3.38 Whilst it is difficult to quantify the response ranges based on a simple threshold approach (e.g. because it does not take into account context), empirical evidence suggests that for similar areas with existing vessel traffic, acoustic activity (and therefore presence of some marine species) may be reduced. Benhemma-Le Gall *et al.* (2021) suggested increased vessel activity (and other construction activities) led to a decrease in porpoise acoustic detections and activity at distances of up to 4 km. Porpoise responses decreased as the mean vessel distance increased (−24% at 3 km) until no apparent response was observed at 4 km. Similarly, McQueen *et al.* (2023) used a distance threshold of 5 km as a point of comparison for screening potential marine mammal habitat displacement (behavioural avoidance), based upon the relative size of the dredging area and habitat range of receptors. Verboom *et al.* (2014) also suggested a porpoise never approaches the study dredging ship in full operation at less than 5 km. Wisniewska *et al.* (2018) used sound and movement recording tags to detect fine-scale responses in harbour porpoise to sound from vessels, and determined that foraging may be temporarily disrupted up to 7 km. Graham *et al.* (2019) indicated higher vessel activity within 1 km was significantly associated with an increased probability of response in harbour porpoise.

4.11.3.39 Therefore, to give a quantitative indication of impact, a range of distances from empirical studies (1 km to 7 km) have been used as an effective impact range and the numbers of animals predicted to be disturbed is presented in **Table 4.33** (noting this distance is based upon VHF species and does not account for different hearing groups, and is likely to be precautionary). The numbers disturbed presented are more likely to represent fast moving vessels such as a CTV (of which there are a maximum of three on site at one time) as opposed to slow-moving vessels such as boulder clearance or jack-up rigs that show much smaller modelled disturbance ranges (**Table 4.32**).

Table 4.33: Potential number of animals predicted to be disturbed per vessel for a range between 1 km (minimum) and 7 km (maximum)

Species	MU	Number of animals disturbed (1 km)	% MU	Number of animals disturbed (7 km)	% MU
Harbour porpoise	CIS MU	<1	0.0011%	35	0.0559%
Bottlenose dolphin	IS MU	<1	0.0013%	<1	0.063%
Short-beaked common dolphin	CGNS MU	<1	0.000001%	<1	0.00004%
Risso's dolphin	CGNS MU	<1	0.0008%	5	0.0393%
Minke whale	CGNS MU	<1	0.0003%	4	0.0161%
Grey seal	GSRP OSPAR Region III reference population	<1	0.0006% 0.0011%	17	0.0274% 0.0558%
Harbour seal	HSRP	<1	0.0001%	<1	0.0005%

4.11.3.40 The impact is predicted to be of local spatial extent, medium term duration, intermittent and reversible (i.e. the elevation in underwater sound only occurs during the activities). The effect of behavioural disturbance is reversible as receptors are expected to recover within hours/days. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.

Significance of effect

Auditory injury

4.11.3.41 Overall, the magnitude of the impact is deemed to be **negligible** and the sensitivity of the receptor is considered to be **high**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Behavioural disturbance

4.11.3.42 Overall, with mitigation measures adopted (**Table 4.12**), the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Operation and maintenance

Sensitivity of the receptor

Auditory injury

4.11.3.43 The sensitivity of marine mammal receptors to auditory injury has been assessed in **paragraph 4.11.3.4** *et seq.* and is not reiterated here. All marine mammals are deemed to be of medium vulnerability, exhibit low recoverability and are considered of international value. The sensitivity of the receptor is therefore, considered to be **high**.

Behavioural disturbance

4.11.3.44 The sensitivity of the receptors during the operation and maintenance is not expected to differ from the sensitivity of the receptors during the construction phase. The sensitivity of marine mammal receptors to elevated underwater sound due to vessel use and other sound producing activities is as described previously in **paragraph 4.11.3.18** *et seq*. All marine mammals are deemed to have some resilience to behavioural disturbance, exhibit high recoverability and are considered of international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Magnitude of impact

4.11.3.45 Vessel use during the operations and maintenance phase of the Transmission Assets may lead to injury and/or disturbance to marine mammals. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, geophysical surveys and offshore export cable repair or reburial (subtidal or intertidal) (**Table 4.13**). This will involve crew transfer vessels/workboats, jack up vessels, cable repair vessels, SOVs or similar vessels, excavators/backhoe dredgers. As per **section 4.9.1** up to 52 operation and maintenance vessel movements (return trips) will be carried out each year for the Morgan Offshore Wind Project: Transmission Assets (28 movements for CTVs/workboats, two movements for jack-up vessels, two movements for cable repair vessels, 16 movements for SOVs or similar and four movements for excavators/backhoe dredgers). Up to 25 operation and maintenance vessel movements (return trips) will be carried out each year for the Morecambe Offshore Windfarm: Transmission Assets (14 movements for CTVs/workboats, one movement for jack-up vessels, two movements for cable repair vessels, four movements for SOVs or similar and four excavators/backhoe dredgers) (**Table 4.13**).

4.11.3.46 The uplift in vessel activity during the operation and maintenance is considered to be relatively small in the context of the baseline levels of vessel traffic in the study area described in **paragraph 4.11.3.24.** Presence of the operational wind farm may divert some of the shipping routes and therefore, current traffic within the Offshore Order Limits, which is not associated with Transmission Assets, is likely to be reduced. It is likely that this reduction will be ultimately counterbalanced by presence of maintenance vessels. Vessel movements will be within the Offshore Order Limits and will follow the measures to minimise disturbance to marine mammals within the Offshore EMPs (CoT65) (**Table 4.12**). Further details on measures to minimise impacts to marine mammals from vessels are set out in Measures to minimise disturbance to marine mammals and rafting birds from vessels (document reference: J16). The Offshore EMPs will be issued to all project vessel operators to minimise the potential for collision risk as described in **Table 4.12**.

4.11.3.47 The size and sound outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase and therefore will result in a similar maximum design spatial scenario (**Table 4.13**). However, the number of vessel round trips and their frequency is much lower for the operation and maintenance phase compared to the construction phase.

Auditory injury

4.11.3.48 An overview of potential impacts for auditory injury to marine mammals from elevated underwater sound due to vessel use and other sound producing activities as well as associated effects (auditory injury) are described in **paragraph 4.11.3.19** for the construction phase and have not been reiterated here for the operation and maintenance phase. The impact is predicted to be of limited spatial extent, long term duration, intermittent and although the impact itself is reversible (i.e. the elevation in underwater sound only occurs during the activities), the effect of PTS (if it were to occur) is permanent. It is predicted that the impact will affect the receptor directly. Since the PTS threshold was not predicted to be exceeded for any activities or species, the magnitude is considered to be **negligible**.

Behavioural disturbance

4.11.3.49 An overview of potential impacts for behavioural disturbance to marine mammals from elevated underwater sound due to vessel use and other sound producing activities as well as associated effects are described in **paragraph 4.11.3.31** for the construction phase with behavioural disturbance ranges presented in **Table 4.32** and have not been reiterated here for the operation and maintenance phase. The impact is predicted to be of local spatial extent, long term duration, intermittent and reversible (i.e. the elevation in underwater sound only occurs during the activities). The effect of behavioural disturbance is reversible as receptors are expected to recover within hours/days. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.

Significance of effect

Auditory injury

4.11.3.50 Overall, the magnitude of the impact is deemed to be **negligible** and the sensitivity of the receptor is considered to be **high**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Behavioural disturbance

4.11.3.51 Overall, with designed in mitigation measures (**Table 4.12**), the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Decommissioning

Sensitivity of the receptor

Auditory injury

4.11.3.52 The sensitivity of marine mammal receptors to auditory injury has been assessed in **paragraph 4.11.3.3** *et seq.* and is not reiterated here. All marine mammals are deemed to have limited resilience to auditory injury (i.e. are highly susceptible to auditory injury), low recoverability and international value. The sensitivity of the receptor is therefore, considered to be **high**.

Behavioural disturbance

4.11.3.53 The sensitivity of the receptors during the decommissioning phase is not expected to differ from the sensitivity of the receptors during the construction phase. The sensitivity of marine mammal receptors to elevated underwater sound due to vessel use and other sound producing activities is as described previously in **paragraph 4.11.3.5** *et seq.* All marine mammals, which are key receptors of international value, are deemed to have limited resilience to behavioural disturbance (i.e. are highly susceptible to behavioural disturbance), high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Magnitude of impact

4.11.3.54 Vessel use during the decommissioning phase of the Transmission Assets may lead to injury and/or disturbance to marine mammals. Vessel types which will be required during the decommissioning phase include those used during removal of offshore export cables and offshore export cable protection (**Table 4.13**).

4.11.3.55 Since the numbers and types of vessel used to remove infrastructure (and hence their size and outputs) are expected to be similar to those used for installation, therefore potential impacts from elevated underwater sound due to vessel use and other sound producing activities is expected to result in a similar maximum design spatial scenario as the construction phase due to involving similar types and numbers of vessels and equipment (see Volume 1, Chapter 3: Project description of the ES). The magnitude of the impact of the decommissioning phase for both auditory injury and disturbance as a result of elevated underwater sound due to vessel use, for all marine mammal receptors, is therefore not expected to differ or be greater than that assessed for the construction phase.

Auditory injury

4.11.3.56 An overview of potential impacts from elevated underwater sound due to vessel use and other sound producing activities as well as associated effects (auditory injury) are described in **paragraph 4.11.3.19** *et seq*. for the construction phase and has not been reiterated here for the decommissioning phase. The impact is predicted to be of local spatial extent, medium term duration, intermittent and although the impact itself is reversible (i.e. the elevation in underwater sound only occurs during the activities), the effect of PTS (if it were to occur) is permanent. It is predicted that the impact will affect the receptor directly. Since the PTS threshold was not predicted to be exceeded for any activities or species, the magnitude is considered to be **negligible**.

Behavioural disturbance

4.11.3.57 An overview of potential impacts from elevated underwater sound due to vessel use and other sound producing activities as well as associated effects (behavioural disturbance) are described in **paragraph 4.11.3.31** *et seq*. for the construction phase with behavioural disturbance ranges presented in **Table 4.32** and has not been reiterated here for the decommissioning phase. The impact is predicted to be of local spatial extent, medium term duration, intermittent and reversible (i.e. the elevation in underwater sound only occurs during the activities). The effect of behavioural disturbance is reversible as receptors are expected to recover within hours/days. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.

Significance of effect

Auditory injury

4.11.3.58 Overall, the magnitude of the impact is deemed to be **negligible** and the sensitivity of the receptor is considered to be **high**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Behavioural disturbance

4.11.3.59 Overall, with designed in mitigation measures, including the requirement for vessels to follow the Offshore EMPs (CoT65) (**Table 4.12**) the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

4.11.4 Increased likelihood of injury due to collision with vessels

4.11.4.1 The Morgan Offshore Wind Project: Generation Assets Marine Mammal chapter, (Morgan Offshore Wind Ltd., 2024) took a qualitative approach to the assessment to 'increased likelihood of injury due to collision with vessels', highlighting the requirement of vessels associated with the Project to follow Offshore EMPs (CoT65) (**Table 4.12**) which would largely remove any risk of increased collision risk. Further details on measures to minimise impacts to marine mammals from vessels are set out in Measures to minimise disturbance to marine mammals and rafting birds from vessels (document reference: J16). For the assessment of 'increased collision risk with vessels during construction' the Morecambe Offshore Windfarm: Generation Assets Marine Mammal chapter (Morecambe Offshore Windfarm Ltd., 2023) presented predicted numbers of marine mammals at risk of collision with construction vessels. These predictions were based on current UK collision rates and vessel presence. The magnitude of impact for each species was concluded based on the percentage of the reference population at risk. The maximum percentage presented was 15.5% for the harbour seal SMU. However, assessments were based on the number of vessels associated with the construction of the Morecambe Offshore Windfarm: Generation Assets (2,583 annual vessel transits). This number is significantly higher than that associated with the Transmission Assets (286 maximum vessel transits within Offshore Order Limits over the 30-month construction phase (noting that there is potential for a gap between the construction periods for Morgan and Morecambe)) (**paragraph 4.11.4.13**) and therefore any quantitative assessment for the Transmission Assets would present negligible results, and would not represent a proportionate approach. As such, a qualitative approach has been applied to this assessment for the Transmission Assets.

Construction Phase

Sensitivity of the receptor

4.11.4.2 Marine mammals are able to detect and avoid vessels in advance, particularly when conducting activities such as seismic surveys (Koski *et al.,* 2009). However, it is unclear why some individuals do not always move out of the path of an approaching vessel (Schoeman *et al.*, 2020) with analysis of data showing various interacting factors (e.g. ambient underwater sound, can affect the ability of marine mammals to detect approaching ships (Gerstein *et al.* 2005). 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; Gerstein *et al.* 2005). There can be consequences to a lack of response to disturbance for all marine mammals; behavioural habituation can result in decreased wariness of vessel traffic, which has the potential to result in an increased collision risk (Cates *et al.*, 2017). Vessel strikes are known to be a cause of mortality in marine mammals (Carrillo and Ritter, 2010), and it is possible that mortality from vessel strikes is under-recorded (Van Waerebeek *et al.*, 2007), particularly for smaller marine mammals (Schoeman *et al.,* 2020).

4.11.4.3 Collisions between vessels and large whales can often lead to death or serious injury (Kraus, 1990), but as discussed in **paragraph 4.11.4.11**, collisions between cetaceans and vessels are not necessarily lethal on all occasions (Van Waerbeek *et al.,* 2007). Although all types of vessels may hit whales, most lethal and serious injuries are caused by large ships (e.g. 80 m or longer) and vessels travelling at speeds faster than 14 knots (Laist *et al.,* 2001).

4.11.4.4 Given that harbour porpoise are small and highly mobile and considering their potential avoidance responses to vessel sound (see **paragraph 4.11.3.7**), it can be anticipated that they will largely avoid vessel collisions. UK Cetacean Stranding's Investigation Programme (CSIP) (CSIP, 2015) reported results of post-mortem analysis conducted on 53 harbour porpoise strandings in 2015. A cause of death was established in 51 examined individuals (approximately 96% of examined cases) and, of these, only four (8%) had died from physical trauma of unknown cause, which could have been vessel strikes (CSIP, 2015).

4.11.4.5 Vessel strikes can result in lethal or non-lethal injuries to dolphins (Schoeman *et al.*, 2020). Olson *et al.* (2020) reported that evidence from long-term photo-identification data shows that only one out of a group of 277 bottlenose dolphins present within the study region exhibit marks indicative of vessel interactions. Van Waerbeek *et al.* (2007) reported that bottlenose dolphin is one of the species that may receive a moderate impact from collisions, however these may be sustainable at species level because many strikes are nonlethal.

4.11.4.6 For seals, trauma ascribed to collisions with vessels has been identified in <2% of both live stranded (Goldstein *et al.*, 1999) and dead stranded seals in the USA (Swails, 2005). The Onoufriou *et al.* (2016) study in the Moray Firth, Scotland showed that seals utilise the same areas as vessels during trips between haul-outs and foraging sites but that seals tended to remain beyond 20 m from vessels with only three instances over 2,241 days of seal activity resulted in passes at <20 m.

4.11.4.7 Although the potential of collision as a result of construction traffic is relatively low, given the high hearing sensitivity of marine mammals, the consequences of collision risk could be fatal. All marine mammal receptors would be highly vulnerable to a collision, and the effect could potentially cause a change in both reproduction and survival of individuals. However, there is a high likelihood that marine mammals will avoid vessels well in advance of collision risk, as they will be disturbed over a wide distance by underwater sound from vessels and move away, and therefore, collision risk is minimised.

4.11.4.8 Therefore, on the basis that not all collisions that do occur are lethal, there is considered to be a medium potential for recovery. Necropsies and observations of whales surviving a vessel strike have provided information about the relationship between the severity of injury (e.g. depth of laceration, anatomical site of injury) and vessel speed (Rommel et al., 2007; Vanderlaan and Taggart, 2007; Conn and Silber, 2013; Wiley et al., 2016; Combs, 2018) but this is highly species dependent and needs further investigation to support mitigation appropriate for each species. Furthermore, factors such as interspecific differences in bone strength may result in different risks of incurring blunt force trauma (Clifton et al., 2008) and provide further complex variability in lethality of collisions.

4.11.4.9 All marine mammals are deemed to have some resilience (largely due to avoidance behaviour and the argument that not all collisions are fatal)), exhibit medium recoverability and are considered of international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Magnitude of impact

4.11.4.10 Vessel traffic associated with the Transmission Assets has the potential to lead to an increase in vessel movements within the Transmission Assets marine mammal study area. This increase in vessel movement could lead to an increase in interactions between marine mammals and vessels during offshore construction. Whilst a broad range of vessel types are 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 impact (Schoeman *et al.*, 2020). The severity of lesions seems also to be a function of speed. Laist *et al.* (2001) reported among collisions with lethal or severe injuries, 89% of the 28 vessels investigated were moving at 14 kn or faster.

4.11.4.11 Collisions of vessels with marine mammals have the potential to result in both fatal and non-fatal injuries (Laist *et al.*, 2001; Vanderlaan and Taggart, 2007; Cates *et al.*, 2017). Evidence for fatal collisions has been gathered from 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; injuries including propeller cuts, significant bruising, oedema, internal bleeding radiating from a specific site, fractures and ship paint marks have strongly suggested ship strike as cause of death (Jensen and Silber, 2003; Douglas *et al.*, 2008). Fatalities from ship strikes, however, often go unreported (Authier *et al.*, 2014). For non-fatal injuries there is evidence of animals which have survived ship strikes with no discernible injury; animals which survive with non-fatal injuries from propellers have been widely documented (Wells *et al.*, 2008; Luksenburg, 2014).

4.11.4.12 Guidance provided by NOAA has defined serious injury to marine mammals as '*any injury that will likely result in mortality*' (NMFS, 2005). NMFS clarified its definition of 'Serious Injury' in 2012 and stated their interpretation of the regulatory definition of serious injury as any injury that is '*more likely than not*' to result in mortality, or any injury that presents a greater than 50% chance of death to the marine mammal (NMFS, 2012; Helker *et al.*, 2017). Non-serious injury is likely to result in short-term impacts which may have long-term effects on health and lifespan.

4.11.4.13 Vessel traffic associated with construction activities will result in an increase in vessel movements within the study area as up to 284 return trips by construction vessels may be made throughout the construction phase. This increase, described in more detail in **paragraph 4.11.3.19** *et seq.*, could lead to an increase in interactions between marine mammals and vessels. Vessels travelling at 7 m/s (or 14 knots) or faster are those most likely to cause death or serious injury to marine mammals (Laist *et al.*, 2001; Wilson *et al.*, 2007). Vessels involved in the construction phase are likely to be travelling at a speed slower than 14 knots, as vessels used for cable laying are typically slow moving and have restricted manoeuvrability, which is appropriate for species found within the marine mammal study areas. However, for larger slow-moving species such as humpback whales *Megaptera novaeangliae* (which are rarely sighted in the Irish Sea), studies have shown a slower speed may be favourable to reduce likelihood of ship strikes (Vanderlaan and Taggart, 2007), with 10 knots adopted for mandatory limits on the US East coast for the conservation of North Atlantic Right Whale for example (NOAA, 2020). With the exception of CTVs, most vessels involved in the construction phase are likely to be travelling considerably slower than this (Laist *et al.*, 2001), and all vessels will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels).

4.11.4.14 The Offshore EMPs (CoT65) (**Table 4.12**) outlines instructions for vessel behaviour and vessel operators, including advice to operators to not deliberately approach marine mammals and to avoid sudden changes in course or speed (**Table 4.12**). Therefore, with the Transmission Assets designed in measures in place, the risk of collision is anticipated to be reduced and would only be present for transiting vessels (as opposed to stationary). A reduction in vessel speed has been successful in reducing collision risk for whales and is preferred measure from the International Whaling Commission (IWC) to implement when vessels cannot be re-routed for smaller marine species (IWC, 2014; International Maritime Organization, 2016).

4.11.4.15 A proportion of vessels involved in construction will be relatively small in size (e.g. tugs, vessels carrying Remote operated Vehicles, crew transfer vessels, dive boats, barges and RIBs) and due to good manoeuvrability able to move to avoid marine mammals, when detected (Schoeman *et al.*, 2020). Larger vessels with lower manoeuvrability may need larger distances to avoid an animal, however they will also be travelling at slower speeds and have more time to react when a marine mammal is detected. In addition, the sound emissions from vessels involved in the construction phase are likely to deter animals from the potential zone of impact. The vessel movements will likely be contained within the Offshore Order Limits and are likely to follow existing shipping routes to and from the ports.

4.11.4.16 With measures adopted as part of the Transmission Assets in place to reduce the risk of collision (CoT65) (**Table 4.12**), the impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.

Significance of effect

4.11.4.17 Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Operation and maintenance

Sensitivity of the receptor

4.11.4.18 The sensitivity of the receptors during the operation and maintenance phase is not expected to differ from the sensitivity of the receptors during the construction phase. Therefore, the sensitivity of marine mammal receptors to collision risk is as described previously in **paragraph 4.11.4.2** *et seq*.

4.11.4.19 All marine mammals are deemed to have some resilience (largely due to avoidance behaviour and the argument that not all collisions are fatal), exhibit medium recoverability and are considered of international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Magnitude of impact

4.11.4.20 Operation and maintenance vessel use during the operation and maintenance phase of the Transmission Assets may increase the likelihood of injury due to collision with vessels. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, geophysical surveys and offshore export cablerepair or reburial (**Table 4.13**). The types of vessels are similar to those presented for the MDS for the construction phase. An overview of the potential impacts due to vessel presence and associated effects (collision) are described in **paragraph 4.11.3.45** *et seq.* for the construction phase and have not been reiterated here for the operation and maintenance phase.

4.11.4.21 With measures adopted as part of Transmission Assets in place to reduce the risk of collision (CoT65) (**Table 4.12**),, the impact is predicted to be of local spatial extent, long term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.

Significance of effect

4.11.4.22 Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Decommissioning

Sensitivity of the receptor

4.11.4.23 The sensitivity of the receptors during the decommissioning phase is not expected to differ from the sensitivity of the receptors during the construction phase. Therefore, the sensitivity of marine mammal receptors to collision risk is as described previously in **paragraph 4.11.4.2** *et seq*.

4.11.4.24 All marine mammals are deemed to have some resilience (largely due to avoidance behaviour and the argument that not all collisions are fatal), exhibit medium recoverability and are considered of international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Magnitude of impact

4.11.4.25 An overview of the potential impacts due to vessel presence and associated effects (collision) are described in **paragraph 4.11.3.45** for the construction phase and have not been reiterated here for the decommissioning phase.

4.11.4.26 Vessel uses during the decommissioning phase of the Transmission Assets may increase the likelihood of injury due to collision with vessels. Vessel types which will be required during the decommissioning phase include those used during removal of export cables and export cable protection (**Table 4.13**). The types of vessels used during the decommissioning will result in a similar MDS as the construction phase.

4.11.4.27 With measures adopted as part of the Transmission Assets in place to reduce the risk of collision (CoT65) (**Table 4.12**),, the impact is predicted to be of local spatial extent, medium term duration, intermittent, and whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.

Significance of effect

4.11.4.28 Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

4.11.5 Effects on marine mammals due to changes in prey availability

4.11.5.1 Potential effects on fish assemblages during the construction, operation and maintenance, and decommissioning phases of the Transmission Assets, as identified in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, may have indirect effects on marine mammals. The assessment includes temporary and long-term habitat loss/disturbance, underwater sound impacting fish and shellfish receptors (i.e. from UXO clearance and vessel activity), increased SSCs and associated sediment deposition, EMF from subsea electrical cabling, introduction of hard substrata, injury due to increased risk of collision with vessels and disturbance/remobilisation of sediment-bound contaminants.

4.11.5.2 The key prey species for marine mammals include small shoaling fish from demersal or pelagic habitats, particularly gadoids (e.g. cod *Gadus morhua*, haddock *Melanogrammus aeglefinus*, whiting *Merlangius merlangus*), *Trisopterus spp*, clupeids (herring), European sprat *Sprattus sprattus*, sandeels, mackerel *Scomber scombrus*, flatfish (plaice *Pleuronectes platessa*, sole, flounder, dab) and cephalopods.

4.11.5.3 These prey species have been identified as being of regional importance within the fish and shellfish ecology study area (see Volume 2, Chapter 3: Fish and shellfish ecology of the ES). For example, there are important spawning and nursery grounds for plaice, dover sole *Solea solea*, cod, whiting, sandeel, herring, mackerel and sprat. There are also nursery grounds for haddock, tope *Galeorhinus galeus* and spurdog *Squalus acanthias*. Consequently, negative effects on fish receptors may have indirect adverse effects on marine mammal receptors.

Construction Phase

Sensitivity of the receptor

4.11.5.4 Although there is interspecific variation in foraging strategies (e.g. income versus capital breeders as discussed in **paragraph 4.11.1.17**), marine mammals often exploit a range of different prey items switching prey sources depending on season and availability, and sometimes covering extensive distances to forage in areas of high productivity. Whilst species may show a degree of site-fidelity (e.g. bottlenose dolphins are semi-resident in Cardigan Bay; and grey seal and harbour seal often return to the same haul-out locations), largely marine mammals are not confined to a particular location and can, and will, freely move to occupy available areas of suitable habitat within large home ranges. Given that the impacts of construction to prey resources will be localised and largely restricted to the boundaries of the Transmission Assets, only a small area will be affected when compared to available foraging habitat in the Irish and Celtic Seas.

4.11.5.5 Where fish receptors are behaviourally disturbed as a result of the Transmission Assets (e.g. as a result of underwater sound), marine mammals also have the potential to be disturbed, likely over a similar, or greater, extent and duration compared to fish receptors. As such, marine mammals are unlikely to be affected by a reduction in prey resources over the area of disturbance; marine mammals would already likely have been disturbed (if within range) from the area of prey resource reduction. In addition, as prey resources are displaced from the areas of potential impact, marine mammals are likely to follow in order to exploit these resources.

4.11.5.6 The fish and shellfish communities found within the Transmission Assets fish and shellfish ecology study area (see Volume 2, Chapter 3: Fish and shellfish ecology of the ES) are characteristic of the fish and shellfish assemblages in the wider Irish Sea and it is therefore reasonable to assume that, due to the highly mobile nature of marine mammals, there will be similar prey resources available in the wider area.

4.11.5.7 There may be an energetic cost associated with increased travelling and two species, harbour porpoise and harbour seal, may be particularly vulnerable to this effect. Harbour porpoise has a high metabolic rate and only a limited energy storage capacity, which limits its ability to buffer against diminished food while harbour seal typically forage close to haul out sites, i.e. within 50 km. Despite this, if animals do have to travel further to alternative foraging grounds, the impacts are expected to be short term in nature and reversible (i.e. elevated underwater sound that has the potential to displace animals would occur only during pre-construction activities, which are short-term in nature). For example, responses by harbour porpoise to pile-driving sounds documented at two offshore wind projects in Denmark indicated a return to activity levels normal for the construction period a few days after pile-driving ceased (Tougaard *et al.* 2005; Tougaard *et al.*, 2003). Displacement may also vary between species, for example Russell *et al.* (2016) showed for harbour seal there was no significant displacement during construction, and displacement was limited to piling activity (within 2 hours of cessation of pile driving, seals were distributed as per non-piling scenario). Whilst this evidence relates to piling, which is not assessed for the Transmission Assets, the elevation in sound is similarly intermittent and short-term in nature, compared to pre-construction surveys, but is likely to occur over longer time scales than the very short-term nature of UXO clearance.

4.11.5.8 Minke whale has the potential to be particularly vulnerable to potential effects on herring. In the Irish Sea, two known herring stocks exist (Manx stock and Mourne stock) and minke whale appear to mirror these stocks in Manx waters. The Manx herring stock are known to spawn on the east coast of the Isle of Man, in September to October each year (Bowers 1969), which aligns with increased sightings of minke whale on the east coast of the Isle of Man during these months. During summer months, the Manx stock and Mourne stock are found together off the west coast of the island (Bowers 1980). Anderwald *et al.* (2012) studied flexibility of minke whale in their habitat use and found that although significantly higher sighting rates often occur in habitats associated with sandeel presence, an area of high occupancy by minke whale coincided with high densities of sprat during spring. Hence, the low energetic cost of swimming in minke whales and its ability to switch between different prey according to their seasonal availability indicates that this species would be able to respond to temporal changes in pelagic prey concentrations.

4.11.5.9 It is likely that during construction, marine mammals may temporarily shift their foraging efforts to other areas within or around the project area due to disturbances to benthic habitat and associated resources (Fiorentino and Wieting, 2014). Therefore, it is expected that all marine mammal receptors would be able to tolerate the effect without any impact on reproduction and survival rates and would be able to return to previous activities once the impact had ceased.

4.11.5.10 Most marine mammals, except for minke whale, are deemed to be able to tolerate changes to prey availability, exhibit high recoverability and are of international value. The sensitivity of the receptor is therefore, considered to be **low**.

4.11.5.11 For minke whale, due to their reliance on herring as a primary food source in the Irish Sea, they are deemed to have some resilience to changes in prey availability, exhibit high recoverability and are considered of international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Magnitude of impact

4.11.5.12 Potential impacts on marine mammal prey species during the construction phase have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the ES using the appropriate MDSs for these receptors. Construction impacts includes temporary and long-term habitat loss/disturbance, underwater sound impacting fish and shellfish receptors (i.e. from UXO clearance and vessel activity), increased SSCs and associated sediment deposition, introduction of hard substrata and disturbance/remobilisation of sediment-bound contaminants. A summary of the impact assessment for fish and shellfish is given in section 3.10 of Volume 2, Chapter 3: Fish and shellfish ecology of the ES.

4.11.5.13 The installation of infrastructure within the Transmission Assets may lead to temporary subtidal habitat loss/disturbance as a result of a range of activities including installation of offshore export cables, sandwave clearance deposition and anchor placements associated with these activities.

4.11.5.14 There is the potential for temporary habitat loss/disturbance to affect up to 14,805,472 m^2 of subtidal seabed during the construction phase, which equates to approximately 2.34% of the area within the Offshore Order Limits overall, although only a small proportion of this will be impacted at any one time.

4.11.5.15 Habitat loss/disturbance could potentially affect spawning, nursery or feeding grounds of fish and shellfish receptors, which will impact those feeding higher up the food chain. However, as suggested in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, only a small proportion of the maximum footprint of habitat loss/disturbance may be affected at any one time during the construction phase, these effects are likely to be limited and reversible. Additionally, habitat disturbance during the construction phase will also expose benthic infaunal species from the sediment, potentially offering foraging opportunities to some fish and shellfish species (e.g. opportunistic scavenging species) immediately after completion of works. Volume 2, Chapter 3: Fish and shellfish ecology of the ES determined the significance of effect for all key receptors, as a result of potential habitat loss/disturbance as minor adverse, which is not significant in EIA terms. There is also the potential for underwater sound from UXO clearance, geophysical surveys and other sound-producing activities (i.e. vessel activity) to result in injury and/or disturbance to fish and shellfish communities. Volume 2, Chapter 3: Fish and shellfish ecology of the ES determined the impact of underwater sound was predicted to be of regional spatial extent, medium term duration, intermittent and of high reversibility, with the soundscape returning to near-baseline conditions upon completion of construction activities. Whilst most fish species were considered low sensitivity for UXO clearance and geophysical surveys, sprat, cod, allis and twaite shad have medium sensitivity and herring have high sensitivity, which could lead to effects on minke whale prey availability given how tightly tied they are to herring stocks. However, due to the short term, intermittent nature of the impact, and the relatively small proportion of spawning habitats affected at any one time (given the broadscale nature of these habitats), Volume 2, Chapter 3: Fish and shellfish ecology of the ES determined the significance of effect as a result of underwater sound to be negligible to minor adverse, for all phases, which is not significant in EIA terms. For all other impacts assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, the significance of effect was determined to be of negligible to minor adverse significance, which is not significant in EIA terms.

4.11.5.16 Herring has been shown to be an important prey species for harbour porpoise (Santos *et al.* (2004), alongside many other prey species (e.g. whiting, sandeel, haddock, saithe, pollock, Norway pout, poor-cod, cod, ling, blue whiting) (see further detail in Volume 2, Annex 4.1: Marine mammal technical report of the ES). Herring and cod are key species for bottlenose dolphin in the UK (Pesante *et al.* (2008); Nuuttila *et al.* (2017); Santos *et al*. (2001).; However, bottlenose dolphin have an opportunistic diet with a wide range of prey species in the Irish Sea, such as mackerel, seabass, whiting, salmon, sandeel, saithe, pollock, haddock, poor-cod (Pesante *et al.* (2008); Nuuttila *et al.* (2017); Evans and Hintner (2013); Hernandez-Milian *et al*. (2011). Therefore, it is highly likely they bottlenose dolphin can adapt to changes in prey availability. Hernandez-Milian *et al.* (2015) identified 37 prey taxa in stomach contents from 12 bottlenose dolphin.

4.11.5.17 Short-beaked common dolphin have a varied diet which often consists of small schooling fish including cod and herring (see further detail in Volume 2, Annex 4.1: Marine mammal technical report of the ES). Risso’s dolphin are almost exclusively teuthophagic, with herring and cod not forming a key prey item for this species. Minke whale appear to be tightly tied to herring stocks in the Irish Sea around the Isle of Man (detailed in Volume 2, Annex 4.1: Marine Mammal technical report of the ES), however specific feeding information on animals in this area is lacking. Sandeel are the key food resource for minke whale throughout the North Sea, with sprat, shad and herring also preferred prey items (Robinson and Tetley, 2007). Samples taken from the stomach contents of specimens within the North Sea determined that in UK waters the dominant prey items were sandeels, followed by clupeids and to a lesser extent mackerel (Robinson and Tetley, 2007).

4.11.5.18 As discussed in Volume 2, Annex 4.1: Marine mammal technical report of the ES, grey seal are generalist feeders, and take a wide variety of prey including sandeels, gadoids (cod, whiting, haddock, ling) and flatfish (plaice, sole, flounder, dab). Similarly harbour seal are opportunistic, generalist feeders and their diet varies both seasonally and from region to region.

4.11.5.19 Therefore, whilst there may be certain prey species that make up the main part of their diet, all marine mammals in this assessment are considered to be generalist opportunistic feeders and are thus not reliant on a single prey species (with the exception of Risso’s dolphins which predominantly feed on cephalopods). Volume 2, Chapter 3: Fish and shellfish ecology of the ES concluded that no marine mammal prey species would be exposed to significant adverse effects as a result of the Transmission Assets. Furthermore, given that marine mammals are wide-ranging in nature with the ability to exploit numerous food sources, there would be a variety of prey species available for foraging, and it is assumed that if marine mammal prey species are disturbed from an area as a result of activities at the Transmission Assets, marine mammals are likely to be disturbed from the same or greater area.

4.11.5.20 In summary, no significant adverse effects were predicted to occur to fish and shellfish species (marine mammal prey) as a result of the construction of the Transmission Assets (Volume 2, Chapter 3: Fish and shellfish ecology of the ES). Therefore, changes in prey availability on marine mammals are predicted to be of local spatial extent, medium-term duration, intermittent and high reversibility. The magnitude was therefore, considered to be **low** for all species.

Significance of effect

4.11.5.21 Overall, the magnitude of the impact is deemed to be **low** for all species and the sensitivity of the receptor is considered to be **low** for all species, except for minke whale, which is **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, for all species.

4.11.5.22 The effect for all species, other than minke whale, could be concluded to be of either negligible or minor adverse significance, in line with the matrix approach set out in **Table 4.16**. From a precautionary perspective, the effect is concluded to be of **minor adverse** significance rather than negligible, as there is likely to be some level of effect. This is not significant in EIA terms. This is however, likely to be a conservative prediction as there is some evidence (although with uncertainties) that marine mammal populations are likely to benefit from introduction of hard substrates and associated fauna during the operation and maintenance phase. However, neither adverse, nor beneficial effects are likely to change the conservation value of the marine mammal receptors.

Operation and maintenance phase

Sensitivity of the receptor

4.11.5.23 Following placement on the seabed, submerged parts of the offshore export cable protection provide hard substrata for colonisation by high diversity and biomass in the flora and fauna. Faecal deposits of dominant communities of suspension feeders are likely to alter the surrounding seafloor communities by locally increasing food availability (Degraer *et al.*, 2020). Higher trophic levels, such as fish and marine mammals, are likely to benefit from locally increased food availability and/or shelter and therefore have the potential to be attracted to forage within the Offshore Order Limits. However, still relatively little is known about the distribution and diversity of marine mammals around offshore anthropogenic structures.

4.11.5.24 Species such as harbour porpoise, minke whale, white-beaked dolphin, harbour seal and grey seal have been frequently recorded around offshore oil and gas structures (Todd *et al.*, 2016; Delefosse *et al.*, 2018; Lindeboom *et al.*, 2011). Acoustic results from a T-POD measurement within a Dutch windfarm found that relatively more harbour porpoise are found in the wind farm area compared to the two reference areas (Scheidat *et al.*, 2011; Lindeboom *et al.*, 2011). Authors of this study concluded that this effect is directly linked to the presence of the wind farm due to increased food availability as well as the exclusion of fisheries and reduced vessel traffic in the wind farm (shelter effect). Similarly, during research on a Danish wind farm, no statistical differences were detected in the presence of harbour porpoise between inside and outside the wind farm (Diederichs *et al.*, 2008). Diederichs *et al.* (2008) suggested that a small increase in acoustic detections during the night by hydrophones deployed in proximity to single wind turbines may indicate increased foraging behaviour near the monopiles.

4.11.5.25 Russell *et al.* (2014) monitored the movements of tagged harbour seal within two active wind farms in the North Sea and demonstrated that animals commonly showed grid-like movement patterns which strongly suggested that the structures were used for foraging.

4.11.5.26 Whilst there is some mounting evidence of potential benefits of anthropogenic structures in the marine environment (Birchenough and Degrae, 2020), the statistical significance of such benefits and details about trophic interactions in the vicinity of artificial structures and their influence on ecological connectivity remain largely unknown (Petersen and Malm, 2007; Inger *et al.*, 2009; Rouse *et al.*, 2020, McLean *et al.*, 2022; Elliott and Birchenough, 2022). Additional details about inter-related effects on marine organisms are provided in **section 4.15**.

4.11.5.27 Overall, the sensitivity of marine mammals during the operation and maintenance phase is not expected to differ from the sensitivity of the receptors during the construction phase described in **paragraph 4.11.5.4**.

4.11.5.28 As such, for most marine mammals, except for minke whale, the sensitivity of the receptor is, considered to be **low**. For minke whale, the sensitivity of the receptor is considered to be **medium.**

Magnitude of the impact

4.11.5.29 Potential impacts on marine mammal prey species during the operation and maintenance phase have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the ES using the appropriate MDS for these receptors. These include temporary and long-term habitat loss/disturbance, underwater sound impacting fish receptors (i.e. from vessel activity), increased SSC and associated sediment deposition, EMF from subsea electrical cabling, introduction of hard substrata and disturbance/remobilisation of sediment-bound contaminants.

4.11.5.30 Impacts, with the exception of EMF from subsea electrical cabling, are the same or less than those described for the construction phase (Volume 2, Chapter 3: Fish and shellfish ecology of the ES).

4.11.5.31 During the operation and maintenance phase, there may be impacts from EMF from offshore export cables. Fish and shellfish species (particularly elasmobranchs) are able to detect applied or modified magnetic fields, and may exploit magnetic fields to detect prey, predators or conspecifics in the local environment to assist with feeding, predator avoidance, navigation, orientation and social or reproductive behaviours. The presence and operation of offshore export cableswill result in emissions of localised electrical and magnetic fields, which could potentially affect the sensory mechanisms of some species of fish and shellfish. However, the impact of EMF on fish and shellfish was predicted to be of local spatial extent, long term duration, continuous and high reversibility (when the offshore export cables are decommissioned) and of minor adverse significance.

4.11.5.32 Volume 2, Chapter 3: Fish and shellfish ecology of the ES also considers long-term habitat loss in the operation and maintenance phase, but highlights the reality is not a loss of habitat, but rather a change in a sedimentary habitat and replacement with hard artificial substrates over the 35-year operational period. Given marine mammals are flexible predators that can switch prey if required, such changes are unlikely to affect prey availability in the long term. Potential colonisation of hard structures could occur within hours or days after construction by demersal and semi-pelagic fish species (Andersson, 2011), with more complex communities later likely attracted to the developing algal and suspension feeder communities as potential new sources of food (Karlsson *et al.*, 2022). Feeding opportunities or the prospect of encountering other individuals in the newly introduced heterogenous environment (Langhamer, 2012) may attract fish aggregations from the surrounding areas, which may increase the carrying capacity of the area in the long-term, and thus lead to a change or increase in prey availability for marine mammals.

4.11.5.33 The impact on marine mammals is predicted to be of local spatial extent, long-term duration, continuous and the effect on marine mammals is of high reversibility. Whilst most impacts are considered to be adverse there is the potential for some beneficial effect with respect to introduction of hard substrate which could increase prey availability for some species. The magnitude for both adverse and beneficial impacts is considered to be **low**.

Significance of effect

4.11.5.34 Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **low** for all species, except for minke whale, which is **medium**. The effect will, therefore, be of **minor adverse** significance, for all species.

4.11.5.35 The effect for all species, other than minke whale, could be concluded to be of either negligible or minor adverse significance, in line with the matrix approach set out in **Table 4.16**. From a precautionary perspective, the effect is concluded to be of **minor adverse** significance rather than negligible, as there is likely to be some level of effect. This is not significant in EIA terms. This is however likely to be a conservative prediction as there is some evidence (although with uncertainties) that marine mammal populations are likely to benefit from introduction of hard substrates and associated fauna during the operation and maintenance phase. However, neither adverse, nor beneficial effects are likely to change the conservation value of the marine mammal receptors.

Decommissioning phase

4.11.5.36 Potential impacts on marine mammal prey species during the decommissiong phase have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the ES using the appropriate MDS for these receptors. These include temporary habitat loss/disturbance, underwater sound impacting fish and shellfish receptors (i.e. from vessel activity), long term habitat loss, increased SSCs and associated sediment deposition, colonisation of hard substrata and disturbance/remobilisation of sediment-bound contaminants.

Sensitivity of the receptor

4.11.5.37 Overall, the sensitivity of marine mammals during the operation and maintenance phase is not expected to differ from the sensitivity of the receptors during the construction phase described in **paragraph 4.11.5.4**.

4.11.5.38 As such, for most marine mammals, except for minke whale, the sensitivity of the receptor is, considered to be **low**. For minke whale, the sensitivity of the receptor is considered to be **medium.**

Magnitude of impact

4.11.5.39 Potential impacts on marine mammal prey species during the decommissioning phase have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the ES using the appropriate MDS for these receptors. Magnitude of impacts are as described for the construction phase in **paragraph 4.11.5.12** *et seq*. The impact on marine mammals is predicted to be of local spatial extent, long-term duration, continuous and the effect on marine mammals is of high reversibility. The magnitude is therefore, considered to be **low**.

Significance of effect

4.11.5.40 Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **low** for all species, except for minke whale, which is **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, for all species.

4.11.5.41 The effect for all species, other than minke whale, could be concluded to be of either negligible or minor adverse significance, in line with the matrix approach set out in **Table 4.16**. From a precautionary perspective, the effect is concluded to be of **minor adverse** significance rather than negligible, as there is likely to be some level of effect. This is not significant in EIA terms. This is however likely to be a conservative prediction as there is some evidence (although with uncertainties) that marine mammal populations are likely to benefit from introduction of hard substrates and associated fauna during the operation and maintenance phase. However, neither adverse, nor beneficial effects are likely to change the conservation value of the marine mammal receptors.

4.11.6 Injury and disturbance from underwater sound generated from pre-construction survey sources

4.11.6.1 Site investigation surveys which will be carried out in advance of, and to directly inform, construction activities have the potential to cause direct or indirect effects (including injury or disturbance) on marine mammal key receptors. For the purposes of the assessment of effects, potential effects from site investigation surveys are assessed under the construction phase. A detailed underwater sound modelling assessment has been carried out to investigate the potential for injurious and behavioural effects on marine mammals as a result of geophysical and geotechnical surveys, using the latest criteria (Volume 1, Annex 5.2: Underwater sound technical report of the ES), which is drawn upon in the assessment below.

Summary of sound modelling

4.11.6.2 It is understood that several sonar-like sources will potentially be used for the geophysical surveys, including MBES, SSS, SBES, SBP and sparkers (UHRS) (0.05 to 4 kHz; 182 dB re 1 µPa re 1 m (SPL_{rms}) **Table 4.13**). The equipment likely to be used can typically work at a range of signal frequencies, depending on the distance to the bottom and the required resolution. For sonar-like sources the signal is highly directional, acts like a beam and is emitted in pulses. Sonar-based sources are considered by the NMFS (2018) as continuous (non-impulsive) because they generally comprise a single (or multiple discrete) frequency as opposed to a broadband signal with high kurtosis, high peak pressures and rapid rise times (see Volume 1, Annex 5.2: Underwater sound technical report of the ES). Unlike the sonar-like survey sources, the UHRS is likely to utilise a sparker, which produces an impulsive, broadband source signal. For geotechnical surveys, site activities include CPTs and vibro-coring. These site investigation surveys will involve the use of several geophysical/geotechnical survey vessels and take place over a period of up to eight months.

4.11.6.3 A full description of the source sound levels for geophysical and geotechnical survey activities is provided in Volume 1, Annex 5.2: Underwater sound technical report of the ES.

Construction Phase

Sensitivity of the receptor

Auditory injury

4.11.6.4 In the absence of studies on potential survey sources which will be used for the geophysical and geotechnical surveys (including MBES, SSS, SBES, SBP, sparkers (UHRS), CPT and vibro-coring) information has been presented below on alternative survey sources, as a proxy, to inform an assessment of sensitivity for auditory injury. The assessment of sensitivity accounts for the paucity of data on relevant survey sources, and subsequently, takes a conservative approach. For geotechnical surveys, injury to marine mammals is unlikely to occur beyond a few tens of metres and sound from vessels themselves is likely to deter marine mammals beyond this range. The maximum range for PTS from geophysical surveys (SBP) is 254 m for harbour porpoise.

4.11.6.5 Ruppel *et al.* (2022) categorised marine acoustic sources into four tiers based on their potential to injure marine mammals using physical criteria about the sources (e.g. source level, transmission frequency, directionality, beamwidth, and pulse repetition rate). Those in Tier Four were considered unlikely to result in 'incidental take' (i.e. loss of individuals) of marine mammals and therefore termed de minimis, and included most high resolution geophysical sources (MBES, SSS, SBP, low powered sparkers). They also suggested that surveys that simultaneously deploy multiple, non-impulsive *de minimis* sources are unlikely to result in incidental take of marine mammals.

4.11.6.6 Matthews *et al.* (2020) used a modelling approach to compare potential effects of a non-impulsive sound source (Marine Vibroseis (MV)) and impulsive seismic sources (air gun) on marine mammals and found few marine mammals could be expected to be exposed to potentially injurious sound levels for either source type, but fewer were predicted for MV arrays than air gun arrays. They found the estimated number of animals exposed to sound levels was dependent on the selection of evaluation criteria, with more behavioural disturbance predicted for MV arrays compared to air gun arrays when using SPL_{pk} but the opposite when using frequency-weighted sound fields and a multiple-step, probabilistic, threshold function. Matthews *et al.* (2020) therefore demonstrated the importance of using both SPL_{pk} and SEL_{cum} threshold metrics, as they relate to different characteristics of both impulsive and continuous sound – e.g. SEL_{cum} looks at accumulative exposure over a set duration whilst SPL_{pk} measures acute exposure to high-amplitude sounds. Sills *et al.* (2020) evaluated TTS onset levels for impulsive sound in seals following exposure to underwater sound from a seismic air gun and found transient shifts in hearing thresholds at 400 Hz were apparent following exposure to four to ten consecutive pulses (SEL_{cum} 191 dB to 195 dB re 1 µPa^{2}s; 167 dB to 171 dB re 1 µPa^{2}s with frequency weighting for phocid carnivores in water).

4.11.6.7 Marine mammals are deemed to have limited resilience to PTS (i.e. are highly susceptible to auditory injury), exhibit low recoverability and are considered of international value. The sensitivity of the receptor to PTS from elevated underwater sound during site investigation surveys is therefore, considered to be **high**.

Behavioural disturbance

4.11.6.8 The transmission frequencies of many commercial sonar systems (approximately 12 kHz to 1800 kHz) overlap with the hearing and vocal ranges of many species (Richardson *et al.*, 1995), and whilst many are high frequency sonar systems with peak frequencies well above marine mammal hearing ranges, it is possible that relatively high levels of sound are also produced as sidebands at lower frequencies (Hayes and Gough, 1992) and therefore may elicit behavioural responses in marine mammals.

4.11.6.9 Hermannsen *et. al.* (2015) reported on the source characteristics and propagation of broadband pulses (10 Hz up to 120 kHz) from a small airgun, confirming that there are substantial medium-to-high frequency components in airgun pulses, indicating that small odontocetes and seals may be affected by even a single airgun. However, findings indicate that in the context of exposure to sonar-like sound sources (e.g. MBES, SBES) marine mammals may show subtle behavioural responses but factors such as species, behavioural context, location, and prey availability may be as important or even more important than the acoustic signals themselves (Ruppel et. al., 2022). MacGillivray *et al.* (2014) compared sound level above hearing threshold as a function of horizontal distance, for seven acoustic sources including air guns, SBP, MBES and SSS. Weighting sounds according to hearing sensitivity allowed assessment of relative risks associated with exposure and whilst this analysis did not directly relate to potential for behavioural responses, it allowed comparison of modelled acoustic sources. Modelling indicated that odontocetes were most likely to hear sounds from mid-frequency sources (fishery, communication, and hydrographic systems), mysticetes from low-frequency sources (SBP and airguns), and pinnipeds from both mid and low-frequency sources. For all species, modelled sensation levels were lowest for the high-frequency sources (e.g. SSS and MBES) which operate at the upper limits of the audible spectrum.

4.11.6.10 In a study on MBES surveys in 2020, Kates Varghese *et al.* (2020) showed that the only marine mammal metric that was identified as changing was vocalisation rate. Neither displacement nor changes in foraging were observed. Quick et. al. (2016) demonstrated that tagged short-finned pilot whales *Globicephala macrorhynchus* that were exposed to a SBES, did not change their foraging behaviour, but variance in directionality of movement was observed, suggesting increased vigilance while the SBES was active. However, the authors acknowledged that the range of behaviours exhibited could not be directly attributed to SBES operation, and that changes in behaviour were unlikely to be biologically significant. Cholewiak *et. al*. (2017) investigated the impact of SBES on toothed whales, recording fewer beaked whale vocalisations when the source was actively transmitting suggesting that animals either move away from the area or reduced foraging activity (even though findings were not statistically significant).

4.11.6.11 Studies have largely focused on the effects of multi-array seismic surveys on marine mammals, and therefore evidence for behavioural responses to sonar-like sources (e.g. MBES, SSS, SBPs) is less widely available. Multi-array impulsive sound sources are broadband in character (i.e. produce sound across a wide range of frequencies), unlike sonar-like sources which typically produce more tonal sound either at a discrete frequency or a range of discrete frequencies. However, findings from studies of multi-array impulsive sources may be useful in supporting predictions of behavioural responses of marine mammals to geophysical survey sources in general, given the overlap of parameters that typically characterise sound sources (i.e transmission frequency; source level; pulse duration) (see MacGillivray *et al.*, 2013; Ruppel *et al.*, 2022). Whilst evidence on the behavioural responses of melon-headed whales *Peponocephala electra* (or similar delphinid species) to MBES is limited, an Independent Scientific Review Panel (ISRP) deemed a 12 kHz MBES to be the most plausible trigger for an extreme behavioural response in melon-headed whales, which resulted in a mass group stranding in a shallow lagoon in Madagascar in 2008 (Southall *et al.*, 2013) (an area where such open-ocean species would not usually frequent). Whilst an unequivocal cause and effect relationship between MBES and the strandings cannot be concluded, the paper states that intermittent, repeated sounds of this nature could present a salient and potential aversive stimulus and suggests potential for such behavioural responses (or indirect injury) from MBES should be considered in environmental assessments (Southall *et al.*, 2013).

4.11.6.12 Fine-scale data from porpoises equipped with high-resolution location and dive loggers when exposed to airgun pulses at ranges of 420 m to 690 m with sound level estimates of 135 dB to 147 dB re 1 µPa^{2}s (SEL) show different responses to sound exposure (van Beest, *et al.*, 2018). One individual displayed rapid and directed movements away from the exposure site whilst two individuals used shorter and shallower dives (compared to natural behaviour) immediately after exposure. This sound-induced movement typically lasted for eight hours or less, with an additional 24-hour recovery period until natural behaviour was resumed.

4.11.6.13 Results from 201 seismic surveys in the UK and adjacent waters demonstrated that cetaceans (including bottlenose dolphin, white-beaked dolphin and minke whale) can be disturbed by seismic exploration (Stone and Tasker, 2006). Small odontocetes showed the strongest lateral spatial avoidance, moving out of the area, whilst mysticetes and killer whale showed more localised spatial avoidance, orienting away from the vessel and increasing distance from source but not leaving the area completely.

4.11.6.14 A study by Sarnocińska *et al.* (2020) indicated temporary displacement or change in harbour porpoise echolocation behaviour in response to a 3D seismic survey in the North Sea. No general displacement was detected from 15 km away from any seismic activity but decreases in echolocation signals were detected up to 8 km to 12 km from the active airguns. Similarly, Thompson *et al.* (2013) used Passive Acoustic Monitoring (PAM) and DAS to study changes in the occurrence of harbour porpoises across a 2,000 km^2 study area during a commercial two-dimensional seismic survey in the North Sea and found acoustic detections decreased significantly during the survey period in the impact area compared with a control area, but this effect was small in relation to natural variation. Animals were typically detected again at affected sites within a few hours, and the level of response declined through the ten-day survey suggesting exposure led to some tolerance of the activity (Thompson *et al.*, 2013). This study suggested that prolonged seismic survey sound did not lead to broader-scale displacement into suboptimal or higher-risk habitat. Likewise, a ten-month study of overt responses to seismic exploration in humpback whale, sperm whale *Physeter macrocephalus* and Atlantic spotted dolphin *Stenella frontalis*, demonstrated no evidence of prolonged or large-scale displacement of each species from the region during the survey (Weir, 2008).

4.11.6.15 Hastie *et al.* (2014) carried out behavioural response tests to two sonar systems (200 kHz and 375 kHz systems) on grey seal at SMRU seal holding facility. Results showed that both systems had significant effects on the seals behaviour. Seals spent significantly more time hauled out during the 200 kHz sonar operation and although seals remained swimming during operation of the 375 kHz sonar, they were distributed further from the sonar.

4.11.6.16 Aside from displacement or avoidance, other behavioural responses have been demonstrated (Wright and Consentino, 2015). Responses to seismic surveys have included cessation of singing (Melcón *et al.*, 2012) and alteration of dive and respiration patterns which may lead to energetic burdens on the animals (Gordon *et al.*, 2004). In some cases, behavioural responses may lead to greater effects than expected such as strandings (Cox *et al.*, 2006, Tyack *et al.*, 2006) or interruptions to migration (Heide-Jørgensen *et al.*, 2013). However such responses are highly context dependent and variable, depending on factors such as the activity of the animal at the time (Robertson *et al.*, 2013), prior experience to exposure (Andersen *et al.*, 2012), extent or type of disturbance (Melcón *et al.*, 2012), environment in which they inhabit (e.g Heide-Jørgensen *et al.*, 2013) and the type of survey (as discussed in **paragraph 4.11.6.5**).

4.11.6.17 It is expected that, to some extent, marine mammals would be able to adapt their behaviour to reduce impacts on survival and reproduction rates and tolerate elevated levels of underwater sound during site investigation surveys. Marine mammals are deemed to have high resilience to behavioural disturbance, exhibit high recoverability and are considered of international value. The sensitivity of the receptor to disturbance from elevated underwater sound during site investigation surveys is therefore considered to be **medium**.

Magnitude of impact

Auditory injury

4.11.6.18 Potential sound impacts of site investigation survey sources will depend on the characteristic of the source, survey design, frequency bands and water depth. Sonar-like sources have very strong directivity which effectively means that there is only potential for injury when a marine mammal is directly underneath the sound source. Once the animal moves outside of the main beam, there is no potential for injury. This section provides estimated ranges for injury of marine mammals in the construction phase of the Transmission Assets.

4.11.6.19 With respect to the ranges within which there is a potential of PTS to occur as a result of geophysical investigation activities, based on the SEL_{cum} metric, the maximum PTS is expected to occur out to 254 m for harbour porpoise due to SBP (chirp/pinger) (**Table 4.34**). For dolphin species the maximum PTS range is expected to occur out to 41 m due to MBES, for minke whale and pinniped species out to 40 m due to SBP (chirp/pinger) (**Table 4.34**).

4.11.6.20 With respect to the ranges within which there is a potential of PTS occurring to marine mammals as a result of geotechnical investigation activities, the

PTS threshold was not exceeded for most marine mammal species, except harbour porpoise and minke whale. For CPTs the maximum PTS range is predicted to occur out to 55 m and 4 m for harbour porpoise and minke whale, respectively, and for vibro-coring to a maximum of 79 m for harbour porpoise.

Table 4.34: PTS ranges (m) for marine mammals during geophysical site investigation surveys, compared to Southall *et al.* (2019) SEL_{cum} thresholds

Activity	LF	HF	VHF	PCW
	PTS	PTS	PTS	PTS
MBES	12	41	68	25
SSS	2	2	41	6
SBES	12	12	68	25
SBP (chirp/pinger)	40	40	254	40
Sparker (UHRS)	N/E	N/E	11	N/E

N/E = threshold not exceeded

Table 4.35: Potential PTS ranges for marine mammals during geotechnical site investigation surveys. Based on comparison to Southall *et al.* (2019) SEL_{cum} thresholds (N/E = threshold not exceeded).

Activity	LF	HF	VHF	PCW
	PTS (m)	PTS (m)	PTS (m)	PTS (m)
Cone penetration testing	4	N/E	55 (14)*	N/E
Vibro-coring	N/E	N/E	79	N/E

*Comparison to ranges for SPLpk where threshold was exceeded (shown in brackets).

4.11.6.21 The number of marine mammals with the potential to be injured within the modelled ranges for PTS presented in **Table 4.36** were estimated using the most up to date species-specific density estimates (**Table 4.9**). Due to low injury ranges, for all marine species, there is the potential for no more than one animal to experience PTS (or no animals where the threshold is not exceeded) as a result of geophysical and geotechnical site investigation surveys. The site-investigation surveys are considered to be short term as they will take place over a period of several months. The largest range predicted was 254 m (for SBP) and it is considered that standard industry measures will be effective at reducing the risk of injury over this distance.

Table 4.36: Estimated number of animals with the potential to experience PTS from geophysical and geotechnical site investigation surveys

Activity	Estimated number of animals						
	Harbour Porpoise	Bottlenose Dolphin	Short-beaked common dolphin	Risso's dolphin	Minke whale	Grey seal	Harbour seal
Geophysical surveys							
MBES	<1	<1	<1	<1	<1	<1	<1
SSS	<1	<1	<1	<1	<1	<1	<1
SBES	<1	<1	<1	<1	<1	<1	<1
SBP (chirp/pinger)	<1	<1	<1	<1	<1	<1	<1
Sparker (UHRS)	<1	0	0	0	0	0	0
Geotechnical surveys							
Cone Penetration Testing	<1	0	0	0	<1	0	0
Vibro-coring	<1	0	0	0	0	0	0

4.11.6.22 Pre-construction site investigation surveys will involve the use of several geophysical/ geotechnical survey vessels. The site-investigation surveys are considered to be short term as they will take place over up to a period of several months (typically up to two months, but can be longer (e.g up to eight months, as per the Transmission Assets MDS, see **Table 4.13**)). The potential impacts of underwater sound associated with vessel movements are described in **section 4.11.3**.

4.11.6.23 The impact of site investigation surveys leading to PTS is predicted to be of very limited spatial extent, short-term duration, intermittent and whilst the impact itself will occur during the pre-construction phase only, the effect of PTS would be permanent. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **negligible**.

Behavioural disturbance

4.11.6.24 The estimated maximum ranges for onset of disturbance are based on the sound level being greater than the 120 dB re 1 µPa (SPL_{rms}) threshold applicable for all marine mammals, noting that this threshold is for 'mild disturbance' and therefore is not likely to result in displacement of animals.

4.11.6.25 The disturbance ranges as a result of geophysical and geotechnical site-investigation surveys (**Table 4.37**) will be higher than those presented for PTS. Most of the predicted ranges are within 100s of meters, however the largest distance over which the disturbance could occur is out to approximately 17.3 km for SBP. This is due to the higher source levels for this piece of equipment compared to other types of survey equipment.

Table 4.37: Disturbance for marine mammals (all species) during geophysical site investigation surveys

Activity	Disturbance all species (m)
Geophysical surveys	
MBES	830
SSS	310
SBES	830
SBP (chirp/pinger)	17,300
Sparker (UHRS)	637 (mild disturbance)
	95 (strong disturbance)
Geotechnical surveys	
CPT	1,350 (mild disturbance)
	158 (strong disturbance)
Vibro-coring	10,603

4.11.6.26 For geophysical surveys the maximum disturbance ranges were predicted for the SBP with mild disturbance up to 17.3 km. For geotechnical surveys the maximum disturbance ranges were predicted for vibro-coring up to 10.6 km (**Table 4.37**).

4.11.6.27 For impulsive sound sources (sparker (UHRS) and CPT) the number of marine mammals potentially disturbed within the modelled ranges for behavioural response are estimated using the most up to date species specific density estimates (**Table 4.37**).

4.11.6.28 The largest distance over which mild disturbance could occur is out to 637 m, and for all marine mammal species less than one animal has the potential to be disturbed within this range.

4.11.6.29 As stated in **paragraph 4.11.3.31** for impulsive sound sources there is an understanding of the difference between strong and mild disturbance, whereas for non-impulsive (continuous) sound sources (MBES, SSS, SBES, SBP (chirp/pinger) and vibro-coring), there is only a single available threshold (120 dB re 1 µPa (SPL_{rms})), which is classed as the distance beyond which no animals would be disturbed. Ranges for disturbance for non-impulsive sound sources are presented up to the 120 dB re 1 µPa (SPL_{rms}) threshold (**Table 4.37**); there is no distinction between mild and strong disturbance. Whilst it can be assumed that not all animals found within those ranges (**Table 4.37**) would be disturbed, for those animals disturbed, there is likely to be a proportional response (i.e. not all animals will be disturbed to the same extent). However, there is no dose-response curve available to apply in the context of non-impulsive sound sources. It is important to note that the life history of an individual and the context will also influence the likelihood of an individual to exhibit an aversive response to sound, and it must be highlighted that these impacts will not be continuous over the construction phase, instead carried out over a shorter number of days within the period. Furthermore, this threshold does not take into account ambient sound levels in the area which may be already above the 120 dB re 1 µPa (SPL_{rms}) (see Farcas *et al.* (2020)).

4.11.6.30 Therefore, given the limited quantitative information available, as described above, any simplified calculation would likely lead to an unrealistic overestimation of the number of animals likely to be disturbed. As such, this value has not been quantified. However, all geophysical and geotechnical surveys will be of medium duration (up to eight months), activities are likely to be intermittent, and animals are expected to recover quickly after cessation of the survey activities. The impact could result in a minor alteration to the distribution of marine mammals.

4.11.6.31 The impact of injury and disturbance from underwater sound generated from pre-construction survey sources is predicted to be of local spatial extent, medium term duration, intermittent and reversible (i.e. the elevation in underwater sound only occurs during the site investigation surveys). The effect of behavioural disturbance is reversible as receptors are expected to recover within hours/days. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.

Significance of effect

4.11.6.32 Overall, the magnitude of the impact of PTS is deemed to be **negligible** and the sensitivity of the receptor is considered to be **high**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

4.11.6.33 Overall, the magnitude of the impact of disturbance is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

4.11.7 Future monitoring

4.11.7.1 Other than the impact of Injury and disturbance from elevated underwater sound during UXO clearance, the assessment of impacts on marine mammals as a result of the construction, operation and maintenance, and decommissioning phases of the Transmission Assets are predicted to be not significant in EIA terms. For the impact of Injury and disturbance from elevated underwater sound during UXO clearance, mitigation measures (CoT64, **Table 4.12**) will be implemented to reduce the magnitude of of underwater sound levels associated with residual significant impacts from the Transmission Assets alone, such that there will be no residual significant effect (in this case, on harbour porpoise), as set out in **paragraphs 4.11.2.56** and **4.11.2.57**. Based on these conclusions, marine mammal monitoring to test the predictions made within the impact assessment is not considered necessary.

4.12 Cumulative effect assessment methodology

4.12.1 Introduction

4.12.1.1 The marine mammals CEA methodology has followed the methodology set out in Volume 1, Chapter 5: Environmental assessment methodology of the ES.

4.12.1.2 The cumulative assessment considers three scenarios; Transmission Assets together with Morecambe Offshore Windfarm: Generation Assets only, Transmission Assets together with Morgan Offshore Wind Project: Generation Assets only and Transmission Assets together with the Generation Assets. These cumulative scenarios are followed by the cumulative assessment of all projects, plans and activities allocated into 'tiers' reflecting their current stage within the planning and development process. This tiered approach is adopted to provide a clear assessment of the Transmission Asses alongside other projects, plans and activities.

The cumulative assessment has been undertaken as follows.

- Scenario 1: Transmission Assets together with Morecambe Offshore Windfarm: Generation Assets.
- Scenario 2: Transmission Assets together with Morgan Offshore Wind Project: Generation Assets.
- Scenario 3: Transmission Assets together with Generation Assets.
- Scenario 4: Scenario 3 together with Tier 1, Tier 2 and Tier 3 projects, plans and activities, defined as follows.
  - Scenario 4a: Scenario 3 and Tier 1 projects, plans and activities which are:
    - under construction;
    - permitted application;
    - submitted application; or
    - those currently operational that were not operational when baseline data were collected, and/or those that are operational but have an ongoing impact.
  - Scenario 4b: Scenario 4a and Tier 2 projects, plans and activities which a:
    - Scoping Report has been submitted in the public domain.
  - Scenario 4c: Scenario 4b and Tier 3 projects, plans and activities which are:
    - where a Scoping Report has not been submitted and it is not in the public domain;
    - identified in the relevant Development Plan; or
    - identified in other plans and programmes.

4.12.1.3 Each project has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved (see Volume 1, Annex 5.5: Cumulative screening matrix and location plan of the ES).

4.12.1.4 The CEA screening area initially focussed on projects within the extent of the harbour porpoise CIS MU, rather than the entire extent of the largest MU: the CGNS MU. This was to ensure a proportionate and pragmatic approach was taken, focussing on a region within which receptor-impact pathways are likely (since cumulative effects from the Transmission Assets within the Irish Sea were considered unlikely to occur with projects in the North Sea, for example). For grey seal, an extended screening area was applied (OSPAR Region III) instead of the GSRP. Only offshore wind projects were included in this extended screening area to allow for a more proportionate approach to the CEA. For harbour seal, the HSRP is used as the relevant screening area.

4.12.1.5 This tiered approach is adopted to provide a clear assessment of the Transmission Assets alongside other projects, plans and activities.

4.12.1.6 The specific projects, plans and activities scoped into the CEA, are outlined in **Table 4.39** and shown in Figure 4.5 (Volume 2, Figures).

4.12.1.7 Note that the significance of cumulative effects is determined by combining the magnitude of the impact of the Transmission Assets with the magnitude of the impact of the relevant projects scoped into the CEA. Thus, the significance determined from the matrix based approach considers the total magnitude and sensitivity of the receptor for projects rather than the accumulation of separate significance of impacts of each individual project/operation.

Table 4.38: List of other projects, plans and activities considered within the CEA

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
Morecambe Offshore Windfarm: Generation Assets	Submitted but not yet determined	0	480 MW Offshore wind farm (generating assets)	2026 to 2029	2029 to 2064	The construction, operation and maintenance, and decommissioning phases of this project will overlap temporally with the construction, operation and maintenance, and decommissioning phases of the Transmission Assets.
Morgan Offshore Wind Project: Generation Assets	Submitted but not yet determined	0	1.5 GW Offshore wind farm (generating assets)	2026 to 2030	2030 to 2065	The construction, operation and maintenance, and decommissioning phases of this project will overlap temporally with the construction, operation and maintenance, and decommissioning phases of the Transmission Assets.
Tier 1						
Mona Offshore Wind Project	Submitted but not yet determined	9.73	Offshore wind farm (generating assets) and offshore export cable (transmission assets)	2026 to 2030	2030 to 2065	The construction, operation and maintenance, and decommissioning phases of this project will overlap temporally with the construction, operation and maintenance, and decommissioning phases of the Transmission Assets.
Awel y Môr Offshore Wind Farm	Permitted but not yet implemented	28.87	Offshore wind farm Over	2026 to 2030	2030 to 2055	The construction, operation and maintenance, and decommissioning phases of this project will overlap temporally with the construction and

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
			100 MW (48 to 91 wind turbines)			operation and maintenance phases of the Transmission Assets.
West Anglesey Demonstration Zone tidal site (Morlais)	Permitted but not yet implemented	78.71	Tidal Demonstration Zone	2021 to 2023	2023 to 2061	The operation and maintenance phase of this project will overlap temporally with the operation and maintenance phase of the Transmission Assets.
Mainstream, Renewable Power Ltd - site investigation surveys off Co, Dublin	Submitted but not yet determined	104.21	Site investigation surveys	Unknown	Unknown	There is potential for construction activities for the Transmission Assets to overlap with site investigation activities for this project.
North Irish Sea Array (NISA) Site investigation surveys	Operational	107.69	Site investigation surveys	N/A	Unknown to 2027	There is potential for construction activities for the Transmission Assets to overlap with site investigation activities for this project.
Sunrise Offshore Wind Farm - site investigation surveys	Submitted but not yet determined	124.75	Site investigation surveys	Unknown	Unknown	There is potential for construction activities for the Transmission Assets to overlap with site investigation activities for this project.
Sea Stacks Offshore Wind - site investigation surveys	Submitted but not yet determined	127.44	Site investigation surveys	Unknown	Unknown	There is potential for construction activities for the Transmission Assets to overlap with site investigation activities for this project.
Banba Offshore Wind - site	Submitted but not yet determined	133.13	Site investigation surveys	Unknown	Unknown	There is potential for construction activities for the Transmission Assets to

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
investigation surveys						overlap with site investigation activities for this project.
Dublin Array Offshore Wind Farm - site investigation surveys	Operational	134.50	Site investigation surveys	Unknown	Unknown	There is potential for construction activities for the Transmission Assets to overlap with site investigation activities for this project.
Wicklow Project Offshore Wind - site investigation surveys	Submitted but not yet determined	149.47	Site investigation surveys	Unknown	Unknown	There is potential for construction activities for the Transmission Assets to overlap with site investigation activities for this project.
Shelmalere Offshore Wind - site investigation surveys	Submitted but not yet determined	182.88	Site investigation surveys	Unknown	Unknown	There is potential for construction activities for the Transmission Assets to overlap with site investigation activities for this project.
SSE Renewables Celtic Sea	Submitted but not yet determined	260.55	Site investigation surveys	Unknown	Unknown	There is potential for construction activities for the Transmission Assets to overlap with site investigation activities for this project.
Project Erebus Floating Wind Demonstration	Under construction	284.61	Floating test and demonstration projects	2025 to 2026	2026 to 2052	The operation and maintenance phase of this project will overlap temporally with the operation and maintenance phase of the Transmission Assets.
Helvick Head Offshore Wind –	Submitted but not yet determined	289.04	Site investigation surveys	Unknown	Unknown	There is potential for construction activities for the Transmission Assets to

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
site investigation surveys						overlap with site investigation activities for this project.
White Cross Offshore Wind Farm	Submitted but not yet determined	311.28	Test and Demonstration Floating Wind Farm	2025 to 2027	2027 to unknown	The construction, operation and maintenance phases of this project may temporally overlap with the construction, operation and maintenance phases of the Transmission Assets.
Celtic Offshore Wind – site investigation surveys	Submitted but not yet determined	325.28	Site investigation surveys	Unknown	Unknown	There is potential for construction activities for the Transmission Assets to overlap with site investigation activities for this project.
Simply Blue Energy (Kinsale) Limited - – site investigation surveys	Submitted but not yet determined	359.16	Site investigation surveys	Unknown	Unknown	There is potential for construction activities for the Transmission Assets to overlap with site investigation activities for this project.
Kinsale Project Offshore Wind Farm – site investigation surveys	Submitted but not yet determined	383.10	Site investigation surveys	Unknown	Unknown	There is potential for construction activities for the Transmission Assets to overlap with site investigation activities for this project.
Tier 2						
Mooir Vannin Offshore Wind Farm	Pre-application	2.59	Offshore wind farm	2030-2032	2032 to unknown	The construction, operation and maintenance phases of this project may temporally overlap with the construction

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
						and operation and maintenance phases of the Transmission Assets.
Eni Hynet – Carbon Capture Project (CCS)	Pre-application	5.74	Carbon Capture Storage project	Unknown	Unknown	The construction, operation and maintenance phases of this project may temporally overlap with the construction, operation and maintenance phases of the Transmission Assets.
North Channel Wind 2	Pre-application	106.47	Offshore Wind Farm	2027 to 2029	2029 to unknown	The construction and operation and maintenance phases of this project may temporally overlap with the construction and operation and maintenance phases of the Transmission Assets.
NISA Offshore Wind Farm	Pre-application	107.69	Offshore Wind Farm	Unknown	Unknown	The construction and operation and maintenance phases of this project may temporally overlap with the construction and operation and maintenance phases of the Transmission Assets.
Codling Wind Park Offshore Wind Farm	Pre-application	114.23	Offshore Wind Farm	Unknown	Unknown	The construction and operation and maintenance phases of this project may temporally overlap with the construction and operation and maintenance phases of the Transmission Assets.
Oriel Offshore Wind Farm	Pre-application	119.47	Offshore Wind Farm	Unknown	Unknown	The construction and operation and maintenance phases of this project may temporally overlap with the construction and operation and maintenance phases of the Transmission Assets.

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
North Channel Wind 1	Pre-application	134.47	Offshore Wind Farm	2027 to 2029	2029 to unknown	The construction and operation and maintenance phases of this project may temporally overlap with the construction and operation and maintenance phases of the Transmission Assets.
Dublin Array Offshore Wind Farm	Pre-application	134.50	Offshore Wind Farm	2026 to 2027	2027 to unknown	The construction and operation and maintenance phases of this project may temporally overlap with the construction and operation and maintenance phases of the Transmission Assets.
Codling Wind Park Extension Offshore Wind Farm	Pre-application	141.23	Offshore Wind Farm	2025 to 2027	2027 to unknown	The construction and operation and maintenance phases of this project may temporally overlap with the construction and operation and maintenance phases of the Transmission Assets.
Arklow Bank Wind Park Phase 2	Pre-application	165.19	Offshore Wind Farm	Unknown	Unknown	The construction and operation and maintenance phases of this project may temporally overlap with the construction and operation and maintenance phases of the Transmission Assets.
Loch Garman – site investigation surveys	Pre-application	193.20	Site investigation surveys	Unknown	Unknown	There is potential for construction activities for the Transmission Assets to overlap with site investigation activities for this project.
Shelmalere Offshore Wind Farm	Pre-application	200.89	Offshore Wind Farm	2028 to 2029	2029 to 2055	The construction and operation and maintenance phases of this project may temporally overlap with the construction

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
						and operation and maintenance phases of the Transmission Assets.
North Celtic Sea Offshore Wind Farm	Pre-application	276.90	Offshore Wind Farm	Unknown	Unknown	The construction and operation and maintenance phases of this project may temporally overlap with the construction and operation and maintenance phases of the Transmission Assets.
Llŷr 2	Pre-application	286.98	Floating Demonstration Project	2025 to 2026	2026 to unknown	The operation and maintenance phase of this project may temporally overlap with the operation and maintenance phase of the Transmission Assets.
Llŷr 1	Pre-application	291.76	Floating Demonstration Project	2025 to 2026	2026 to unknown	The operation and maintenance phase of this project may temporally overlap with the operation and maintenance phase of the Transmission Assets.
Inis Ealga Marine Energy Park	Pre-application	326.54	Offshore Wind Farm	2028 to 2029	2029 to Unknown	The construction, operation and maintenance phases of this project may temporally overlap with the construction, operation and maintenance phases of the Transmission Assets.
Clarus Floating Offshore Wind Farm	Pre-application	339.06	Floating Offshore Wind Farm	2028 to 2029	2029 to unknown	The construction, operation and maintenance phases of this project may temporally overlap with the construction, operation and maintenance phases of the Transmission Assets.

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
Simply Blue Emerald	Pre-application	359.16	Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phases of this project may temporally overlap with the construction, operation and maintenance phases of the Transmission Assets.
Tier 3						
MaresConnect Wales-Ireland Interconnector Cable ('MaresConnect')	Pre-application	34.44	A subsea and underground electricity interconnector system between Ireland and Great Britain	2026 to 2028	2028 to unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Cooley Point Offshore Wind Farm	Pre-application	108.19	Site investigation surveys	Unknown	Unknown	The construction, operation and maintenance phases of this project may temporally overlap with the construction, operation and maintenance phases of the Transmission Assets.
Setanta Offshore Wind Project	Pre-application	113.68	Offshore Wind Farm	2027 to 2029	2029 to unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Clogher Head Offshore Wind Farm	Pre-application	114.37	Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
						and maintenance phases of the Transmission Assets.
Lir Offshore Array	Pre-application	115.88	Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Greystones Offshore Wind Farm	Pre-application	122.97	Offshore Wind Farm	2027 to 2029	2029 to unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Realt na Mara Offshore Wind Project	Pre-application	162.10	Offshore Wind Farm	2028 to 2029	2029 to unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Mac Lir Offshore Wind Project	Pre-application	182.84	Offshore Wind Farm	2028 to 2029	2029 to unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Malin Sea Wind	Pre-application	220.38	Floating Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
Nomadic Offshore Wind Project	Pre-application	227.31	Floating Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets
Haven Offshore Array	Pre-application	247.84	Offshore Wind Farm (static and floating)	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets
Machair Wind – Hybrid Energy Project	Pre-application	253.73	Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets
Celtic Sea Array Offshore Wind Farm	Pre-application	260.55	Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets
Blackwater Offshore Wind Farm	Pre-Application	265.53	Floating Offshore Wind Farm	2027 to 2029	2029 to unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
South Pembrokeshire Demonstration Zone	Submitted but not yet determined	269.21	Wave energy demonstration projects	Unknown	Unknown	There is potential for construction and/or operational activities at the Transmission Assets to overlap with construction and/or operational activities at this project .
Celtic Horizon Offshore Wind Project	Pre-application	273.12	Offshore Wind Farm	2027 to 2029	2029 to unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
East Celtic Offshore Wind Project	Pre-application	290.28	Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Aniar Offshore Array Phase 1 Offshore Wind Project ('Aniar Offshore Array (Fixed)')	Pre-application	307.31	Offshore Wind Farm Array	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Llywelyn Offshore Wind Project	Pre-application	315.15	Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
Péarla Offshore Wind Farm	Pre-application	317.03	Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets
Arranmore Offshore Wind Project	Pre-application	319.83	Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets
Aniar Offshore Array Phase 2 Offshore Wind Project 'Aniar Offshore Array (Floating)'	Pre-application	325.39	Floating Offshore Wind Farm Array	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Inis Offshore Wind Munster	Pre-Application	326.54	Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Clarus Floating Offshore Wind Farm	Pre-application	339.06	Floating Offshore Wind Farm	2028 to 2029	2029 to unknown	The construction, operation and maintenance phases of this project may temporally overlap with the construction, operation and maintenance phases of the Transmission Assets.

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
Voyage Offshore Array	Pre-application	362.41	Floating Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Project Saoirse Wave Energy	Pre-application	372.37	Floating wind and wave energy conversion project	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Tralee Offshore Wind Project	Pre-application	416.57	Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Tulca Offshore Array Phase 2	Pre-application	427.30	Offshore Wind Farm Array	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Moneypoint One Offshore Wind Project	Pre-application	443.97	Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Cork Offshore Wind Project	Pre-application	445.46	Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
						overlap with the construction, operation and maintenance phases of the Transmission Assets.
Urban Sea Offshore Wind Project	Pre-application	488.41	Floating Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Rian Offshore Array Phase 1	Pre-application	488.86	Offshore Wind Farm Array	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Valentia Phase 1 Offshore Wind Project	Pre-application	505.85	Floating Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Valentia Phase 2 Offshore Wind Project	Pre-application	506.89	Floating Offshore Wind Farm	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Rian Offshore Array Phase 2	Pre-application	513.43	Floating Offshore Wind Farm Array	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
						and maintenance phases of the Transmission Assets.
Talisk Offshore Wind Project	Pre-application	535.12	Floating Offshore Wind Farm	2028 to 2029	2029 to unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Isle of Man-UK Interconnector 2	Pre-application	N/A	70 MW to 100 MW HVAC interconnector between Pulrose substation and north west England Distribution network	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.
Mooir Vannin UK Transmission Assets	Pre-application	N/A	TBC	Unknown	Unknown	The construction, operation and maintenance phase of this project may overlap with the construction, operation and maintenance phases of the Transmission Assets.

4.12.2 Scope of cumulative effects assessment

4.12.2.1 The impacts identified in **Table 4.39** have been selected as those having the potential to result in the greatest cumulative effect on an identified receptor or receptor group. The cumulative effects presented and assessed in this section have been selected from the Project Design Envelope provided in Volume 1, Chapter 5: Project Description of the ES as well as the publicly available information on other projects and plans. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Design Envelope (e.g., different foundation type or substation layout), to that assessed here, be taken forward in the final design scheme.

4.12.2.2 Some of the potential impacts considered within the Transmission Assets alone assessment are specific to a particular phase of development (e.g. construction, operation and maintenance, or decommissioning). Where there is no spatial or temporal overlap with the activities during certain phases of the Transmission Assets, impacts associated with other projects listed in **Table 4.38**, may be excluded from further consideration.

4.12.2.3 The assessment of cumulative effects with relevant projects is based on information available in the public domain. Only potential impacts screened in for the assessment for Transmission Assets alone are considered (**Table 4.13**). In this regard, where an impact has been considered in the relevant projects' ES (Tier 1 projects) or screened in as a result of inclusion in the available Scoping Report (Tier 2 projects), a potential for cumulative effects is considered and the impact will be considered further in **section 4.13**. Given the limited data about Tier 3 projects available at the time of writing, projects were screened in precautionarily based on temporal and/or spatial overlap.

Some impacts are not included in the scope of the Transmission Assets ES CEA (see **Table 4.12**) but are included in the scope of the Generation Assets respective ESs. The MDS for the CEA for these impacts is therefore assessed in either the Morgan Offshore Wind Project: Generation Assets ES, or the Morecambe Offshore Windfarm: Generation Assets ES.

Table 4.39: Scope of assessment of cumulative effects

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
Injury and disturbance from elevated underwater sound during UXO clearance	✓	✗	✗	MDS as described for the Transmission Assets (**Table 4.13**) assessed cumulatively with the following other projects/plans: • Morgan Offshore Wind Project: Generation Assets • Morecambe Offshore Wind Project: Generation Assets. **Tier 1 projects** • Awel y Môr Offshore Wind Farm • Mona Offshore Wind Project • Project Erebus Floating Wind Demonstration • White Cross Offshore Wind Farm **Tier 2 projects** • Llŷr 1 • Llŷr 2 • Shelmalere Offshore Wind Farm • Inis Ealga Marine Energy Park • North Channel Wind 1 • North Channel Wind 2 • Mooir Vannin Offshore Wind Farm • Dublin Array Offshore Wind Farm • Projects with no temporal information available: Arklow Bank Wind Park Phase 2, Codling Wind Park Extension Offshore Wind Farm, Eni Hynet CCS, North Celtic Sea Offshore Wind Farm, Oriel Offshore Wind Farm, NISA Offshore Wind Farm and Simply Blue Emerald.	The ZoI for UXO clearance can extend beyond the boundaries of other proposed offshore wind farms. Therefore, of proposed projects listed **Table 4.39**, the cumulative assessment has screened in projects within the cumulative marine mammal study area (the Irish Sea and wider Celtic Sea) whose construction phases (which would include pre-construction UXO clearance) overlap temporally with the construction phase for the Transmission Assets. Note, projects with completed UXO clearance campaigns are screened out of the assessment. Projects whose construction phase finishes in a year preceding the commencement of construction phase at the Transmission Assets (2026) were screened in as the sequential UXO clearance at respective projects could lead to a longer duration of impacts affecting marine mammals. The MDS for each project is presented in **section 4.13.2**.

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				Tier 3 projects • Blackwater Offshore Wind Farm • Clarus Floating Offshore Wind Farm • Celtic Horizon Offshore Wind Project • Greystones Offshore Wind Farm • Mac Lir Offshore Wind Project • Talisk Offshore Wind Project • Realt na Mara Offshore Wind Project • Setanta Offshore Wind Project • MaresConnect • Projects with no temporal information available: Aniar Offshore Array (Fixed), Aniar Offshore Array (Floating), Arranmore Offshore Wind Project, Celtic Sea Array Offshore Wind Farm, Clogher Head Offshore Wind Farm, Cooley Point Offshore Wind Farm, Cork Offshore Wind Project, East Celtic Offshore Wind Project, Haven Offshore Array, Inis Offshore Wind Munster, Lir Offshore Array, Llywelyn Offshore Wind Project, Machair Wind – Hybrid Energy Project, Malin Sea Wind, Moneypoint Offshore One, Nomadic Offshore Wind Project, Péarla Offshore Wind Farm, Project Saoirse Wave Energy, Rian Offshore Array Phase 1, Rhian Offshore Array Phase 2, South Pembrokeshire Demonstration Zone, Tralee Offshore Wind Project, Tulca Offshore Array Phase 2, Urban Sea Offshore Wind Project, Valentia Phase 1 Offshore Wind Project, Valentia Phase 2 Offshore Wind Project, and Voyage Offshore Array.	
Injury and disturbance to marine mammals from elevated	✓	✓	✓	**Construction phase:** MDS as described for the Transmission Assets (**Table 4.13**) assessed cumulatively with the following other projects/plans:	It is expected that each project will contribute to the increase of vessel traffic and hence to the amount of vessel sound in the environment during the

Cumulative effect	Phase[a] C	O	D	Project(s) considered	Justification
underwater sound due to vessel use and other sound-producing activities				• Morgan Offshore Wind Project: Generation Assets • Morecambe Offshore Wind Project: Generation Assets. **Tier 1 projects** • Awel y Môr Offshore Wind Farm • Project Erebus Floating Wind Demonstration • West Anglesey Demonstration Zone tidal site. • Mona Offshore Wind Project • White Cross Offshore Wind Farm **Tier 2 projects** • Shelmalere Offshore Wind Farm • Dublin Array Offshore Wind Farm • Inis Ealga Marine Energy Park • Llŷr 1 • Llŷr 2 • North Channel Wind 1 • North Channel Wind 2 • Mooir Vannin Offshore Wind Farm • Projects with no temporal information available: Arklow Bank Wind Park Phase 2, Codling Wind Park, Eni Hynet CCS, NISA Offshore Wind Farm, Simply Blue Emerald, Oriel Offshore Wind Farm, North Celtic Sea Offshore Wind Farm. **Tier 3 projects** • Blackwater Offshore Wind Farm • Clarus Floating Offshore Wind Farm	construction, operation and maintenance, and decommissioning phases. Therefore, of proposed projects listed in **Table 4.39**, the cumulative assessment has screened in projects within the cumulative marine mammal study area whose construction, operation and maintenance, and decommissioning phases overlap temporally with the construction, operation and maintenance, and decommissioning phases for the Transmission Assets. The MDS for each project is presented in **section 4.13.3**.

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				Celtic Horizon Offshore Wind Project. • Greystones Offshore Wind Farm • Mac Lir Offshore Wind Project • Realt na Mara Offshore Wind Project • Setanta Offshore Wind Project • MaresConnect • Projects with no temporal information available: Aniar Offshore Array (Fixed), Aniar Offshore Array (Floating), Arranmore Offshore Wind Project, Celtic Sea Array Offshore Wind Farm, Clogher Head Offshore Wind Farm, Cork Offshore Wind Project, Inis Offshore Wind Munster, East Celtic Offshore Wind Project, Haven Offshore Array Wind Farm, Inis Offshore Wind Munster, Isle of Man-UK Interconnector 2, Lir Offshore Array, Llywelyn Offshore Wind Project, Machair Wind – Hybrid Energy Project, Mooir Vannin UK Transmission Assets, Moneypoint Offshore One, Péarla Offshore Wind Farm, Nomadic Offshore Wind Project, Project Saoirse Wave Energy, Rian Offshore Array Phase 1, Rian Offshore Array Phase 2, South Pembrokeshire Demonstration Zone, Tralee Offshore Wind Project, Tulca Offshore Array Phase 2, Urban Sea Offshore Wind Project, Valentia Phase 1 Offshore Wind Project, Valentia Phase 2 Offshore Wind Project and Voyage Offshore Array. **Operation and maintenance phase:** MDS as described for the Transmission Assets (**Table 4.13**) assessed cumulatively with the following other projects/plans: • Morgan Offshore Wind Project: Generation Assets • Morecambe Offshore Wind Project: Generation Assets. **Tier 1 projects** • Awel y Môr Offshore Wind Farm	

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				• Project Erebus Floating Wind Demonstration • West Anglesey Demonstration Zone tidal site • Mona Offshore Wind Project • White Cross Offshore Wind Farm **Tier 2 projects** • Shelmalere Offshore Wind Farm • Dublin Array Offshore Wind Farm • Inis Ealga Marine Energy Park • Llŷr 1 • Llŷr 2 • North Channel Wind 1 • North Channel Wind 2 • Mooir Vannin Offshore Wind Farm • Projects with no temporal information available: Arklow Bank Wind Park Phase 2, Codling Wind Park, Eni Hynet CCS, Simply Blue Emerald, NISA Offshore Wind Farm, Oriel Offshore Wind Farm, North Celtic Sea Offshore Wind Farm. **Tier 3 projects** • Blackwater Offshore Wind Farm • Clarus Floating Offshore Wind Farm • Celtic Horizon Offshore Wind Project • Greystones Offshore Wind Farm • Mac Lir Offshore Wind Project • Talisk Offshore Wind Project	

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				• Realt na Mara Offshore Wind Project. • Setanta Offshore Wind Project • MaresConnect • Projects with no temporal information available: Aniar Offshore Array (Fixed), Aniar Offshore Array (Floating), Arranmore Offshore Wind Project, Celtic Sea Array Offshore Wind Farm, Clogher Head Offshore Wind Farm, Cork Offshore Wind Project, Inis Offshore Wind Munster, East Celtic Offshore Wind Project, Haven Offshore Array Wind Farm, Inis Offshore Wind Munster, Isle of Man-UK Interconnector 2, Lir Offshore Array, Llywelyn Offshore Wind Project, Machair Wind – Hybrid Energy Project, Mooir Vannin UK Transmission Assets, Moneypoint Offshore One, Péarla Offshore Wind Farm, Nomadic Offshore Wind Project, Project Saoirse Wave Energy, Rian Offshore Array Phase 1, Rian Offshore Array Phase 2, South Pembrokeshire Demonstration Zone, Tralee Offshore Wind Project, Tulca Offshore Array Phase 2, Urban Sea Offshore Wind Project, Valentia Phase 1 Offshore Wind Project, Valentia Phase 2 Offshore Wind Project and Voyage Offshore Array. **Decommissioning phase:** MDS as described for the Transmission Assets (**Table 4.13**) assessed cumulatively with the following other projects/plans: • Morgan Offshore Wind Project: Generation Assets • Morecambe Offshore Wind Project: Generation Assets. **Tier 1 projects** • Mona Offshore Wind Project • Projects with no temporal information available for the decommissioning phase: White Cross Offshore Wind Farm and Project Erebus Floating Wind Demonstration.	

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				Tier 2 projects • Projects with no temporal information available for the decommissioning phase: Mooir Vannin Offshore Wind Farm, Eni Hynet – Carbon Capture Project (CCS), Codling Wind Park Offshore Wind Farm, Oriel Offshore Wind Farm, Dublin Array Offshore Wind Farm, Codling Wind Park Extension Offshore Wind Farm, Arklow Bank Wind Park Phase 2, North Celtic Sea Offshore Wind Farm, Llŷr 2, Llŷr 1, North Channel Wind 2, NISA Offshore Wind Farm, North Channel Wind 1, Inis Ealga Marine Energy Park and Simply Blue Emerald. **Tier 3 projects** • Projects with no temporal information available for the decommissioning phase: Malin Sea Wind, Clarus Floating Offshore Wind Farm, Project Saoirse Wave Energy, MaresConnect Wales-Ireland Interconnector Cable (‘MaresConnect’), Cooley Point Offshore Wind Farm, Setanta Offshore Wind Project, Clogher Head Offshore Wind Farm, Lir Offshore Array, Greystones Offshore Wind Farm, Realt na Mara Offshore Wind Project,Mac Lir Offshore Wind Project, Nomadic Offshore Wind Project, Haven Offshore Array, Machair Wind – Hybrid Energy Project, Celtic Sea Array Offshore Wind Farm, Blackwater Offshore Wind Farm, South Pembrokeshire Demonstration Zone, Celtic Horizon Offshore Wind Project, East Celtic Offshore Wind Project, Aniar Offshore Array Phase 1 Offshore Wind Project ('Aniar Offshore Array (Fixed)’), Llywelyn Offshore Wind Project, Péarla Offshore Wind Farm, Arranmore Offshore Wind Project, Aniar Offshore Array Phase 2 Offshore Wind Project , ‘Aniar Offshore Array (Floating)’, Inis Offshore Wind Munster, Voyage Offshore Array, Tralee Offshore Wind Project, Tulca Offshore Array Phase 2, Moneypoint One Offshore Wind Project, Cork Offshore Wind Project, Urban Sea Offshore Wind Project, Rian Offshore Array Phase 1, Valentia Phase 1 Offshore Wind Project, Valentia Phase 2 Offshore Wind Project, Rian Offshore Array Phase 2, Talisk Offshore Wind Project, Mooir Vannin UK Transmission Assets and Isle of Man-UK Interconnector 2.	

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
Increased likelihood of injury due to collision with vessels	✓	✓	✓	**Construction phase:** MDS as described for the Transmission Assets (**Table 4.13**) assessed cumulatively with the following other projects/plans: • Morgan Offshore Wind Project: Generation Assets • Morecambe Offshore Windfarm: Generation Assets. **Tier 1 projects** • Awel y Môr Offshore Wind Farm • Project Erebus Floating Wind Demonstration • West Anglesey Demonstration Zone tidal site • Mona Offshore Wind Project • White Cross Offshore Wind Farm. **Tier 2 projects** • Dublin Array Offshore Wind Farm • Inis Ealga Marine Energy Park • Llŷr 1 • Llŷr 2 • Mooir Vannin Offshore Wind Farm • North Channel Wind 1 • North Channel Wind 2 • Shelmalere Offshore Wind Farm. • Projects with no temporal information available: Oriel Offshore Wind Farm, Arklow Bank Wind Park Phase 2, Codling Wind Park Offshore Wind Farm, Simply Blue Emerald, NISA Offshore Wind Farm, North Celtic Sea Offshore Wind Farm.	It is expected that each project will contribute to the increase of vessel traffic and hence to the potential risk of collision during the construction, operation and maintenance, and decommissioning phases. However, the risk of collision would be expected to be localised to within the close vicinity of the respective projects. Nevertheless, of proposed projects listed in **Table 4.39**, the cumulative assessment has screened in projects within the cumulative marine mammal study area whose construction, operation and maintenance, and decommissioning phases overlap temporally with the construction, operation and maintenance, and decommissioning phases for the Transmission Assets. The MDS for each project is presented in **section 4.13.4**.

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				Tier 3 projects Blackwater Offshore Wind Farm • Celtic Horizon Offshore Wind Project • Greystones Offshore Wind Farm • Mac Lir Offshore Wind Project • Talisk Offshore Wind Project • Realt na Mara Offshore Wind Project • Setanta Offshore Wind Project • MaresConnect • Projects with no temporal information available: Aniar Offshore Array (Fixed), Aniar Offshore Array (Floating), Arranmore Offshore Wind Project, Celtic Sea Array Offshore Wind Farm , Clogher Head Offshore Wind Farm, Codling Wind Park Extension Offshore Wind Farm, Cooley Point Offshore Wind Farm, Cork Offshore Wind Project, Inis Offshore Wind Munster, East Celtic Offshore Wind Project, Haven Offshore Array Wind Farm, Lir Offshore Array, Llywelyn Offshore Wind Project, Machair Wind – Hybrid Energy Project, Malin Sea Wind, Moneypoint Offshore One, Nomadic Offshore Wind Project, Péarla Offshore Wind Farm, Project Saoirse Wave Energy, South Pembrokeshire Demonstration Zone, Rian Offshore Array Phase 1, Rian Offshore Array Phase 2, Tralee Offshore Wind Project, Tulca Offshore Array Phase 2, Urban Sea Offshore Wind Project, Valentia Phase 1 Offshore Wind Project, Valentia Phase 2 Offshore Wind Project and Voyage Offshore Array. **Operation and maintenance phase**: MDS as described for the Transmission Assets (**Table 4.13**) assessed cumulatively with the following other projects/plans. • Morgan Offshore Wind Project: Generation Assets • Morecambe Offshore Windfarm: Generation Assets.	

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				Tier 1 projects • Awel y Môr Offshore Wind Farm • Project Erebus Floating Wind Demonstration • West Anglesey Demonstration Zone tidal site • Mona Offshore Wind Project • White Cross Offshore Wind Farm. **Tier 2 projects** • Dublin Array Offshore Wind Farm • Inis Ealga Marine Energy Park • Llŷr 1 • Llŷr 2 • Mooir Vannin Offshore Wind Farm • North Channel Wind 1 • North Channel Wind 2 • Shelmalere Offshore Wind Farm. • Projects with no temporal information available: Arklow Bank Wind Park Phase 2, Codling Wind Park Extension Offshore Wind Farm, Eni Hynet CCS, North Celtic Sea Offshore Wind Farm, NISA Offshore Wind Farm, Oriel Offshore Wind Farm and Simply Blue Emerald. **Tier 3 projects** • Blackwater Offshore Wind Farm • Celtic Horizon • Greystones Offshore Wind Farm • Mac Lir Offshore Wind Project	

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				• Talisk Offshore Wind Projec. • Realt na Mara Offshore Wind Project • Setanta Offshore Wind Project • MaresConnect. • Projects with no temporal information available: Aniar Offshore Array (Fixed), Aniar Offshore Array (Floating), Arranmore Offshore Wind Project,Clogher Head Offshore Wind Farm, Codling Wind Park Extension Offshore Wind Farm, Celtic Sea Array Offshore Wind Farm, Cooley Point Offshore Wind Farm, Cork Offshore Wind Project, Inis Offshore Wind Munster, East Celtic Offshore Wind Project, Haven Offshore Array Wind Farm, Lir Offshore Array, Llywelyn Offshore Wind Project, Machair Wind – Hybrid Energy Project, Malin Sea Wind, Moneypoint Offshore One, Nomadic Offshore Wind Project, Péarla Offshore Wind Farm, Project Saoirse Wave Energy, South Pembrokeshire Demonstration Zone, Rian Offshore Array Phase 1, Rian Offshore Array Phase 2, South Pembrokeshire Demonstration Zone, Tralee Offshore Wind Project, Tulca Offshore Array Phase 2, Urban Sea Offshore Wind Project, Valentia Phase 1 Offshore Wind Project, Valentia Phase 2 Offshore Wind Project and Voyage Offshore Array. **Decommissioning phase:** MDS as described for the Transmission Assets (**Table 4.13**) assessed cumulatively with the following other projects/plans: • Morgan Offshore Wind Project: Generation Assets. • Morecambe Offshore Wind Project: Generation Assets. **Tier 1 projects** • Mona Offshore Wind Project.	

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				• Projects with no temporal information available for the decommissioning phase: White Cross Offshore Wind Farm and Project Erebus Floating Wind Demonstration. **Tier 2 projects** • Projects with no temporal information available for the decommissioning phase: Mooir Vannin Offshore Wind Farm, Eni Hynet – Carbon Capture Project (CCS), Codling Wind Park Offshore Wind Farm, Oriel Offshore Wind Farm, Dublin Array Offshore Wind Farm, Codling Wind Park Extension Offshore Wind Farm, Arklow Bank Wind Park Phase 2, North Celtic Sea Offshore Wind Farm, Llŷr 2, Llŷr 1, North Channel Wind 2, NISA Offshore Wind Farm, North Channel Wind 1, Inis Ealga Marine Energy Park and Simply Blue Emerald. **Tier 3 projects** • Projects with no temporal information available for the decommissioning phase: Malin Sea Wind, Clarus Floating Offshore Wind Farm, Project Saoirse Wave Energy, MaresConnect Wales-Ireland Interconnector Cable ('MaresConnect'), Cooley Point Offshore Wind Farm, Setanta Offshore Wind Project, Clogher Head Offshore Wind Farm, Lir Offshore Array, Greystones Offshore Wind Farm, Realt na Mara Offshore Wind Project,Mac Lir Offshore Wind Project, Nomadic Offshore Wind Project, Haven Offshore Array, Machair Wind – Hybrid Energy Project, Celtic Sea Array Offshore Wind Farm, Blackwater Offshore Wind Farm, South Pembrokeshire Demonstration Zone, Celtic Horizon Offshore Wind Project, East Celtic Offshore Wind Project, Aniar Offshore Array Phase 1 Offshore Wind Project ('Aniar Offshore Array (Fixed)'), Llywelyn Offshore Wind Project, Péarla Offshore Wind Farm, Arranmore Offshore Wind Project, Aniar Offshore Array Phase 2 Offshore Wind Project , 'Aniar Offshore Array (Floating)', Inis Offshore Wind Munster, Voyage Offshore Array, Tralee Offshore Wind Project, Tulca Offshore Array Phase 2, Mooir Vannin UK Transmission Assets ,	

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				Moneypoint One Offshore Wind Project, Cork Offshore Wind Project, Urban Sea Offshore Wind Project, Rian Offshore Array Phase 1, Valentia Phase 1 Offshore Wind Project, Valentia Phase 2 Offshore Wind Project, Rian Offshore Array Phase 2, Talisk Offshore Wind Project and Isle of Man-UK Interconnector 2.	
Effects on marine mammals due to changes in prey availability	✓	✗	✓	MDS as described for the Transmission Assets (**Table 4.13**) assessed cumulatively with projects listed in Volume 2, Chapter 3: Fish and shellfish ecology	It is expected that potential cumulative effects on fish and shellfish communities, as identified in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, may have indirect effects on marine mammals. As identified in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, for the purposes of the fish and shellfish ecology assessment of effects, cumulative effects have been assessed within a representative 50 km buffer from the Transmission Assets. This 50 km buffer applies to all impacts considered in the assessment, except underwater sound, where a larger buffer of 100 km has been used to account for the greater zone of influence associated with construction phase. The MDS for each project is presented in **section 4.13.5.**

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
Injury and disturbance from underwater sound generated from pre-construction survey sources	✓	×	×	MDS as described for the Transmission Assets (**Table 4.13**) assessed cumulatively with the following other projects/plans: • Morgan Offshore Wind Project: Generation Assets • Morecambe Offshore Windfarm: Generation Assets. **Tier 1 projects** • Mona Offshore Wind Project. There are up to 12 Tier 1 site investigation surveys identified in the CEA screening area for marine mammals: • Banba Offshore Wind – site investigation surveys • ESB Celtic Offshore Wind - site Investigations surveys • Sea Stacks Offshore Wind – site investigation surveys • Helvick Head Offshore Wind – site investigation surveys • Mainstream, Renewable Power Ltd- Site Investigations • Dublin Array Offshore Wind Farm – site investigation surveys • Shelmalere Offshore Wind Farm - site investigations surveys • Kinsale Project Offshore Wind Farm – site investigation surveys • Sunrise Offshore Wind Farm – site investigation surveys • Wicklow Project Offshore Wind Farm – site investigation surveys • SSE Renewables Celtic Sea - site investigation surveys • Simply Blue Energy (Kinsale) Limited - site investigation surveys • NISA Offshore Wind Farm - site investigation surveys.	It is anticipated that the magnitude of the impacts will be of a similar scale to that described for the Transmission Assets with the potential to experience disturbance over a range of up to 18 km. Therefore, the screening exercise has screened in projects within an 18 km buffer from the Transmission Assets whose construction phases (which would include pre-construction site investigation surveys) overlap temporally with the construction phase for the Transmission Assets. The MDS for each project is presented in **section 4.13.6**.

[a] C=construction phase, O=operation and maintenance phase, D=decommissioning phase

Table 4.40: Temporal time scale for potential cumulative projects with direct impacts on marine mammals

Cells shaded in blue refer to construction not started, cells in green refer to construction phase, cells in grey refer to operation and maintenance phase.

Tier	Project	Distance from the Transmission Assets (km)	2024	2025	2026	2027	2028	2029	2030 onward	Operational end date
	Morecambe Offshore Windfarm: Generation Assets	0								2065
	Morgan Offshore Wind Project: Generation Assets	0								2065
Tier 1	Mona Offshore Wind Project	9.73								2065
	Awel y Môr Offshore Wind Farm	28.87								2055
	West Anglesey Demonstration Zone (Morlais)	78.71								2061
	Mainstream, Renewable Power Ltd - site investigation surveys off Co, Dublin	104.21	Unknown							
	Northern Irish Sea Array (NISA) Site investigation surveys	107.69								2027
	Sunrise Offshore Wind Farm - site investigation surveys	124.75	Unknown							

Tier	Project	Distance from the Transmission Assets (km)	2024	2025	2026	2027	2028	2029	2030 onward	Operational end date
	Sea Stacks Offshore Wind - site investigation surveys	127.44	Unknown							
	Banba Offshore Wind - site investigation surveys	133.13	Unknown							
	Dublin Array Offshore Wind Farm - site investigation surveys	134.50	Unknown							
	Wicklow Project Offshore Wind - site investigation surveys	149.47	Unknown							
	Shelmalere Offshore Wind - site investigation surveys	182.88	Unknown							
	SSE Renewables Celtic Sea	260.55	Unknown							
	Helvick Head Offshore Wind – site investigation surveys	289.04	Unknown							
	White Cross Offshore Wind Farm	311.28								Unknown
	Celtic Offshore Wind – site investigation surveys	325.28	Unknown							

Tier	Project	Distance from the Transmission Assets (km)	2024	2025	2026	2027	2028	2029	2030 onward	Operational end date
	Simply Blue Energy (Kinsale) Limited - – site investigation surveys	359.16	Unknown							
	Kinsale Project Offshore Wind Farm – site investigation surveys	383.10	Unknown							
	Project Erebus Floating Wind Demonstration	284.61								Unknown
Tier 2	Mooir Vannin Offshore Wind Farm	2.59								Unknown
	Eni Hynet – Carbon Capture Project (CCS)	5.74	Unknown							
	Codling Wind Park Offshore Wind Farm	141.23	Unknown							
	Oriel Offshore Wind Farm	119.47	Unknown							
	Dublin Array Offshore Wind Farm	134.50								Unknown
	Codling Wind Park Extension Offshore Wind Farm	141.23								Unknown
	Arklow Bank Wind Park Phase 2	165.19	Unknown							

Tier	Project	Distance from the Transmission Assets (km)	2024	2025	2026	2027	2028	2029	2030 onward	Operational end date
	Loch Garman – site investigation surveys	193.20	Unknown							
	Shelmalere Offshore Wind Farm	200.89								2055
	North Celtic Sea Offshore Wind Farm	276.90	Unknown							
	Llŷr 2	286.98								Unknown
	Llŷr 1	291.76								Unknown
	Inis Ealga Marine Energy Park	326.54								Unknown
	North Channel Wind 1	134.47								Unknown
	North Channel Wind 2	106.47								Unknown
	NISA Offshore Wind Farm	107.69	Unknown							
Tier 3	Simply Blue Emerald	359.16	Unknown							
	Clarus Floating Offshore Wind Farm	339.06	Unknown							
	Project Saoirse Wave Energy	372.37	Unknown							
	Malin Sea Wind	22.38	Unknown							

Tier	Project	Distance from the Transmission Assets (km)	2024	2025	2026	2027	2028	2029	2030 onward	Operational end date
	MaresConnect Wales-Ireland Interconnector Cable ('MaresConnect')	34.44								Unknown
	Cooley Point Offshore Wind Farm	108.19	Unknown							
	Setanta Offshore Wind Project	113.68								Unknown
	Clogher Head Offshore Wind Farm	114.37	Unknown							
	Lir Offshore Array	115.88	Unknown							
	Greystones Offshore Wind Farm	122.97								Unknown
	Realt na Mara Offshore Wind Project	162.10								Unknown
	Mac Lir Offshore Wind Project	182.84								Unknown
	Nomadic Offshore Wind Project	227.31	Unknown							
	Haven Offshore Array	247.84	Unknown							
	Machair Wind – Hybrid Energy Project	253.73	Unknown							
	Celtic Sea Array Offshore Wind Farm	260.55	Unknown							

Tier	Project	Distance from the Transmission Assets (km)	2024	2025	2026	2027	2028	2029	2030 onward	Operational end date
	Blackwater Offshore Wind Farm	265.53								Unknown
	South Pembrokeshire Demonstration Zone	269.21	Unknown							
	Celtic Horizon Offshore Wind Project	273.12								Unknown
	East Celtic Offshore Wind Project	290.28	Unknown							
	Aniar Offshore Array Phase 1 Offshore Wind Project ('Aniar Offshore Array (Fixed)')	307.31	Unknown							
	Llywelyn Offshore Wind Project	315.15	Unknown							
	Péarla Offshore Wind Farm	317.03	Unknown							
	Arranmore Offshore Wind Project	319.83	Unknown							
	Aniar Offshore Array Phase 2 Offshore Wind Project 'Aniar Offshore Array (Floating)'	325.39	Unknown							
	Inis Offshore Wind Munster	326.54	Unknown							
	Voyage Offshore Array	362.41	Unknown							

Tier	Project	Distance from the Transmission Assets (km)	2024	2025	2026	2027	2028	2029	2030 onward	Operational end date
	Tralee Offshore Wind Project	416.57	Unknown							
	Tulca Offshore Array Phase 2	427.30	Unknown							
	Moneypoint One Offshore Wind Project	443.97	Unknown							
	Cork Offshore Wind Project	445.46	Unknown							
	Urban Sea Offshore Wind Project	488.41	Unknown							
	Urban Sea Offshore Wind Project	488.41	Unknown							
	Rian Offshore Array Phase 1	488.86	Unknown							
	Valentia Phase 1 Offshore Wind Project	505.85	Unknown							
	Valentia Phase 2 Offshore Wind Project	506.89	Unknown							
	Rian Offshore Array Phase 2	513.43	Unknown							
	Talisk Offshore Wind Project	535.12								Unknown
	Isle of Man Offshore Wind Farm	N/A	Unknown							

Tier	Project	Distance from the Transmission Assets (km)	2024	2025	2026	2027	2028	2029	2030 onward	Operational end date
	Mooir Vannin UK Transmission Assets	N/A	Unknown							

4.13 Cumulative effects assessment

4.13.1 Introduction

4.13.1.1 A description of the significance of cumulative effects upon marine mammal receptors arising from each identified impact is given below.

4.1.1.3 The CEA is presented in a series of tables (one for each potential cumulative impact) and considers the following.

- Scenario 1: Transmission Assets together with Morecambe Offshore Windfarm: Generation Assets.
- Scenario 2: Transmission Assets together with Morgan Offshore Wind Project: Generation Assets.
- Scenario 3: Transmission Assets together with Generation Assets.
- Scenario 4a to 4c: Transmission Assets together with Generation Assets and other relevant projects and plans.

4.13.2 Injury and disturbance from elevated underwater sound during UXO clearance

4.13.2.1 As for the assessment of the Transmission Assets alone, whilst the duration of impact (elevated underwater sound) for each UXO detonation is very short (seconds), elevation in subsea sound during clearance could potentially lead to PTS and behavioural effects. Given that there are no published thresholds for behavioural effects from UXO clearance, the use of the TTS-onset threshold was considered as a proxy for disturbance and referred to as such in this section) (see **paragraph 4.11.2.43** for more details).

4.13.2.2 An assessment of the potential for cumulative impacts as a result of injury and disturbance from elevated underwater sound during UXO clearance has been presented in full in **Appendix A**, **section A.1**. A summary of the assessments for Transmission Assets alongside the Generations Assets is presented in **Table 4.42**, and alongside other relevant Tier 1 projects, Tier 2 projects and Tier 3 projects in **Table 4.43** below.

Table 4.41: Injury and disturbance from elevated underwater sound during UXO clearance (Scenario 1, Scenario 2, Scenario 3)

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
Construction phase			
Sensitivity of receptor	The sensitivity of marine mammals to injury and disturbance from elevated underwater sound during UXO clearance is as described in **paragraph 4.11.2.4** *et seq*. and **paragraph 4.11.2.10** *et seq.* and is not reiterated in detail here. PTS As a result of UXO clearance, all marine mammals are deemed to have limited resilience, low recoverability and international value. The sensitivity of the receptors to PTS is therefore, considered to be **high**. Behavioural disturbance (using TTS-onset as a proxy) As a result of UXO clearance, all marine mammals are deemed to have some resilience, high recoverability and international value. The sensitivity of the receptor to TTS is therefore, considered to be **low**.		
Magnitude of impact	The cumulative effects assessment for Scenario 1 considers the following. • Number of UXO requiring clearing at the Transmission Assets: 25 UXO (up to 22 UXO at the Morgan Offshore Wind Project: Transmission Assets and three UXO at the Morecambe Offshore Windfarm: Transmission Assets). • The Morecambe Offshore Windfarm: Generation Assets did not identify the number of UXO requiring clearing • Both projects present impact ranges for low order clearance	The cumulative effects assessment for Scenario 2 considers the following. • Number of UXO requiring clearing at each project: – 25 UXO at the Transmission Assets (up to 22 UXO at the Morgan Offshore Wind Project: Transmission Assets and three UXO at the Morecambe Offshore Windfarm: Transmission Assets); and – 13 UXO at the Morgan Offshore Wind Project: Generation Assets. • Both projects present a range of impacts for low order clearance as well as low-yield donor charges, however the assessment is based on worst case high	The cumulative effects assessment for Scenario 3 considers the following. – 25 UXO at the Transmission Assets (up to 22 UXO at the Morgan Offshore Wind Project: Transmission Assets and three UXO at the Morecambe Offshore Windfarm: Transmission Assets). – 13 UXO at the Morgan Offshore Wind Project: Generation Assets. – The Morecambe Offshore Windfarm: Generation Assets but did not identify the

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	as well as high order clearance. The Transmission Assets also presented impact ranges for as low-yield donor charges. • The assessment for Transmission Assets is based on higher order clearance of 907 kg (absolute maximum) whereas Morecambe Offshore Windfarm: Generation Assets assessment is based on higher order clearance of 3546 kg (plus donor charge) (absolute maximum). • Number of animals likely to experience PTS and behavioural disturbance (TTS as a proxy) as a result of UXO clearance was established for both projects for a range of UXO sizes, for both low order and high order clearance. • The Transmission Assets also identified that there would be a residual risk of injury over a range of 2,290 m for harbour porpoise only (based on clearance of 907 kg UXO) that would require further mitigation (CoT64) (**Table 4.12**). • The Morecambe Offshore Windfarm: Generation Assets, in line with the Transmission Assets stated that numbers presented are expected to be highly precautionary. The	order clearance of 907 kg (absolute maximum). • Number of animals likely to experience PTS and behavioural disturbance (using TTS as a proxy) as a result of UXO clearance was established for both projects, with and without embedded mitigation (for PTS) (see CoT64 (**Table 4.12**) for the Transmission Assets). • The Morgan Offshore Wind Project: Generation Assets, in line with the Transmission Assets identified that clearance of UXO with an NEQ of 130 kg is considered the more likely (common) maximum scenario. As such, the numbers presented are expected to be highly precautionary. Proposed mitigation measures for both Transmission Assets and Morgan Offshore Wind Project: Generation Assets for UXO clearance include the application of a UXO-specific measures within the MMMPs (CoT64) (**Table 4.12**) (document reference: J18), using low order techniques, where possible, as the primary mitigation measure alongside other measures as may be agreed with Natural England and the MMO (such as including the use of MMObs, PAM and ADDs). • With primary measures in place the Morgan Offshore Wind Project: Generation Assets, in line with the	number of UXO requiring clearing. • The approach to assessing the cumulative impact of injury and disturbance from elevated underwater sound during UXO clearance is as per Scenario 1 and Scenario 2 respectively. • Whilst cumulatively there are more clearance events considered, and a spatial MDS would occur where UXO clearance activities coincide at all three project, it is not expected that injury and disturbance from elevated underwater sound during UXO clearance would be significantly higher than Scenario 1 or Scenario 2 separately. • UXO clearance activities would likely take place before construction activities commence, and whilst there may be some overlap in pre-construction activities, UXO clearance at each project will occur as a discrete stage within the overall construction phase. Furthermore, each clearance event results in a very short duration of sound emission

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	proposed mitigation measures for consideration in the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) for UXO clearance, as set out in the Morecambe Offshore Windfarm: Generation Assets ES include the use of low-order clearance techniques such as deflagration, potential use of bubble curtains, establishing a monitoring zone and surveying prior to UXO clearance (MMObs and potentially PAMs), and the use of ADDs. • The Morecambe Offshore Windfarm: Generation Assets ES also presented numbers of animals likely to be disturbed via: – 26 km Effective Disturbance Range (EDR) for harbour porpoise; – 5 km disturbance range for all marine mammal receptors; and – during ADD activation over 80 minutes for high order UXO clearance. • UXO clearance activities would likely take place before construction activities commence, and whilst there may be some overlap in pre-construction	Transmission Assets, found that there would be a residual risk of injury over a range of 2,290 m for harbour porpoise only (based on clearance of 907 kg UXO) that would require further mitigation. Therefore the Morgan Offshore Wind Project: Generation Assets will be adopting standard industry practice (JNCC, 2010b) tertiary measures as part of detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) (as an annex to an Underwater sound management strategy discussed and agreed with consultees post-consent. • UXO clearance activities would likely take place before construction activities commence, and whilst there may be some overlap in pre-construction activities, UXO clearance at each project will occur as a discrete stage within the overall construction phase. Furthermore, each clearance event results in a very short duration of sound emission (seconds) and therefore the impact will be short in duration and unlikely to overlap. Production of underwater sound during detonation of UXOs at both projects has the potential to cause behavioural disturbance in marine mammal receptors, however, this effect will be short-lived and reversible. Since behavioural disturbance is a recoverable and the duration of impact will be very	(seconds) and therefore the impact will be short in duration and unlikely to overlap. Production of underwater sound during detonation of UXOs at all three projects has the potential to cause behavioural disturbance in marine mammal receptors, however, this effect will be short-lived and reversible. Since behavioural disturbance is a recoverable and the duration of impact will be very short, the potential for cumulative impact is considered to be limited. PTS The magnitude of the cumulative impact is predicted to be of local to regional spatial extent, very short-term duration, intermittent and, although the impact itself is reversible (i.e. elevated underwater sound during the detonation event only), the effect of injury on sensitive receptors is permanent. It is predicted that the impact will affect the receptor directly. In line with UXO guidance (JNCC, 2010b), assuming standard industry measures applied for each project, it is anticipated that for most species animals would be deterred from the injury zone and therefore the risk of PTS would be reduced. The magnitude is therefore considered to be

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	activities, UXO clearance at each project will occur as a discrete stage within the overall construction phase. Furthermore, each clearance event results in a very short duration of sound emission (seconds) and therefore the impact will be short in duration and unlikely to overlap. Production of underwater sound during detonation of UXOs at both projects has the potential to cause behavioural disturbance in marine mammal receptors, however, this effect will be short-lived and reversible. Since behavioural disturbance is a recoverable and the duration of impact will be very short, the potential for cumulative impact is considered to be limited. <u>PTS</u> The magnitude of the cumulative impact is predicted to be of local to regional spatial extent, very short-term duration, intermittent and, although the impact itself is reversible (i.e. elevated underwater sound during the detonation event only), the effect of injury on sensitive receptors is permanent. It is predicted that the impact will affect the receptor directly. In line with UXO guidance (JNCC, 2010b), assuming standard industry measures applied for each project, it is anticipated that for most species animals would be deterred from the injury zone and therefore the risk of PTS would be reduced. The magnitude is therefore considered to be	short, the potential for cumulative impact is considered to be limited. <u>PTS</u> The magnitude of the cumulative impact is predicted to be of local to regional spatial extent, very short-term duration, intermittent and, although the impact itself is reversible (i.e. elevated underwater sound during the detonation event only), the effect of injury on sensitive receptors is permanent. It is predicted that the impact will affect the receptor directly. In line with UXO guidance (JNCC, 2010b), assuming standard industry measures applied for each project, it is anticipated that for most species animals would be deterred from the injury zone and therefore the risk of PTS would be reduced. The magnitude is therefore considered to be **negligible** for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal. For harbour porpoise, PTS ranges are large and there is considered to be a residual risk of PTS to a small number of individuals, even with the application of standard industry measures. The magnitude is therefore considered to be **medium**. <u>Behavioural disturbance (using TTS-onset as a proxy)</u> The magnitude of cumulative impact (elevated underwater sound due to UXO	**negligible** for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal. For harbour porpoise, PTS ranges are large and there is considered to be a residual risk of PTS to a small number of individuals, even with the application of standard industry measures. The magnitude is therefore considered to be **medium**. <u>Behavioural disturbance (using TTS-onset as a proxy)</u> The magnitude of cumulative impact (elevated underwater sound due to UXO clearance) resulting from a high order detonation is predicted to be of regional spatial extent, short-term duration, intermittent and both the impact itself (i.e. elevated underwater sound during the detonation event only) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low** for all species.

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	negligible for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal. For harbour porpoise, PTS ranges are large and there is considered to be a residual risk of PTS to a small number of individuals, even with the application of standard industry measures. The magnitude is therefore considered to be **medium**. <u>Behavioural disturbance (using TTS-onset as a proxy)</u> The magnitude of cumulative impact (elevated underwater sound due to UXO clearance) resulting from a high order detonation is predicted to be of regional spatial extent, short-term duration, intermittent and both the impact itself (i.e. elevated underwater sound during the detonation event only) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low** for all species.	clearance) resulting from a high order detonation is predicted to be of regional spatial extent, short-term duration, intermittent and both the impact itself (i.e. elevated underwater sound during the detonation event only) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low** for all species.	
Significance of effect	<u>PTS</u> With embedded mitigation applied, for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal the magnitude of the cumulative impact is deemed to be **negligible** and the sensitivity of the receptors is considered to be **high**. There is	<u>PTS</u> With embedded mitigation applied, for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal the magnitude of the cumulative impact is deemed to be **negligible** and the sensitivity of the receptors is considered to be **high**. There is	<u>PTS</u> With embedded mitigation applied, for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal the magnitude of the cumulative impact is deemed to be **negligible** and the sensitivity of the receptors is considered to be **high**. There is

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	not anticipated to be any effect on the international value of these species. The cumulative effect will, therefore, be **of minor adverse** significance, which is not significant in EIA terms. For harbour porpoise, with embedded mitigation applied, the magnitude of the cumulative impact is deemed to be **medium**, and the sensitivity of the receptors is considered to be **high**. On the basis of high order detonation, there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS. The effect could be concluded to be of either minor adverse or moderate adverse significance, in line with the matrix approach set out in **Table** 4.16. Whilst there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS, based on expert judgement it is considered that this would not manifest to population level effects, and is unlikely to affect the international value of the species. The cumulative effect will, therefore, be of **moderate adverse** significance, which is significant in EIA terms. <u>Behavioural disturbance (using TTS-onset as a proxy)</u>	not anticipated to be any effect on the international value of these species. The cumulative effect will, therefore, be **of minor adverse** significance, which is not significant in EIA terms. For harbour porpoise, with embedded mitigation applied, the magnitude of the cumulative impact is deemed to be **medium**, and the sensitivity of the receptors is considered to be **high**. On the basis of high order detonation, there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS. The effect could be concluded to be of either minor adverse or moderate adverse significance, in line with the matrix approach set out in **Table** 4.16. Whilst there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS, based on expert judgement it is considered that this would not manifest to population level effects, and is unlikely to affect the international value of the species. The cumulative effect will, therefore, be of **moderate adverse** significance, which is significant in EIA terms. <u>Behavioural disturbance (using TTS-onset as a proxy)</u>	not anticipated to be any effect on the international value of these species. The cumulative effect will, therefore, be **of minor adverse** significance, which is not significant in EIA terms. For harbour porpoise, with embedded mitigation applied, the magnitude of the cumulative impact is deemed to be **medium**, and the sensitivity of the receptors is considered to be **high**. On the basis of high order detonation, there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS. The effect could be concluded to be of either minor adverse or moderate adverse significance, in line with the matrix approach set out in **Table** 4.16. Whilst there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS, based on expert judgement it is considered that this would not manifest to population level effects, and is unlikely to affect the international value of the species. The cumulative effect will, therefore, be of **moderate adverse** significance, which is significant in EIA terms. <u>Behavioural disturbance (using TTS-onset as a proxy)</u>

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	With standard industry measures applied, the magnitude of the cumulative impact for all species is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. There is not anticipated to be any effect on the international value of any marine mammal species. The effect could be concluded to be of either negligible or minor adverse significance, in line with the matrix approach set out in **Table** 4.16. The effect is concluded to be of **minor adverse** significance rather than negligible, as there is evidence of an effect. This is not significant in EIA terms.The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	With standard industry measures applied, the magnitude of the cumulative impact for all species is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. There is not anticipated to be any effect on the international value of any marine mammal species. The effect could be concluded to be of either negligible or minor adverse significance, in line with the matrix approach set out in **Table** 4.16. The effect is concluded to be of **minor adverse** significance rather than negligible, as there is evidence of an effect. This is not significant in EIA terms.The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	With standard industry measures applied, the magnitude of the cumulative impact for all species is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. There is not anticipated to be any effect on the international value of any marine mammal species. The effect could be concluded to be of either negligible or minor adverse significance, in line with the matrix approach set out in **Table** 4.16. The effect is concluded to be of **minor adverse** significance rather than negligible, as there is evidence of an effect. This is not significant in EIA terms.The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.
Further mitigation measures	The Applicants have committed to the development of detailed MMMPs (which will be developed and implemented in accordance with the Outline MMMP (document reference: J18) (CoT64) (**Table 4.12**) to manage underwater sound levels associated with significant impacts from the Transmission Assets , to reduce the magnitude of impacts such that there will be no residual significant effect.	The Applicants have committed to the development of detailed MMMPs (which will be developed and implemented in accordance with the Outline MMMP (document reference: J18) (CoT64) (**Table 4.12**) to manage underwater sound levels associated with significant impacts from the Transmission Assets alone, to reduce the magnitude of impacts such that there will be no residual significant effect.	The Applicants have committed to the development of detailed MMMPs (which will be developed and implemented in accordance with the Outline MMMP (document reference: J18) (CoT64) (**Table 4.12**) to manage underwater sound levels associated with significant impacts from the Transmission Assets , to reduce the magnitude of impacts such that there will be no residual significant effect.

Table 4.42: Injury and disturbance from elevated underwater sound during UXO clearance (Scenario 4a, Scenario 4b, Scenario 4c)

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
Construction phase			
Sensitivity of receptor	The sensitivity of marine mammals to Injury and disturbance from elevated underwater sound during UXO clearance is as described in **paragraph 4.11.2.4** *et seq*. and **paragraph 4.11.2.10** *et seq.* and is not reiterated here. <u>PTS</u> As a result of UXO clearance, all marine mammals are deemed to have limited resilience, low recoverability and international value. The sensitivity of the receptors to PTS is therefore, considered to be **high**. <u>Behavioural disturbance (using TTS-onset as a proxy)</u> As a result of UXO clearance, all marine mammals are deemed to have some resilience, high recoverability and international value. The sensitivity of the receptor to TTS is therefore, considered to be **low**.		
Magnitude of impact	The cumulative effects assessment for Scenario 4a which, includes the Transmission Assets and Generation Assets (Scenario 3) (**Table 4.41**) and Tier 1 projects identified in **Table 4.38**, considers the following: • The approach to assessing the cumulative impact of injury and disturbance from elevated underwater sound during UXO clearance is as per Scenario 1 (see **Table 4.41**). • Project details for the Generation Assets are set out in **Table 4.41** and are not reiterated here. • Tier 1 projects assessed include Mona Offshore Wind Project, Awel y Môr Offshore	The cumulative effects assessment for Scenario 4b considers Scenario 4a and Tier 2 projects. • For all Tier 2 projects (set out in **Table 4.39**; n = 15), EIA Scoping Reports do not provide detailed information on UXO clearance activities. Projects screened in for this cumulative assessment are expected to involve similar construction activities to those described for the Transmission Assets alone, including UXO clearance activities. • Projects are likely to have effects similar to the Transmission Assets and will likely apply similar mitigation measures (e.g. detailed MMMPs or separate marine licenses) to avoid injury; but at this stage a more detailed assessment cannot be presented.	The cumulative effects assessment for Scenario 4c considers Scenario 4b and Tier 3 projects. • Tier 3 projects screened into the assessment (precautionarily based on their location) are set out in **Table 4.39** (n = 36). There is limited/no information on the construction/operation dates or whether UXO clearance will be considered in respective EIA assessments. Although temporal and/or spatial overlap with Tier 3 projects cannot be discounted, at the current time it is not possible to undertake any kind of meaningful assessment. As such the magnitude for Transmission Assets, Generation Assets, Tier 1, Tier 2 and Tier 3 projects combined is concluded to be no

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	Wind Farm, White Cross Offshore Wind Farm and Project Erebus Floating Wind Demonstration. • The number of UXO expected to require clearing, alongside a range of charge sizes and UXO sizes were presented for each Tier 1 project. • Number of animals likely to experience PTS as a result of UXO clearance was presented for each project. • Number of animals likely to experience behavioural disturbance as a result of UXO clearance was presented for each project. A number of approaches was applied including: – using TTS as a proxy for disturbance; – EDRs of 26 km (for harbour porpoise); and – 25 km disturbance ranges (for grey seal). • All Tier 1 projects set out intentions of implementing UXO-specific detailed MMMPs. • A spatial MDS would occur where UXO clearance activities coincide at the respective projects considered in the CEA.	• Adopting a precautionary approach, and assuming application of standard industry measures (such as MMObs, PAM and ADDs), the assessment considered the magnitude of impact for a high order detonation. <u>PTS</u> The magnitude of the cumulative impact is predicted to be of local to regional spatial extent, very short-term duration, intermittent and, although the impact itself is reversible (i.e. elevated underwater sound during the detonation event only), the effect of injury on sensitive receptors is permanent. It is predicted that the impact will affect the receptor directly. In line with UXO guidance, assuming standard industry measures applied for each project, it is anticipated that for most species animals would be deterred from the injury zone and therefore the risk of PTS would be reduced. The magnitude is therefore considered to be **negligible** for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal. For harbour porpoise, PTS ranges are large and there is considered to be a residual risk of PTS to a small number of individuals, even with the application of standard industry measures. The magnitude is therefore considered to be **medium**. <u>Behavioural disturbance (using TTS-onset as a proxy)</u>	different to the magnitude for Tier 1 and Tier 2 projects combined. <u>PTS</u> The magnitude of the cumulative impact is predicted to be of local to regional spatial extent, very short-term duration, intermittent and, although the impact itself is reversible (i.e. elevated underwater sound during the detonation event only), the effect of injury on sensitive receptors is permanent. It is predicted that the impact will affect the receptor directly. In line with UXO guidance, assuming standard industry measures applied for each project, it is anticipated that for most species animals would be deterred from the injury zone and therefore the risk of PTS would be reduced. The magnitude is therefore considered to be **negligible** for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal. For harbour porpoise, PTS ranges are large and there is considered to be a residual risk of PTS to a small number of individuals, even with the application of standard industry measures. The magnitude is therefore considered to be **medium**. <u>Behavioural disturbance (using TTS-onset as a proxy)</u> The magnitude of cumulative impact resulting from a high order detonation is predicted to be of regional spatial extent, short-term duration, intermittent and both the impact itself (i.e. elevated underwater sound

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	This is, however, highly unlikely, as due to safety reasons. UXO clearance activities would take place before construction activities commence. Sequential UXO clearance is therefore more likely for Tier 1 projects noting, however, that there may be some overlap in pre-construction activities of Mona Offshore Wind Project and Awel y Môr Offshore Wind Farm with the Transmission Assets and Generation Assets, based on indicative construction timelines. • UXO clearance at each of these projects will occur as a discrete stage within the overall construction phase and therefore will not coincide continuously over the duration of temporal overlap. Furthermore, each clearance event results in a very short duration of sound emission (seconds) and the impact will be short in duration and unlikely to overlap. PTS The magnitude of the cumulative impact is predicted to be of local to regional spatial extent, very short-term duration, intermittent and, although the impact itself is reversible	The magnitude of cumulative impact resulting from a high order detonation is predicted to be of regional spatial extent, short-term duration, intermittent and both the impact itself (i.e. elevated underwater sound during the detonation event only) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low** for all species.	during the detonation event only) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low** for all species.

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	(i.e. elevated underwater sound during the detonation event only), the effect of injury on sensitive receptors is permanent. It is predicted that the impact will affect the receptor directly. In line with UXO guidance (JNCC, 2010b), assuming standard industry measures applied for each project, it is anticipated that for most species animals would be deterred from the injury zone and therefore the risk of PTS would be reduced. The magnitude is therefore considered to be **negligible** for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal. For harbour porpoise, PTS ranges are large and there is considered to be a residual risk of PTS to a small number of individuals, even with the application of standard industry measures. The magnitude is therefore considered to be **medium**. <u>Behavioural disturbance (using TTS-onset as a proxy)</u> The magnitude of cumulative impact (elevated underwater sound due to UXO clearance) resulting from a high order detonation is predicted to be of regional spatial extent, short-term duration, intermittent and both the impact itself (i.e. elevated underwater sound during the detonation event only) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low** for all species.		

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
Significance of effect	PTS With embedded mitigation applied, for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal the magnitude of the cumulative impact is deemed to be **negligible** and the sensitivity of the receptors is considered to be **high**. There is not anticipated to be any effect on the international value of these species. The cumulative effect will, therefore, be **of minor adverse** significance, which is not significant in EIA terms. For harbour porpoise, with embedded mitigation applied, the magnitude of the cumulative impact is deemed to be **medium**, and the sensitivity of the receptors is considered to be **high**. On the basis of high order detonation, there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS. The effect could be concluded to be of either minor adverse or moderate adverse significance, in line with the matrix approach set out in **Table** 4.16. Whilst there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS, based on expert judgement it is considered that this would not manifest to population level effects, and is unlikely to affect the international value of the species. The cumulative effect will,	PTS With embedded mitigation applied, for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal the magnitude of the cumulative impact is deemed to be **negligible** and the sensitivity of the receptors is considered to be **high**. There is not anticipated to be any effect on the international value of these species. The cumulative effect will, therefore, be **of minor adverse** significance, which is not significant in EIA terms. For harbour porpoise, with embedded mitigation applied, the magnitude of the cumulative impact is deemed to be **medium**, and the sensitivity of the receptors is considered to be **high**. On the basis of high order detonation, there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS. The effect could be concluded to be of either minor adverse or moderate adverse significance, in line with the matrix approach set out in **Table** 4.16. Whilst there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS, based on expert judgement it is considered that this would not manifest to population level effects, and is unlikely to affect the international value of the species. The cumulative effect will,	PTS With embedded mitigation applied, for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal the magnitude of the cumulative impact is deemed to be **negligible** and the sensitivity of the receptors is considered to be **high**. There is not anticipated to be any effect on the international value of these species. The cumulative effect will, therefore, be **of minor adverse** significance, which is not significant in EIA terms. For harbour porpoise, with embedded mitigation applied, the magnitude of the cumulative impact is deemed to be **medium**, and the sensitivity of the receptors is considered to be **high**. On the basis of high order detonation, there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS. The effect could be concluded to be of either minor adverse or moderate adverse significance, in line with the matrix approach set out in **Table** 4.16. Whilst there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS, based on expert judgement it is considered that this would not manifest to population level effects, and is unlikely to affect the international value of the species. The cumulative effect will,

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	therefore, be of **moderate adverse** significance, which is significant in EIA terms. <u>Behavioural disturbance (using TTS-onset as a proxy)</u> With standard industry measures applied, the magnitude of the cumulative impact for all species is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. There is not anticipated to be any effect on the international value of any marine mammal species. The effect could be concluded to be of either negligible or minor adverse significance, in line with the matrix approach set out in **Table** 4.16. The effect is concluded to be of **minor adverse** significance rather than negligible, as there is evidence of an effect. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	therefore, be of **moderate adverse** significance, which is significant in EIA terms. <u>Behavioural disturbance (using TTS-onset as a proxy)</u> With standard industry measures applied, the magnitude of the cumulative impact for all species is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. There is not anticipated to be any effect on the international value of any marine mammal species. The effect could be concluded to be of either negligible or minor adverse significance, in line with the matrix approach set out in **Table** 4.16. The effect is concluded to be of **minor adverse** significance rather than negligible, as there is evidence of an effect. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	therefore, be of **moderate adverse** significance, which is significant in EIA terms. <u>Behavioural disturbance (using TTS-onset as a proxy)</u> With standard industry measures applied, the magnitude of the cumulative impact for all species is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. There is not anticipated to be any effect on the international value of any marine mammal species. The effect could be concluded to be of either negligible or minor adverse significance, in line with the matrix approach set out in **Table** 4.16. The effect is concluded to be of **minor adverse** significance rather than negligible, as there is evidence of an effect. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.
Further mitigation measures	The Applicants have committed to the development of detailed MMMPs (which will be developed and implemented in accordance with the Outline MMMP (document reference: J18) (CoT64) (**Table 4.12**) to manage underwater sound levels associated with significant impacts from the Transmission Assets alone, to reduce the magnitude of impacts such that there will be no residual significant effect	The Applicants have committed to the development of detailed MMMPs (which will be developed and implemented in accordance with the Outline MMMP (document reference: J18) (CoT64) (**Table 4.12**) to manage underwater sound levels associated with significant impacts from the Transmission Assets alone, to reduce the magnitude of impacts such that there will be no residual significant effect	The Applicants have committed to the development of detailed MMMPs (which will be developed and implemented in accordance with the Outline MMMP (document reference: J18) (CoT64) (**Table 4.12**) to manage underwater sound levels associated with significant impacts from the Transmission Assets alone, to reduce the magnitude of impacts such that there will be no residual significant effect

4.13.3 Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities

4.13.3.1 As for the assessment of the Transmission Assets alone, the risk of injury in terms of PTS to marine mammal receptors as a result of underwater sound due to vessel use and other sound producing activities would be expected to be very low. The assessment for Transmission Assets alone (**section 4.11.3**) identified PTS thresholds were unlikely to be exceeded (**paragraph 4.11.3.28**) and therefore the magnitude of the impact and associated effect (PTS) occurring in marine mammals has been assessed as negligible. Given the above, there is very low potential for cumulative impacts to cause injury as a result of elevated underwater sound due to vessel use and other sound producing activities. Instead, the cumulative assessment focuses on disturbance only for this impact.

4.13.3.2 An assessment of the potential for cumulative impacts as a result of Injury and disturbance from elevated underwater sound due to vessel use and other sound producing activities has been presented for Transmission Assets alongside the Generations Assets in **Table 4.45**, and alongside other relevant Tier 1 projects, and Tier 2 and Tier 3 projects in **Table 4.46** below.

Table 4.43: Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities (Scenario 1, Scenario 2, Scenario 3)

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
Construction phase			
Sensitivity of receptor	The sensitivity of marine mammals to elevated underwater sound due to vessel use and other sound producing activities is as described in **paragraph 4.11.3.5** *et seq*. All marine mammals are deemed to have some resilience to behavioural disturbance, high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **medium**.		
Magnitude of impact	The cumulative effects assessment for Scenario 1 considers the following. • It is a standard practice that estimated ranges over which behavioural disturbance may occur are presented for different vessel types in isolation. • For the Transmission Assets, maximum disturbance ranges of up to approximately 4.02 km were predicted for survey vessel, support vessels, crew transfer vessel, scour/cable protection/seabed preparation and installation vessels. It is likely that several activities could be potentially occurring at the same time and therefore disturbance ranges may extend from several vessels/locations. However (as discussed in **paragraphs 4.11.3.38** and **4.11.3.39**) a range of distances from empirical studies (1 km to 7 km) were used as effective impact ranges. • The Morecambe Offshore Windfarm: Generation Assets ES identified the following.	The cumulative effects assessment for Scenario 2 considers the following: • It is a standard practice that estimated ranges over which behavioural disturbance may occur are presented for different vessel types in isolation. • The Transmission Assets MDS is as per Scenario 1. • The Morgan Offshore Wind Project: Generation Assets MDS identified the following. – Up to 69 construction vessels on site at any one time. – The greatest modelled disturbance range for vessels at the Transmission Assets was 3.627 km, for survey and support vessels, crew transfer vessels, cable protection and seabed preparation/installation vessels. – Modelled disturbance ranges for cable trenching activities were 3.119 km.	The cumulative effects assessment for Scenario 3 considers the following: – 28 construction vessels on site at any one time for the Transmission Assets. – 37 vessels on site at any one for the Morecambe Offshore Windfarm: Generation Assets. – 69 construction vessels on site at any one time for Morgan Offshore Wind Project: Generation Assets. • The approach to assessing the cumulative impact of disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities is as per Scenario 1 and 2. Whilst cumulatively there are predicted to be more vessels and other sound-producing activities in the region, many vessels associated with the construction of

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	– A MDS of up to 37 vessels on site at any one time. – The assessment considered the impact of one vessel with a 4 km disturbance buffer (50.27 km^2). – The assessment also considered the impact of all 37 vessels together within the windfarm site with a 4 km site disturbance buffer (285.4 km^2). – Other modelled disturbances included cable laying, suction dredging, trenching and rock placement. All were modelled with a predicted impact range of less than 100 m with the exception of harbour porpoise which had predicted impact ranges for TTS of 0.99 km for rock placement, 0.23 km for dredging and 3.11 km for cable repair/burial. • Both the Transmission Assets and the Morecambe Offshore Windfarm: Generation Assets presented the number of animals predicted to be disturbed by vessels and other non-piling sound-producing activities. Maximum number of animals were estimated as follows. – Transmission Assets (based on a maximum disturbance range of 7 km): up to 35 harbour	• In line with the Transmission Assets, the Morgan Offshore Wind Project: Generation Assets highlighted that it is likely that several activities could be potentially occurring at the same time and therefore disturbance ranges may extend from several vessels/locations. However a range of distances from empirical studies (1 km to 7 km) were used as effective impact ranges. • Both the Transmission Assets and the Morgan Offshore Wind Project: Generation Assets presented the number of animals predicted to be disturbed by vessels and other sound-producing activities. Maximum number of animals were estimated as follows. – Transmission Assets approach to assessing the cumulative impact of injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities is as per Scenario 1 – Morgan Offshore Wind Project: Generation Assets (based on a maximum disturbance range of 7 km): up to 41 harbour porpoise; up to 5 Risso's dolphin; up to 3 minke whale; up to 7 grey seal and less than one bottlenose dolphin, short-	Generation Assets are likely to be also associated with Transmission Assets, reducing the amount of cumulative vessel numbers. As per Scenario 1 and Scenario 2 embedded measures at the Transmission Assets (CoT65) (**Table 4.12**) and measures set out for the Generation Assets, respectively are put in place to reduce the risk of disturbance to marine mammals. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	porpoise; up to 5 Risso's dolphin; up to 4 minke whale; up to 17 grey seal and less than one bottlenose dolphin, short-beaked common dolphin or harbour seal. – Morecambe Offshore Windfarm: Generation Assets (based on a maximum disturbance area of 285.4 km^2): up to 463 harbour porpoise; up to 3 bottlenose dolphin; up to 8 short-beaked common dolphin; up to 3 minke whale; up to 29 grey seal; and less than one Risso's dolphin or harbour seal. • Introduction of vessels will not be a novel impact for marine mammals present in the area and there is some evidence of tolerance by marine mammals to boat traffic (see discussion in **paragraph 4.11.3.14**). • Vessel activity is expected to be localised to each project, the duration of vessel activity is considered to be medium term (throughout the construction phase of the Transmission Assets) and vessel movements will occur intermittently over a number of years. • Vessels at the Transmission Assets will be required to follow Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels	beaked common dolphin or harbour seal. • Introduction of vessels will not be a novel impact for marine mammals present in the area and there is some evidence of tolerance by marine mammals to boat traffic (see discussion in **paragraph 4.11.3.14**). • Vessel activity is expected to be localised to each project, the duration of vessel activity is considered to be medium term (throughout the construction phase of the Transmission Assets) and vessel movements will occur intermittently over a number of years. • As per Scenario 1, vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels). The Morgan Offshore Wind Project: Generation Assets has included for an Offshore Environmental Management Plan, which also includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels). • Whilst disturbance ranges such as 7 km could potentially affect animals over regional scales, many vessels associated with the construction of the Transmission Assets are likely to also be associated with the construction of the Morgan Offshore Wind Project: Generation Assets and	

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	(these measures are also set out in Measures to minimise disturbance to marine mammals and rafting birds from vessels, document reference: J16)). The Morecambe Offshore Windfarm: Generation Assets ES has included for a Project Environmental Management Plan, to reduce the risk of collisions and disturbance at seal haul-outs. • Whilst disturbance ranges such as 7 km could potentially affect animals over regional scales, many vessels associated with the construction of the Transmission Assets are likely to also be associated with the construction of the Morecambe Offshore Windfarm: Generation Assets and therefore cumulative vessel numbers will not be significantly higher than the Transmission Assets alone. As such, vessel numbers have not been summed, cumulatively. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.	therefore cumulative vessel numbers will not be significantly higher than the Transmission Assets alone. As such, vessel numbers have not been summed, cumulatively. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.	
Significance of effect	Overall, with standard industry measures in place the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The cumulative effect will, therefore,	Overall, with standard industry measures in place the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The cumulative effect will, therefore,	Overall, with standard industry measures in place the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The cumulative effect will, therefore,

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	be of **minor adverse** significance, which is not significant in EIA terms.	be of **minor adverse** significance, which is not significant in EIA terms.	be of **minor adverse** significance, which is not significant in EIA terms.
Operation and maintenance phase			
Sensitivity of receptor	The sensitivity of marine mammals to elevated underwater sound due to vessel use and other sound producing activities is as described in **paragraph 4.11.3.5** *et seq*. All marine mammals are deemed to have some resilience to behavioural disturbance, high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **medium**.		
Magnitude of impact	The cumulative effects assessment for Scenario 1 considers the following. • The Transmission Assets MDS identified up to 14 operational vessels (eight at Morgan Offshore Wind Project: Transmission Assets and six at Morecambe Offshore Windfarm: Transmission Assets) on site at any one time. • The Morecambe Offshore Windfarm: Generation Assets MDS identified: – up to 10 vessels on site at any one time. • The duration of vessel activity is considered to be long term (throughout the operations and maintenance phase of the Transmission Assets) and localised for each project with vessel movements occurring intermittently over the lifetime of Transmission Assets. It is	The cumulative effects assessment for Scenario 2 considers the following. • The Transmission Assets MDS is as per Scenario 1. • The Morgan Offshore Wind Project: Generation Assets MDS identified: – up to 16 vessels on site at any one time. • The duration of vessel activity is considered to be long term (throughout the operations and maintenance phase of the Transmission Assets) and localised for each project with vessel movements occurring intermittently over the lifetime of Transmission Assets. It is expected that on average the offshore export cables will require up to one visit per year. Maintenance works to rebury/replace and carry out	The cumulative effects assessment for Scenario 3 considers the following. • The Transmission Assets MDS is as per Scenario 1. • Up to 10 vessels on site at any one for the Morecambe Offshore Windfarm: Generation Assets. • Up to 16 vessels on site at any one time for Morgan Offshore Wind Project: Generation Assets. • The duration of vessel activity is considered to be long term (throughout the operations and maintenance phase of the Transmission Assets) and localised for each project with vessel movements occurring intermittently over the lifetime of Transmission Assets. The cumulative number of vessels at any given time is expected to be lower for the operations and maintenance phase compared to

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	expected that on average the offshore export cables will require up to one visit per year. Maintenance works to rebury/replace and carry out repair works on offshore export cables generally takes between one to two weeks. Therefore, cumulative vessel numbers are not expected to be significantly higher than the Transmission Assets alone, however, cumulatively there could be up to 24 vessels on site at any one time during the operations and maintenance phase. Therefore, the magnitude of the impact and associated effect (disturbance) as a result of elevated underwater sound due to vessel use and other activities, for all marine mammal receptors, is expected to be less than that assessed for the construction phase. However, considering that vessel movements are temporally spaced over a longer timescale, over the decadal operating lifetime of the Morecambe Offshore Windfarm: Generation Assets, a precautionary approach has been taken in assessing the magnitude. As per the construction phase, vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels (these measures	repair works on offshore export cables generally takes between one to two weeks. Therefore, cumulative vessel numbers are not expected to be significantly higher than the Transmission Assets alone, however, cumulatively there could be up to 30 vessels on site at any one time. Therefore, the magnitude of the impact and associated effect (disturbance) as a result of elevated underwater sound due to vessel use and other activities, for all marine mammal receptors, is expected to be less than that assessed for the construction phase. However, considering that vessel movements are temporally spaced over a longer timescale, over the decadal operating lifetime of the Morgan Offshore Wind Project: Generation Assets, a precautionary approach has been taken in assessing the magnitude. As per the construction phase, vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels), and the Morgan Offshore Wind Project: Generation Assets has included for an Offshore Environmental Management Plan, which also includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels).	the construction phase. It is expected that on average the offshore export cables will require up to one visit per year. Maintenance works to rebury/replace and carry out repair works on offshore export cables generally takes between one to two weeks. Therefore, cumulative vessel numbers are not expected to be significantly higher than the Transmission Assets alone, however, cumulatively there could be up to 40 vessels on site at any one time during the operations Therefore, the magnitude of the impact and associated effect (disturbance) as a result of elevated underwater sound due to vessel use and other activities, for all marine mammal receptors, is expected to be less than that assessed for the construction phase. However, considering that vessel movements are temporally spaced over a longer timescale, over the decadal operating lifetime of the Generation Assets, a precautionary approach has been taken in assessing the magnitude. As per the construction phase, in line with Scenario 1 and Scenario 2 embedded measures at the Transmission Assets (CoT65) (**Table 4.12**) and measures set out for the Generation Assets, respectively are put in place to reduce the risk of disturbance to marine mammals.

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	are also set out in Measures to minimise disturbance to marine mammals and rafting birds from vessels, document reference: J16)), and the Morecambe Offshore Windfarm: Generation Assets ES has included for a Project Environmental Management Plan, to reduce the risk of collisions and disturbance at seal haul-outs. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use and other activities) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low.**	The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use and other activities) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low.**	The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use and other activities) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low.**
Significance of effect	Overall, with standard industry measures in place, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, with standard industry measures in place, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, with standard industry measures in place, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.
Decommissioning phase			
Sensitivity of receptor	The sensitivity of marine mammals to elevated underwater sound due to vessel use and other sound producing activities is as described in **paragraph 4.11.3.5** *et seq*. All marine mammals are deemed to have some resilience to behavioural disturbance, high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **medium**.		

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
Magnitude of impact	The cumulative effects assessment for Scenario 1 considers the following. • There is potential for decommissioning activities at the Transmission Assets to overlap with decommissioning activities at the Morecambe Offshore: Generation Assets. • The impact of the receptors during the decommissioning phase is not expected to differ from the impact of the receptors during the construction phase (see the assessment of magnitude of impact for the construction phase, above). • The numbers and types of vessel used to remove infrastructure (and hence their size and outputs) are expected to be similar to those used during installation, therefore potential impacts from elevated underwater sound due to vessel use and other sound producing activities is expected to be similar to the construction phase. • An Offshore Decommissioning Programme (CoT55) (**Table 4.12**) will be developed for the Transmission Assets prior to decommissioning in consultation with stakeholders, at the time of	The cumulative effects assessment for Scenario 2 considers the following. • There is potential for decommissioning activities at the Transmission Assets to overlap with decommissioning activities at the Morgan Offshore Wind Project: Generation Assets. • The impact of the receptors during the decommissioning phase is not expected to differ from the impact of the receptors during the construction phase (See the assessment of magnitude of impact for the construction phase, above). • The numbers and types of vessel used to remove infrastructure (and hence their size and outputs) are expected to be similar to those used during installation, therefore potential impacts from elevated underwater sound due to vessel use and other sound producing activities is expected to be similar to the construction phase. • An Offshore Decommissioning Programme (CoT55) (**Table 4.12**) will be developed for the Transmission Assets prior to decommissioning in consultation with stakeholders, at time of	The cumulative effects assessment for Scenario 3 considers the following. • There is potential for decommissioning activities at the Transmission Assets to overlap with decommissioning activities at the Generation Assets. • The impact of the receptors during the decommissioning phase is not expected to differ from the impact of the receptors during the construction phase (See the assessment of magnitude of impact for the construction phase, above). • The numbers and types of vessel used to remove infrastructure (and hence their size and outputs) are expected to be similar to those used during installation, therefore potential impacts from elevated underwater sound due to vessel use and other sound producing activities is expected to be similar to the construction phase. • An Offshore Decommissioning Programme (CoT55) (**Table 4.12**) will be developed for the Transmission Assets prior to decommissioning in consultation with stakeholders, at time of

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	decommissioning, on the basis of a refined project design. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.	decommissioning, on the basis of a refined project design. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.	decommissioning, on the basis of a refined project design. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.
Significance of effect	Overall, with standard industry measures in place the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, with standard industry measures in place the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, with standard industry measures in place the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Table 4.44: Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities (Scenario 4a, Scenario 4b, Scenario 4c)

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
Construction phase			
Sensitivity of receptor	The sensitivity of marine mammals to elevated underwater sound due to vessel use and other sound producing activities is as described in **paragraph 4.11.3.5** *et seq*. All marine mammals are deemed to have some resilience to behavioural disturbance, high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **medium**.		
Magnitude of impact	The cumulative effects assessment for Scenario 4a which, includes the Transmission Assets and Generation Assets (Scenario 3) (**Table 4.43**) and Tier 1 projects identified in **Table 4.38**, considers the following: • The approach to assessing the cumulative impact of disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities is as per Scenario 1 (see **Table 4.43**). • Project details for the Generation Assets are set out in **Table 4.43** and are not reiterated here. • The approach to assessing the cumulative impact of injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities is as per Scenario 1, it is assumed that modelled disturbance distances are likely to be overestimated, as per Benhemma-Le Gall *et al.* (2021) (a decrease in porpoise activity in response to vessels beyond 4 km from the source).	The cumulative effects assessment for Scenario 4b considers Scenario 4a and Tier 2 projects. • For all Tier 2 projects (set out in **Table 4.39**; n = 15), EIA Scoping Reports do not provide detailed information on vessel numbers. • The impact for each of these Tier 2 projects is predicted to be localised to within the close vicinity of the respective projects. As per **paragraphs 4.11.3.38** and **4.11.3.39** distances of between 1 km and 7 km (Brandt *et al.*, 2018; McQueen *et al.* 2020; Benhemma-Le Gall *et al.* 2021; Wisniewska *et al.* 2018) have been suggested for disturbance. • Although animals may be disturbed from isolated project areas at different points in time, and cumulatively could lead to a larger area of disturbance at any one time compared to Scenario 4a (Transmission Assets plus Generation Assets plus Tier 1 projects) (assuming activities overlapped temporally), in the context of the wider habitat available within the cumulative marine mammal study area, the scale of	The cumulative effects assessment for Scenario 4c considers Scenario 4b and Tier 3 projects. • The Lir Offshore Array, MaresConnect and Eni Hynet CCP are located within 50 km of Transmission Assets. The Isle of Man to UK Interconnector 2 and Mooir Vannin UK Transmission Assets are assumed to be located within 50 km of Transmission Assets. All other Tier 3 projects (set out in **Table 4.39**; n = 33) are all located over 100 km away from the Transmission Assets. • The construction timelines for the Isle of Man to UK Interconnector 2, Mooir Vannin UK Transmission Assets, Lir Offshore Array and ENI Hynet CCP are not yet available, but given that they are in pre-application stage, the construction phase may overlap temporally towards the end of

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	• Tier 1 projects (and respective distances from the Offshore Order Limits) assessed alongside Transmission Assets and Generation Assets include: Mona Offshore Wind Project (9.73 km); Awel y Môr Offshore Wind Farm (28.87 km); West Anglesey Demonstration Zone tidal site (78.71 km); Project Erebus Floating Wind Demonstration (284.61 km); White Cross Offshore Wind Farm (311.28 km). • The Mona Offshore Wind Project MDS identified: – For the Mona Array Area, up to a total of 69 construction vessels on site at any one time. For the Mona Offshore Cable Corridor and Access Areas, up to a total of 17 construction vessels on site at any one time, and up to 12 vessels at any one time associated with the landfall cable installation. – Based on a sound modelling assessment, the maximum disturbance range is 5.38 km. • The Awel y Môr Offshore Wind Farm Project MDS identified: – up to 101 construction vessels in total, of which 35 may be on site during peak period; – the ES assumed that based on Benhemma-Le Gall *et al.* (2021), harbour porpoise and other cetaceans may be displaced up to 4 km from construction vessels; and	the disturbance effects is considered to be small. • Vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels) and it is expected that Tier 2 projects will have similar measures. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use and other activities) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.	the Transmission Assets construction phase. • It is anticipated that the construction phase of MaresConnect (estimated 2026, with operations phase commencing in 2029) may overlap temporally with construction activities at Transmission Assets (MaresConnect, 2023). Maintenance of the offshore export cable during the operations phase typically involves considerably fewer vessels and round trips compared to construction. • Whilst this has the potential to increase vessel numbers in the Irish Sea this is not expected to be significantly larger than that already assessed for Transmission Assets and Generation Assets alongside Tier 1 and Tier 2 projects. • Vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels) and it is expected that Tier 3 projects will allow for similar measures.

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	– Identified localised behavioural disturbance ranges for harbour porpoise and grey seal (avoidance reported up to 5 km from dredging activities). There was a reduction in bottlenose dolphin presence and, during the initial dredge operations, bottlenose dolphins were absent for five weeks. • The West Anglesey Demonstration Zone tidal site Project MDS identified: – up to 16 vessels on site at any one time during the operations and maintenance phase. – The maximum behavioural disturbance range across all species was predicted in harbour porpoise for two percussive drilling rigs and cutter-suction dredging as up to 530 m and 580 m, respectively. • The White Cross Offshore Wind Farm Project MDS identified: – up to five vessels on site at any one time during the construction phase; – the assessment concluded that the number of vessels would not exceed the Heinänen and Skov (2015) threshold (five vessels within 49.4 km^2 would equate to approximately 0.1 vessels per km^2); and – the ES assumed that based on Benhemma-Le Gall *et al.* (2021), disturbance ranges for other sound-producing activities (other than vessels) would be up to 4 km from construction vessels.		The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use and other activities) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	• The Project Erebus Floating Wind Demonstration MDS identified: – up to two crew transfer vessels on site per day during the operations and maintenance phase (assumed stationary or slow moving); and ○ the maximum predicted behavioural disturbance range for large vessels was assessed as 480 m for minke whale. • Introduction of vessels will not be a novel impact for marine mammals present in the area there is some evidence of tolerance by marine mammals to boat traffic (see discussion in **paragraph 4.11.3.14**) • Vessel activity is expected to be localised to each project, the duration of vessel activity is considered to be medium term (throughout the construction phase of the Transmission Assets) and vessel movements will occur intermittently over a number of years. • Vessels such as boulder clearance, jack-up rigs, tug/anchor handlers and guard vessels will have smaller disturbance ranges (between 1 to 4 km) and therefore the extent of effect will be local. Where vessels may disturb animals up to ranges of 7 km, this represents a larger proportion of the Irish and Celtic Seas and may potentially affect animals over regional scales. Nevertheless, most of the vessels will be associated with the construction phases of Awel y Môr Offshore Wind		

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	Farm, Mona Offshore Wind Project, Transmission Assets and Generation Assets, and all five projects are located within an area of relatively low marine mammal densities (except bottlenose dolphin, see Volume 2, Annex 4.1: Marine mammal technical report of the ES) • There may be an uplift in vessel activity within the cumulative marine mammal study area. However, assessments are based on respective projects' MDSs, therefore vessels present at any one time are likely to be lower. In addition, vessel movements will be confined to the array areas and/or offshore export cable corridor routes and are likely to follow existing shipping routes. As such, it would not be realistic to present a sum of all vessels anticipated within each offshore wind farm as per respective MDSs. • Vessels at the Transmission Assets will be required to follow Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels) and it is expected that Tier 1 projects will allow for similar measures. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use and other activities) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the		

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	receptor directly. The magnitude is therefore, considered to be **low**.		
Significance of effect	Overall, with standard industry measures in place, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, with standard industry measures in place the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, with standard industry measures in place the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.
Operation and maintenance phase			
Sensitivity of receptor	The sensitivity of marine mammals to elevated underwater sound due to vessel use and other sound producing activities is as described in **paragraph 4.11.3.5** *et seq*. All marine mammals are deemed to have some resilience to behavioural disturbance, high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **medium**.		
Magnitude of impact	**Tier 1 (Scenario 4a)** The cumulative effects assessment for Scenario 4a (Scenario 3 (**Table 4.43**) and Tier 1 projects) considers the following. • The approach to assessing the cumulative impact of injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities is as per Scenario 1(see **Table 4.43**). • Project details for the Generation Assets are set out in **Table 4.43** and are not reiterated here. • The range of vessels used in operations and maintenance	**Tier 2 (Scenario 4b)** The approach to assessing the cumulative impact of marine mammals to elevated underwater sound due to vessel use and other sound producing activities is as per construction phase. • The range of vessels used in operations and maintenance activities in other Tier 2 projects (identified in **Table 4.39**) will be similar to those employed during the construction phases of cumulative projects although fewer vessels are likely to be involved but over a longer duration. • The number of vessels present during the operations and maintenance phases of respective projects in isolation is considered to be smaller than for the construction phase. Nevertheless,	**Tier 3 (Scenario 4c)** • The Lir Offshore Array, MaresConnect and Eni Hynet CCP are located within 50 km of Transmission Assets. The Isle of Man to UK Interconnector 2 and Mooir Vannin UK Transmission Assets are assumed to be located within 50 km of Morgan Offshore Wind Project: Generation Assets. All other Tier 3 projects (set out in **Table 4.39**; n = 36) are all located over 100 km away from the Transmission Assets. • Cable maintenance during the operations phase typically involves considerably smaller

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	activities will be similar to those employed during the construction phases of cumulative projects although fewer vessels will be involved but over a longer duration albeit at more localised locations and temporally spaced. • The Mona Offshore Wind Project MDS identified: – up to 21 vessels on site at any one time; – up to 849 vessel movements per year; and – The assessment approach to assessing the cumulative impact of marine mammals to elevated underwater sound due to vessel use and other sound producing activities is as per construction phase. • The Awel y Môr Offshore Wind Farm Project MDS identified: – numerous different vessel types would be conducting round trips to and from port and the array area, but only two jack-up vessels and two SOVs would be present at any one time; and – The approach to assessing the cumulative impact of marine mammals to elevated underwater sound due to	cumulatively it could be expected that the total number of vessel movements will exceed the existing average traffic levels. • Qualitatively, the impact would lead to a larger area of disturbance within the cumulative marine mammal study area compared to the Transmission Assets and Generation Assets alone. Although animals may be disturbed from isolated project areas at different points in time, in the context of the wider habitat available the scale of the disturbance effects (which would be localised) is considered to be small. • Vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels) and it is expected that Tier 2 projects will allow for similar measures. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (elevated underwater sound due to vessel use and other activities) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.	numbers of vessels and round trips compared to construction activities. Whilst this has the potential to increase vessel numbers in the Irish Sea this is not expected to be significantly larger than that already assessed for Transmission Assets and Generation Assets alongside Tier 1 and Tier 2 projects. • As per the construction phase, vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels) and it is expected that Tier 3 projects will allow for similar measures. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (elevated underwater sound due to vessel use and other activities) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	vessel use and other sound producing activities is as per construction phase. • The West Anglesey Demonstration Zone tidal site MDS identified: – up to two drilling activities, two cable installation activities, two cable protection activities and 16 vessels on site at any one time; and – the maximum behavioural disturbance range across all species was predicted in harbour porpoise for two percussive drilling rigs and cutter-suction dredging as up to 530 m and 580 m, respectively. • The White Cross Offshore Wind Farm MDS identified: – up to five vessels on site at any one time during the construction phase (no numbers provided for operations phase – this is likely to be lower); and – The approach to assessing the cumulative impact of marine mammals to elevated underwater sound due to vessel use and other sound producing activities is as per construction phase.		

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	• The Project Erebus Floating Wind Demonstration MDS identified: – up to two crew transfer vessels on site per day during the operations and maintenance phase (assumed stationary or slow moving); and – the maximum predicted behavioural disturbance range for large vessels was assessed as 480 m for minke whale. • The duration of vessel activity is considered to be long term (throughout the operations and maintenance phase of the Transmission Assets and Generation Assets) and localised for each project with vessel movements occurring intermittently over the lifetime of Transmission Assets and Generation Assets. The cumulative number of vessels at any given time is expected to be lower for the operations and maintenance phase compared to the construction phase. Therefore, the magnitude of the impact and associated effect (disturbance) as a result of elevated underwater sound due to vessel use and other activities, for all marine mammal		

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	receptors, is expected to be less than that assessed for the construction phase. However, considering that vessel movements are temporally spaced over a longer timescale, over the decadal operating lifetime of the Transmission Assets and Generation Assets, a precautionary approach has been taken in assessing the magnitude. • Vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels) and it is expected that Tier 1 projects will allow for similar measures. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use and other activities) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.		
Significance of effect	Overall, with standard industry measures in place the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these	Overall, with standard industry measures in place the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium.** There would be no change to the international value of these	Overall, with standard industry measures in place the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium.** There would be no change to the international value of these

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

4.13.4 Increased likelihood of injury due to collision with vessels

4.13.4.1 An assessment of the potential for cumulative impacts as a result of Increased likelihood of injury due to collision with vessels has been presented for Transmission Assets alongside the Generations Assets in **Table 4.45**, and alongside other relevant Tier 1 projects, and Tier 2 and Tier 3 projects in **Table 4.46** below.

Table 4.45: Increased likelihood of injury due to collision with vessels (Scenario 1, Scenario 2, Scenario 3)

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
Construction phase			
Sensitivity of receptor	The sensitivity of marine mammals to collision risk is as described in **paragraph 4.11.4.2** for Transmission Assets alone. Whilst there are no seal haul-out sites in the Transmission Assets marine mammal study area, there are grey seal and harbour seal haul-out sites within the cumulative marine mammal study area and therefore cumulatively there is the potential for increase in the likelihood of vessel collision. All marine mammals are deemed to have some resilience (largely due to avoidance behaviour and the argument that not all collisions are fatal), medium recoverability and international value. The sensitivity of the receptor is therefore considered to be **medium**.		
Magnitude of impact	The cumulative effects assessment for Scenario 1 considers the following. • The Morecambe Offshore Windfarm: Generation Assets MDS identified up to 37 construction vessels on site at any one time. The types of vessel associated with construction phase of Morecambe Offshore Windfarm: Generation Assets is set out in **Table 4.43**. • Cumulatively, as described in **Table 4.43**, the total number of vessels associated with construction of the two projects will represent an increase in vessel activity within the cumulative marine mammal study area. Considering that the assessment is based on the maximum design scenario for both projects, the number of	The cumulative effects assessment for Scenario 2 considers the following. • The Morgan Offshore Wind Project: Generation Assets MDS identified up to 69 construction vessels on site at any one time. The types of vessel associated with construction phase of Morgan Offshore Wind Project: Generation Assets are set out in **Table 4.43**. • Cumulatively, as described in **Table 4.43**, the total number of vessels associated with construction of the two projects will represent an increase in vessel activity within the cumulative marine mammal study area. Considering that the assessment is based on the maximum design scenario for both projects, the number of	The cumulative effects assessment for Scenario 3 considers the following. – The Transmission Assets MDS identified up to 28 construction vessels on site at any one time. – The Morecambe Offshore Windfarm: Generation Assets identified up to 37 construction vessels on site at any one time. – Morgan Offshore Wind Project: Generation Assets MDS identified up to 69 construction vessels on site at any one time. • The approach to assessing the cumulative impact of increased likelihood of injury due to collision with vessels is as per Scenario 1 and 2 respectively.

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	vessels present at the two projects at any given time will in reality be lower. • Vessels involved in the two projects are likely to be travelling slowly, at a speed that is unlikely to pose a significant collision risk to marine mammals (below 14 to 15 knots; Laist *et al.,* 2001; Wilson *et al.,* 2007). With the exception of CTVs, most vessels involved in the construction phase of both projects are likely to be travelling considerably slower than this (Laist *et al.*, 2001), and all vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels (these measures are also set out in Measures to minimise disturbance to marine mammals and rafting birds from vessels, document reference: J16)). The Morecambe Offshore Windfarm: Generation Assets ES has committed to a Project Environmental Management Plan, to reduce the risk of collisions.	vessels present at the two projects at any given time will in reality be lower. • Vessels involved in the two projects are likely to be travelling slowly, at a speed that is unlikely to pose a significant collision risk to marine mammals (below 14 to 15 knots; Laist *et al.,* 2001, Wilson *et al.,* 2007). With the exception of CTVs, most vessels involved in the construction phase of both projects are likely to be travelling considerably slower than this (Laist *et al.*, 2001), and all vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels) as will the Morgan Offshore Wind Project: Generation Assets as per their application commitment. • In addition, sound emissions from vessels will likely deter animals from the potential zone of impact. • Given that vessel movements will be confined to project areas and are likely to follow existing shipping routes to/from port,	• Cumulatively, as described in **Table 4.43**, the total number of vessels associated with construction of Transmission Assets and Generation Assets will represent an increase in vessel activity within the cumulative marine mammal study area. Considering that the assessment is based on MDSs, the number of vessels present at the two projects at any given time will in reality be lower. With standard industry measures in place to reduce the risk of collision the impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	• In addition, sound emissions from vessels will likely deter animals from the potential zone of impact. • Given that vessel movements will be confined to project areas and are likely to follow existing shipping routes to/from port, collision risk is expected to be localised to within the boundaries of the respective projects. Additionally, works will take place in an area characterised by relatively high levels of traffic and both projects will adhere to best practice protocols. The Transmission Assets has committed to the development of VTMPs which will minimise, as far as reasonably practicable, encounters with marine mammals and basking sharks (CoT69) (**Table 4.12**). The Morecambe Offshore Windfarm: Generation Assets has also committed to a VTMP as best practice to reduce vessel collision risk. • The duration of vessel activity is considered to be medium term (throughout the construction phase of Transmission Assets) and localised for each project, however vessel movements will	collision risk is expected to be localised to within the boundaries of the respective projects. Additionally, works will take place in an area characterised by relatively high levels of traffic and both projects will adhere to best practice protocols. The Transmission Assets has committed to the development of VTMPs which will minimise, as far as reasonably practicable, encounters with marine mammals and basking sharks (CoT60) (**Table 4.12**). • The duration of vessel activity is considered to be medium term (throughout the construction phase of Transmission Assets) and localised for each project, however vessel movements will occur intermittently over this period • It is not anticipated that the cumulative level of vessel activity during construction will cause an increase of collisions with marine mammals. With standard industry measures in place to reduce the risk of collision the impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits,	

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	occur intermittently over this period. • It is not anticipated that the cumulative level of vessel activity during construction will cause an increase of collisions with marine mammals. With standard industry measures in place to reduce the risk of collision the cumulative impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.	the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.	
Significance of effect	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.
Operation and maintenance phase			
Sensitivity of receptor	The sensitivity of marine mammals to collision risk is as described in the construction phase above. All marine mammals are deemed to have some resilience (largely due to avoidance behaviour and the argument that not all collisions are fatal), medium recoverability and international value. The sensitivity of the receptor is therefore considered to be **medium**.		

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
Magnitude of impact	The cumulative effects assessment for Scenario 1 considers the following. • The approach to assessing the cumulative impact of increased likelihood of injury due to collision with vessels is as per construction phase. • The Transmission Assets MDS identified up to 14 operational vessels (eight at Morgan Offshore Wind Project: Transmission Assets and six at Morecambe Offshore Windfarm: Transmission Assets) on site at any one time. • The Morecambe Offshore Windfarm: Generation Assets MDS identified up to 10 operational vessels on site at any one time. The types of vessel associated with the operation and maintenance phase of Morecambe Offshore Windfarm: Generation Assets are set out in **Table 4.43**. • The duration of vessel activity is considered to be long term (throughout the operations and maintenance phase of the Transmission Assets) and localised for each project with vessel movements occurring intermittently over the lifetime of	The cumulative effects assessment for Scenario 2 considers the following. • The approach to assessing the cumulative impact of increased likelihood of injury due to collision with vessels is as per construction phase. • The Transmission Assets MDS is as per Scenario 1. • The Morgan Offshore Wind Project: Generation Assets MDS identified up to 16 operational vessels on site at any one time. The types of vessel associated with the operation and maintenance phase of Morgan Offshore Wind Project: Generation Assets are set out in **Table 4.43**. • The duration of vessel activity is considered to be long term (throughout the operations and maintenance phase of the Transmission Assets) and localised for each project with vessel movements occurring intermittently over the lifetime of Transmission Assets It is expected that on average the offshore export cables will require up to one visit per year. Maintenance works to rebury/replace and carry out	The cumulative effects assessments for Scenario 3 considers the following. • The approach to assessing the cumulative impact of increased likelihood of injury due to collision with vessels is as per Scenario 1 and 2 • The Transmission Assets MDS is as per Scenario 1. • The Morecambe Offshore Windfarm: Generation Assets MDS identified up to 10 operational vessels on site at any one time. • The Morgan Offshore Wind Project: Generation Assets MDS identified up to 16 operational vessels on site at any one time. • The duration of vessel activity is considered to be long term (throughout the operations and maintenance phase of the Transmission Assets) and localised for each project with vessel movements occurring intermittently over the lifetime of Transmission Assets. It is expected that on average the offshore export cables will require up to one visit per year. Maintenance works to rebury/replace and carry out

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	Transmission Assets. It is expected that on average the offshore export cables will require up to one visit per year. Maintenance works to rebury/replace and carry out repair works on offshore export cables generally takes between one to two weeks. The cumulative number of vessels at any given time is expected to be lower for the operations and maintenance phase compared to the construction phase, however, cumulatively for concurrent events, there could be up to 24 vessels on site at any one time during the operations and maintenance phase. • Therefore, the magnitude of the impact and associated effect (disturbance) as a result of elevated underwater sound due to vessel use and other activities, for all marine mammal receptors, is expected to be less than that assessed for the construction phase. However, considering that vessel movements are temporally spaced over a longer timescale, over the decadal operating lifetime of the Transmission Assets, a precautionary approach	repair works on offshore export cables generally takes between one to two weeks. The cumulative number of vessels at any given time is expected to be lower for the operations and maintenance phase compared to the construction phase, however, cumulatively there could be up to 30 vessels on site at any one time. • Therefore, the magnitude of the impact and associated effect (disturbance) as a result of elevated underwater sound due to vessel use and other activities, for all marine mammal receptors, is expected to be less than that assessed for the construction phase. However considering that vessel movements are temporally spaced over a longer timescale, over the decadal operating lifetime of the Transmission Assets, a precautionary approach has been taken in assessing the magnitude. • All vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting	repair works on offshore export cables generally takes between one to two weeks. The cumulative number of vessels at any given time is expected to be lower for the operations and maintenance phase compared to the construction phase, however, cumulatively there could be up to 40 vessels on site at any one time during the operations and maintenance phase. • Therefore, the magnitude of the impact and associated effect (disturbance) as a result of elevated underwater sound due to vessel use and other activities, for all marine mammal receptors, is expected to be less than that assessed for the construction phase. However considering that vessel movements are temporally spaced over a longer timescale, over the decadal operating lifetime of the Transmission Assets, a precautionary approach has been taken in assessing the magnitude. With standard industry measures in place to reduce the risk of collision the cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use and other

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	has been taken in assessing the magnitude. • As per the construction phase all vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels (these measures are also set out in Measures to minimise disturbance to marine mammals and rafting birds from vessels, document reference: J16)) and VTMPs which will minimise, as far as reasonably practicable, encounters with marine mammals and basking sharks (CoT69) (**Table 4.12**). The Morecambe Offshore Windfarm: Generation Assets ES has committed to a Project Environmental Management Plan and a VTMP, to reduce the risk of collisions. With standard industry measures in place to reduce the risk of collision the cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use and other activities) and effect of behavioural disturbance is reversible. It is predicted that	vessels) and VTMPs which will minimise, as far as reasonably practicable, encounters with marine mammals and basking sharks (CoT69) (**Table 4.12**); likewise, the Morgan Offshore Wind Project: Generation Assets has a similar commitment to an Offshore EMPs (which includes measures to minimise disturbance to marine mammals). With standard industry measures in place to reduce the risk of collision the cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use and other activities) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.	activities) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.		
Significance of effect	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.
Decommissioning phase			
Sensitivity of receptor	The sensitivity of marine mammals to collision risk is as described in the construction phase above. All marine mammals are deemed to have some resilience (largely due to avoidance behaviour and the argument that not all collisions are fatal), medium recoverability and international value. The sensitivity of the receptor is therefore considered to be **medium**.		
Magnitude of impact	The cumulative effects assessment for Scenario 1 considers the following. • There is potential for decommissioning activities at the Transmission Assets to overlap with decommissioning activities at the Morecambe Offshore: Generation Assets. • The impact of the receptors during the decommissioning phase is not expected to differ from the impact of the receptors during the construction phase (see the assessment of magnitude of impact for the construction phase, above).	The cumulative effects assessment for Scenario 2 considers the following. • There is potential for decommissioning activities at the Transmission Assets to overlap with decommissioning activities at the Morgan Offshore Wind Project: Generation Assets. • The impact of the receptors during the decommissioning phase is not expected to differ from the impact of the receptors during the construction phase (see the assessment of magnitude of impact for the construction phase, above).	The cumulative effects assessment for Scenario 3 considers the following. • There is potential for decommissioning activities at the Transmission Assets to overlap with decommissioning activities at the Generation Assets. • The impact of the receptors during the decommissioning phase is not expected to differ from the impact of the receptors during the construction phase (see the assessment of magnitude of impact for the construction phase, above). • Vessel types which will be required during the

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	• Vessel types which will be required during the decommissioning phase include those used during removal of export cables and export cable protection. The numbers and types of vessel used to remove infrastructure (and hence their size and outputs) are expected to be similar to those used during installation, therefore the potential risk of collision is expected to be similar to the construction phase. • An Offshore Decommissioning Programme (CoT55) (**Table 4.12**) will be developed prior to decommissioning in consultation with stakeholders, at the time of decommissioning, on the basis of a refined project design. With standard industry measures in place to reduce the risk of collision the impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.	• Vessel types which will be required during the decommissioning phase include those used during removal of export cables and export cable protection. The numbers and types of vessel used to remove infrastructure (and hence their size and outputs) are expected to be similar to those used during installation, therefore the potential risk of collision is expected to be similar to the construction phase. • An Offshore Decommissioning Programme (CoT55) (**Table 4.12**) will be developed prior to decommissioning in consultation with stakeholders, at time of decommissioning, on the basis of a refined project design. With standard industry measures in place to reduce the risk of collision the impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.	decommissioning phase include those used during removal of export cables and export cable protection. The numbers and types of vessel used to remove infrastructure (and hence their size and outputs) are expected to be similar to those used during installation, therefore the potential risk of collision is expected to be similar to the construction phase. • An Offshore Decommissioning Programme (CoT55) (**Table 4.12**) will be developed prior to decommissioning in consultation with stakeholders, at time of decommissioning, on the basis of a refined project design. With standard industry measures in place to reduce the risk of collision the impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
Significance of effect	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Table 4.46: Increased likelihood of injury due to collision with vessels (Scenario 4a, Scenario 4b, Scenario 4c)

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
Construction phase			
Sensitivity of receptor	The sensitivity of marine mammals to collision risk is as described in **paragraph 4.11.4.2** for Transmission Assets alone. Whilst there are no seal haul-out sites in the study area, there are grey seal and harbour seal haul-out sites within the cumulative marine mammal study area and therefore cumulatively there is the potential for increase in the likelihood of vessel collision. All marine mammals are deemed to have some resilience (largely due to avoidance behaviour and the argument that not all collisions are fatal), medium recoverability and international value. The sensitivity of the receptor is therefore considered to be **medium**.		
Magnitude of impact	The cumulative effects assessment for Scenario 4a which, includes the Transmission Assets and Generation Assets (Scenario 3) (**Table 4.45**) and Tier 1 projects identified in **Table 4.38**, considers the following: • The approach to assessing the cumulative impact of increased likelihood of injury due to collision with vessels is as per Scenario 1 (see **Table 4.45**). • Project details for the Generation Assets are set out in **Table 4.45** (Scenario 3) and are not reiterated here. • Given the temporal overlap, the construction of the Transmission Assets and Generation Assets, together with construction and operations and maintenance phases of Tier 1 projects may lead to cumulative disturbance to marine mammals from vessel use and other sound producing activities. • Numbers and types of vessel associated with construction and operation and maintenance phases of Mona Offshore Wind Project; Awel y Môr Offshore Wind Farm; West Anglesey Demonstration Zone	The cumulative effects assessment for Scenario 4b considers the following: • Given the temporal overlap, the construction of the Transmission Assets and Generation Assets, together with construction and operations and maintenance phases of Tier 1 and Tier 2 projects may lead to cumulative disturbance to marine mammals from vessel use and other sound producing activities. • For all Tier 2 projects (set out in **Table 4.39**; n = 15), EIA Scoping Reports do not provide detailed information on vessel numbers. • The types of vessels involved in construction activities at the other offshore wind farms are anticipated to be similar to those identified for construction of the Transmission Assets and Generation Assets. • The duration of vessel activity is considered to be medium term (throughout the construction phase of Transmission Assets and Generation Assets) and	The cumulative effects assessment for Scenario 4c considers the following: • Given the temporal overlap, the construction of the Transmission Assets and Generation Assets, together with construction and operations and maintenance phases of Tier 1, Tier 2 and Tier 3 projects may lead to cumulative disturbance to marine mammals from vessel use and other sound producing activities. • The Lir Offshore Array, MaresConnect and Eni Hynet CCP are located within 50 km of Transmission Assets. The Isle of Man to UK Interconnector 2 and Mooir Vannin UK Transmission Assets are assumed to be located within 50 km of Transmission Assets.. All other Tier 3 projects (set out in **Table 4.39**; n = 36) are located over 100 km away from the Transmission Assets. • The construction timelines for the Isle of Man to UK Interconnector 2, Mooir Vannin UK Transmission Assets, Lir Offshore Array and Eni Hynet CCP are not yet

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	tidal site; White Cross Offshore Wind Farm and Project Erebus Floating Wind Demonstration are set out in **Table 4.44**. • Cumulatively, as described in **Table 4.44**, the total number of vessels associated with the construction of respective projects will represent an increase in vessel activity within the cumulative marine mammal study area. Considering that the assessment is based on MDSs for Tier 1 projects, the number of vessels present at respective projects at any given time is unlikely to be concurrent and will in reality be lower. • The duration of vessel activity is considered to be medium term (throughout the construction phase of Transmission Assets and Generation Assets) and localised for each project, however vessel movements will occur intermittently over a number of years. • All vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals from transiting vessels) and VTMPs which will minimise, as far as reasonably practicable, encounters with marine mammals and basking sharks (CoT69) (**Table 4.12**) and the Tier 1 projects are expected to have similar measures. With standard industry measures in place to reduce the risk of collision the impact is predicted to be of limited spatial extent,	localised for each project, however vessel movements will occur intermittently over a number of years. Although the exact number of vessels associated with most Tier 2 projects is unknown, cumulatively across the sites there will be an increase in vessel activity within the cumulative marine mammal study area. If the construction phase at all Tier 2 projects were to occur simultaneously, vessels associated with each project would contribute further to the increase over a number of years. • All vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and from transiting vessels) and VTMPs which will minimise, as far as reasonably practicable, encounters with marine mammals and basking sharks (CoT69) (**Table 4.12**) and the Tier 2 projects are expected to have similar best practice measures. With standard industry measures in place to reduce the risk of the impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.	available, but given that they are in pre-application stage, the construction phases may overlap temporally towards the end of the Transmission Assets construction phase • It is anticipated that the construction phase of MaresConnect (estimated 2026, with operations phase commencing in 2029) may overlap temporally with construction activities at Transmission Assets (MaresConnect, 2023). Maintenance of the cable during the operations phase typically involves considerably fewer vessels and round trips compared to construction. • Therefore, it is anticipated that these will not add substantially to the number of vessels present during the construction of the Transmission Assets and that the potential for cumulative effects is unlikely. • In addition, all vessels at the Transmission Assets will be required to follow Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels) and VTMPs which will minimise, as far as reasonably practicable, encounters with marine mammals and basking sharks (CoT69) (**Table 4.12**) and Tier 3 projects are expected to have similar best practice measures. With standard industry measures in place to reduce the risk of collision the impact is predicted to be of limited spatial extent,

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.		medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.
Significance of effect	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.
Operation and maintenance phase			
Sensitivity of receptor	The sensitivity of marine mammals to collision risk is as described in the construction phase above. All marine mammals are deemed to have some resilience (largely due to avoidance behaviour and the argument that not all collisions are fatal), medium recoverability and international value. The sensitivity of the receptor is therefore considered to be **medium**.		
Magnitude of impact	The cumulative effects assessment for Scenario 4a (Scenario 3 (**Table 4.45**) and Tier 1 projects) considers the following: • Given the temporal overlap, the operation and maintenance phase of the Transmission Assets and Generation Assets, together with Tier 1 projects may lead to cumulative disturbance to marine mammals from vessel use and other sound producing activities. • Project details for the Generation Assets are set out in Table 4.45 (Scenario 4a operational and maintenance phase	The cumulative effects assessment for Scenario 4b considers the following: • The operations and maintenance phase of the Transmission Assets and Generation Assets, together with operations and maintenance phases of Tier 1 and Tier 2 projects have the potential to result in cumulative risk of collision to marine mammals. • The range of vessels used in operation and maintenance activities of other Tier 2 projects (identified in **Table 4.39**) are anticipated to be similar to those identified for Scenario 4a, such as vessels used	The cumulative effects assessment for Scenario 4c considers the following: • The operations and maintenance phase of the Transmission Assets and Generation Assets, together with operations and maintenance phases of Tier 1, Tier 2 and Tier 3 projects have the potential to result in cumulative risk of collision to marine mammals. • All Tier 3 projects are in pre-application phase and no ESs are available to inform a quantitative assessment. • Maintenance of cable or offshore wind farm typically involves considerably

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	section of the table) and are not reiterated here. • The range of vessels used in operation and maintenance activities of relevant projects (Mona Offshore Wind Project; Awel y Môr Offshore Wind Farm; West Anglesey Demonstration Zone tidal site; White Cross Offshore Wind Farm; and Project Erebus Floating Wind Demonstration) is as set out in **Table 4.44** (Scenario 4a operational and maintenance phase section of the table). • The duration of vessel activity is considered to be long term (throughout the operations and maintenance phase of the Transmission Assets and Generation Assets) and localised for each project, however vessel movements will occur intermittently over the lifetime of the Transmission Assets and Generation Assets. The cumulative number of vessels is expected to be lower for the operations and maintenance phase compared to the construction phase (see **Table 4.44**). • As per the construction phase, all vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels) and VTMPs which will minimise, as far as reasonably practicable, encounters with marine mammals and basking sharks (CoT69) (**Table 4.12**) and	during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth and replacement of access ladders • The duration of vessel activity is considered to be long term (throughout the operations and maintenance phase of the Transmission Assets and Generation Assets) and localised for each project, however vessel movements will occur intermittently over the lifetime of the Transmission Assets and Generation Assets. The cumulative number of vessels is expected to be lower for the operations and maintenance phase compared to the construction phase of the Transmission Assets. • As per the construction phase, all vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels) and VTMPs which will minimise, as far as reasonably practicable, encounters with marine mammals and basking sharks (CoT69) (**Table 4.12**) and Tier 1 and Tier 2 projects are expected to have similar best practice measures. With standard industry measures in place to reduce the risk of collision the impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is	smaller numbers of vessels and round trips compared to construction. Considering the vessel activity within the Irish Sea, it is anticipated that these will not add substantially to the number of vessels present during the operations and maintenance phases of the Transmission Assets, Generation Assets, Tier 1 and Tier 2 projects and that the potential for cumulative effects is unlikely. • As per the construction phase, all vessels at the Transmission Assets will be required to follow an Offshore EMPs (CoT65) (**Table 4.12**) (which includes measures to minimise disturbance to marine mammals and rafting birds from transiting vessels) and VTMPs which will minimise, as far as reasonably practicable, encounters with marine mammals and basking sharks (CoT69) (**Table 4.12**) and Tier 3 projects are expected to have similar best practice measures. With standard industry measures in place to reduce the risk of collision the impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	Tier 1 projects are expected to have similar measures. With standard industry measures in place to reduce the risk of collision the impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.	of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.	
Significance of effect	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.
Decommissioning phase			
Sensitivity of receptor	The sensitivity of marine mammals to collision risk is as described in the construction phase above. All marine mammals are deemed to have some resilience (largely due to avoidance behaviour and the argument that not all collisions are fatal), medium recoverability and international value. The sensitivity of the receptor is therefore considered to be **medium**.		
Magnitude of impact	The cumulative effects assessment for Scenario 4a (Scenario 3 (**Table 4.45**) and Tier 1 projects) considers the following: • Decommissioning activities at the Transmission Assets and Generation Assets have the potential to overlap with decommissioning activities at the following Tier 1 projects.	The cumulative effects assessment for Scenario 4b considers the following: • Decommissioning activities at the Transmission Assets, Generation Assets and Tier 1 projects have the potential to overlap with decommissioning activities at Tier 2 projects as set out in **Table 4.39**.	The cumulative effects assessment for Scenario 4c considers the following: • Decommissioning activities at the Transmission Assets, Generation Assets, Tier 1 and Tier 2 projects have the potential to overlap with decommissioning activities at Tier 3 projects as set out in **Table 4.39**.

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	– Mona Offshore Wind Project (9.73 km from the Transmission Assets). – White Cross Offshore Wind Farm (a project with no temporal information available) (311.28 km from the Transmission Assets). • Project details for the Generation Assets are set out in **Table 4.45** and are not reiterated here. • The impact of the receptors during the decommissioning phase is not expected to differ from the impact of the receptors during the construction phase (see the assessment of magnitude of impact for the construction phase, in this table above). • The numbers and types of vessel used to remove infrastructure are expected to be similar to those used during construction, therefore potential impacts from elevated underwater sound due to vessel use and other sound producing activities is expected to be similar to the construction phase. • An Offshore Decommissioning Programme (CoT55) (**Table 4.12**) will be developed for the	• The impact of the receptors during the decommissioning phase is not expected to differ from the impact of the receptors during the construction phase (See the assessment of magnitude of impact for the construction phase, in this table above). • The numbers and types of vessel used to remove infrastructure are expected to be similar to those used during construction, therefore potential impacts from elevated underwater sound due to vessel use and other sound producing activities is expected to be similar to the construction phase. • The numbers and types of vessel used to remove infrastructure are expected to be similar to those used during construction, therefore potential impacts from elevated underwater sound due to vessel use and other sound producing activities is expected to be similar to the construction phase. • An Offshore Decommissioning Programme (CoT55) (**Table 4.12**) will be developed for the Transmission Assets prior to	• The impact of the receptors during the decommissioning phase is not expected to differ from the impact of the receptors during the construction phase (See the assessment of magnitude of impact for the construction phase, in this table above). • The numbers and types of vessel used to remove infrastructure are expected to be similar to those used during construction, therefore potential impacts from elevated underwater sound due to vessel use and other sound producing activities is expected to be similar to the construction phase. • An Offshore Decommissioning Programme (CoT55) (**Table 4.12**) will be developed for the Transmission Assets prior to decommissioning in consultation with stakeholders. With standard industry measures in place to reduce the risk of collision, the impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	Transmission Assets prior to decommissioning in consultation with stakeholders. With standard industry measures in place to reduce the risk of collision, the impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.	decommissioning in consultation with stakeholders. With standard industry measures in place to reduce the risk of collision, the impact is predicted to be of limited spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is, conservatively, considered to be **low**.	magnitude is, conservatively, considered to be **low**.
Significance of effect	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

4.13.5 Effects on marine mammals due to changes in prey availability

4.13.5.1 Impacts on fish and shellfish receptors have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, and therefore a brief overview of impacts on marine mammals due to changes in prey availability, and a summary of magnitude, sensitivity and significance for Transmission Assets alone is presented in **section 4.11.5**. An assessment of the potential for cumulative impacts as a result of changes in fish and shellfish communities affecting prey availability has been presented for Transmission Assets alongside the Generations Assets in **Table 4.47** and alongside other relevant Tier 1 projects, and Tier 2 and Tier 3 projects in **Table 4.48** below.

Table 4.47: Effects on marine mammals due to changes in prey availability (Scenario 1, Scenario 2, Scenario 3)

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
Construction phase			
Sensitivity of receptor	The sensitivity of marine mammals to changes in prey availability is as described in **paragraph 4.11.5.4** *et seq.* for Transmission Assets alone. Most marine mammals, except for minke whale, are deemed to be able to tolerate changes in prey availability, have high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **low**. For minke whale, due to their reliance on herring, sprat and sandeel as a primary food source in the Irish Sea, minke whale may be more sensitive than other marine mammal species to changes in prey resources. Therefore this receptor is deemed to have some resilience to changes in prey availability, high recoverability and international value. The sensitivity of the receptor is therefore considered to be **medium**.		
Magnitude of impact	The cumulative effects assessment for Scenario 1 considers the following. • Potential cumulative impacts on marine mammals as a result of changes to the fish and shellfish community may occur as a result of the construction of Transmission Assets alongside Morecambe Offshore Windfarm: Generation Assets (Scenario 1). • Potential cumulative impacts from Scenario 1 on marine mammal prey species during the construction phase of Transmission Assets have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, which identified: – temporary habitat loss or disturbance. ○ Total cumulative temporary habitat loss and disturbance: up to	The cumulative effects assessment for Scenario 2 considers the following. • Potential cumulative impacts on marine mammals as a result of changes to the fish and shellfish community may occur as a result of the construction of Transmission Assets alongside Morgan Offshore Wind Project: Generation Assets (Scenario 2). • Potential cumulative impacts from Scenario 2 on marine mammal prey species during the construction phase of Morgan Offshore Wind Project: Generation Assets have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of ES, which identified: – temporary habitat loss or disturbance.	The cumulative effects assessment for Scenario 3 considers the following. • Potential cumulative impacts on marine mammals as a result of changes to the fish and shellfish community may occur as a result of the construction of Transmission Assets alongside Generation Assets (Scenario 3). • Potential cumulative impacts from Scenario 3 on marine mammal prey species during the construction phase of Transmission Assets have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, which identified: – temporary habitat loss or disturbance. ○ Total cumulative temporary habitat loss and disturbance: up to 78.58 km^2 and was

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	17.26 km² and was assessed as minor adverse significance for most fish and shellfish ecology receptors, and negligible for diadromous fish species IEFs, and therefore is unlikely to result in changes to prey availability for marine mammals. – <u>Long term habitat loss.</u> ○ Total cumulative area of long term habitat loss: up to 0.99 km²; this represents a small area in the context of the cumulative fish and shellfish ecology study area (13,065.53 km²). ○ Long term habitat loss may commence within the construction phases and continue into the operation and maintenance phases of both projects. ○ The significance for long-term habitat loss for fish and shellfish was assessed as minor adverse significance for all fish and shellfish ecology receptors, and therefore is unlikely to result in changes in prey availability in marine mammals. – <u>Underwater sound from UXO clearance and geophysical</u>	○ Total cumulative temporary habitat loss and disturbance: up to 76.23 km² and was assessed as minor adverse for most fish and shellfish ecology receptors, and negligible for diadromous fish species IEFs, and therefore is unlikely to result in changes to prey availability for marine mammals. – <u>Long term habitat loss.</u> ○ Total cumulative area of long term habitat loss: up to 1.89 km²; this represents a small area in the context of the cumulative fish and shellfish ecology study area (13,065.53 km²). ○ Long term habitat loss may commence within the construction phases and continue into the operation and maintenance phases of both projects. ○ The significance for long-term habitat loss for fish and shellfish was assessed as minor adverse significance for all fish and shellfish ecology receptors, and therefore is unlikely to result	assessed as minor adverse for most fish and shellfish ecology receptors, and negligible for diadromous fish species IEFs, and therefore is unlikely to result in changes to prey availability for marine mammals. – <u>Long term habitat loss.</u> ○ Total cumulative area of long term habitat loss: up to 2.3 km²; this represents a small area in the context of the cumulative fish and shellfish ecology study area (13,065.53 km²). ○ The significance for long term habitat loss for fish and shellfish was assessed as minor adverse significance for all fish shellfish ecology receptors, and therefore is unlikely to result in changes in prey availability in marine mammals. – <u>Underwater sound from UXO clearance and geophysical surveys impacting fish and shellfish receptors.</u> ○ Cumulatively up to 38 UXO are estimated to require clearance for the Transmission Assets (25

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	surveys impacting fish and shellfish receptors. ○ Up to 25 UXO (up to 22 UXO at the Morgan Offshore Wind Project: Transmission Assets and three UXO at the Morecambe Offshore Windfarm: Transmission Assets) are estimated to require clearance for the Transmission Assets. ○ The Morecambe Offshore Windfarm: Generation Assets but did not identify the number of UXO requiring clearing. ○ Underwater sound from UXO clearance associated with the construction phase of the Transmission Assets and Morecambe Offshore Windfarm: Generation Assets, has the potential to result in impacts to fish and shellfish receptors. ○ Whilst each clearance event is considered of a short-term, almost instantaneous nature, and is likely to result in close range mortality and mortal injury to fish and shellfish species, it is considered that	in changes in prey availability in marine mammals. – Underwater sound from UXO clearance and geophysical/geotechnical surveys impacting fish and shellfish receptors. ○ Cumulatively up to 38 UXO are estimated to require clearance for the Transmission Assets (25 UXO, with up to 22 UXO at the Morgan Offshore Wind Project: Transmission Assets and three UXO at the Morecambe Offshore Windfarm: Transmission Assets) and Morgan Offshore Wind Project: Generation Assets (13 UXO). ○ Underwater sound from UXO clearance associated with the construction phase of Transmission Assets, has the potential to result in impacts to fish and shellfish receptors. ○ Whilst each clearance event is considered of a short-term, almost instantaneous nature, and is likely to result in close range mortality and mortal injury to fish and shellfish	UXO, with up to 22 UXO at the Morgan Offshore Wind Project: Transmission Assets and three UXO at the Morecambe Offshore Windfarm: Transmission Assets) and Morgan Offshore Wind Project: Generation Assets (13 UXO) along with clearance of UXO at Morecambe Offshore Windfarm: Generation Assets (un-specified at the time of writing). ○ As described for Scenario 1 and 2, it is considered unlikely that these projects will undertake clearance detonations simultaneously. ○ The cumulative significance of effect on fish and shellfish receptors as a result of underwater sound was assessed as minor adverse for all fish and shellfish ecology receptors, and therefore this is unlikely to impact marine mammals. – Increased SSC and associated sediment deposition. ○ Seabed preparation and installation of foundations

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	there is a very low likelihood that clearance activities (or detonations) from both Morecambe Offshore Windfarm: Generation Assets and Transmission Assets would occur simultaneously. ○ Whilst there may be certain prey species that make up the main part of their diet, all marine mammals in this assessment are considered to be generalist opportunistic feeders and are thus not reliant on a single prey species. ○ The cumulative significance of effect on fish and shellfish receptors as a result of underwater sound was assessed as minor adverse for all fish and shellfish ecology receptors, and therefore this is unlikely to impact marine mammals. – <u>Increased SSC and associated sediment deposition.</u> ○ Seabed preparation and installation of foundations and cables for the two projects may increase SSC and associated sediment deposition.	species, it is considered that there is a very low likelihood that clearance activities (or detonations) from both Morgan Offshore Wind Project: Generation Assets and Transmission Assets would occur simultaneously. ○ Whilst there may be certain prey species that make up the main part of their diet, all marine mammals in this assessment are considered to be generalist opportunistic feeders and are thus not reliant on a single prey species. ○ The cumulative significance of effect on fish and shellfish receptors as a result of underwater sound was assessed as minor adverse for all fish and shellfish ecology receptors, and therefore this is unlikely to impact marine mammals. – <u>Increased SSC and associated sediment deposition.</u> ○ Seabed preparation and installation of foundations and offshore export cables for the two projects may	and offshore export cables for the three projects may increase SSC and associated sediment deposition. ○ A total volume of 24,968,183 m^3 disturbed sediments at all three projects. This represents only a small increase in spoil volume when compared to Scenario 2. ○ As mentioned in Scenario 2, whilst the total spoil volume is higher than for Scenario 1, the sediment plumes creating the highest turbidity are still anticipated to occur immediately adjacent to the release site, returning to background levels within a few tidal cycles. ○ Therefore Volume 2, Chapter 3: Fish and shellfish ecology of the ES considered the magnitude to be consistent with that presented in Scenario 1 and Scenario 2. ○ The cumulative significance of the effect on fish and shellfish receptors was considered to be of minor adverse significance and

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	○ A total volume of 4,706,263 m^3 disturbed sediments at the two projects. ○ The two projects combined are not expected to significantly increase the magnitude compared to the Transmission Assets alone, with sediment plumes creating the highest turbidity immediately adjacent to the release site and returning to background levels within a few tidal cycles. ○ Deposited sediments are expected to be incorporated into the natural hydrodynamic regime and redistributed over the course of a series of spring tides. ○ The cumulative significance of the effect on fish and shellfish receptors was considered to be of minor adverse significance and therefore this is unlikely to impact marine mammals. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use) and effect of behavioural disturbance is	increase SSC and associated sediment deposition. ○ A total volume of 23,866,720 m^3 disturbed sediments at the two projects. ○ Whilst the total spoil volume is higher than for Scenario 1, the sediment plumes creating the highest turbidity are still anticipated to occur immediately adjacent to the release site, returning to background levels within a few tidal cycles. ○ Therefore Volume 2, Chapter 3: Fish and shellfish ecology of the ES considered the magnitude to be consistent with that presented in Scenario 1. ○ The cumulative significance of the effect on fish and shellfish receptors was considered to be of minor adverse significance and therefore this is unlikely to impact marine mammals. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use) and effect of behavioural disturbance is	therefore this is unlikely to impact marine mammals. The cumulative impact is predicted to be of local to regional spatial extent, long term duration, intermittent and both the impact itself (i.e. elevated underwater sound due to vessel use) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.	reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.	
Significance of effect	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species, except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approach was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse, in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approach was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approach was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.
Operation and maintenance phase			
Sensitivity of receptor	The sensitivity of marine mammals to changes in prey availability is as described for the construction phase and in **paragraph 4.11.5.4** *et seq.* for the Transmission Assets alone assessment. Most marine mammals, except for minke whale, are deemed to be able to tolerate changes in prey availability, have high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **low**.		

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	For minke whale, due to their reliance on herring, sprat and sandeel as a primary food source in the Irish Sea, minke whale may be more sensitive than other marine mammal species to changes in prey resources. Therefore this receptor is deemed to have some resilience to changes in prey availability, high recoverability and international value. The sensitivity of the receptor is therefore considered to be **medium**.		
Magnitude of impact	The cumulative effects assessment for Scenario 1 considers the following. • Potential cumulative impacts on marine mammals as a result of changes to the fish and shellfish community may occur as a result of the operation and maintenance of Transmission Assets and Morecambe Offshore Windfarm: Generation Assets. • Potential cumulative impacts from Transmission Assets and Morecambe Offshore Windfarm: Generation Assets on marine mammal prey species during the operation and maintenance phase have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, which identified the following. – <u>Long term habitat loss.</u> ○ Total cumulative area of long term habitat loss is as per the construction phase. ○ Long term habitat loss may commence within the construction phase, and continue into the operation and maintenance phase.	The cumulative effects assessment for Scenario 2 considers the following. • Cumulative impacts on marine mammals as a result of changes to the fish and shellfish community may occur as a result of the operation and maintenance phase of Transmission Assets and Morgan Offshore Wind Project: Generation Assets. • Potential cumulative impacts from Transmission Assets and Morgan Offshore Wind Project: Generation Assets on marine mammal prey species during the operation and maintenance phase have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, which identified the following. – <u>Long term habitat loss.</u> ○ Total cumulative area of long term habitat loss is as per the construction phase. ○ Long term habitat loss may commence within the construction phase and continue into the operation and maintenance phase.	The cumulative effects assessment for Scenario 3 considers the following. • Potential cumulative impacts on marine mammals as a result of changes to the fish and shellfish community may occur as a result of the operation and maintenance of Transmission Assets and Generation Assets. • Potential cumulative impacts from Transmission Assets and Generation Assets on marine mammal prey species during the operation and maintenance phase have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, which identified the following. – Long term habitat loss. ○ Total cumulative area of long term habitat loss is as per the construction phase. ○ Long term habitat loss may commence within the construction phase and continue into the operation and maintenance phase. ○ The significance for long-term habitat loss for fish and

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	○ The significance for long-term habitat loss for fish and shellfish was assessed as minor adverse significance for all fish and shellfish ecology receptors, and therefore is unlikely to result in changes in prey availability in marine mammals. – Introduction and colonisation of hard substrata. ○ Total cumulative area of introduction and colonisation of hard substrata: 0.99 km^2; this represents a small area of change when compared to the extent of the cumulative fish and shellfish ecology study area (13,065.53 km^2). ○ The significance for introduction and colonisation of hard substrata for fish and shellfish was assessed as minor adverse significance for all fish and shellfish ecology receptors, and therefore is unlikely to result in changes in prey availability in marine mammals. – EMF from subsea electrical cabling.	○ The significance for long-term habitat loss for fish and shellfish was assessed as minor adverse significance for all fish and shellfish ecology receptors, and therefore is unlikely to result in changes in prey availability in marine mammals. – Introduction and colonisation of hard structures. ○ Total cumulative area of permanent hard structures: up to 2.37 km^2; this represents a small area of change when compared to the extent of the cumulative fish and shellfish ecology study area (13,065.53 km^2). ○ The significance for introduction and colonisation of hard substrata for fish and shellfish was assessed as minor adverse significance for all fish and shellfish ecology receptors, and therefore is unlikely to result in changes in prey availability in marine mammals. – EMF from subsea electrical cabling.	shellfish was assessed as minor adverse significance for all fish and shellfish ecology receptors, and therefore is unlikely to result in changes in prey availability in marine mammals. – Introduction and colonisation of hard structures. ○ Total cumulative area of permanent hard structures: up to 2.8 km^2; this represents a small area of change when compared to the extent of the cumulative fish and shellfish ecology study area (13,065.53 km^2). ○ The significance for introduction and colonisation of hard substrata for fish and shellfish was assessed as minor adverse significance for all fish and shellfish ecology receptors, and therefore is unlikely to result in changes in prey availability in marine mammals. – EMF from subsea electrical cabling. ○ Impacts from EMFs emitted from subsea electrical cabling has the potential to

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	○ Impacts from EMFs emitted from subsea electrical cabling has the potential to impact fish and shellfish ecology receptors. ○ Effects of EMFs are expected to be limited to a range of just metres from the cables associated with both projects. ○ The cumulative significance of the effect on fish and shellfish receptors as a result of EMF from subsea electrical cabling was determined to be minor adverse significance for all fish and shellfish ecology receptors, and therefore is unlikely to impact marine mammals. No significant adverse cumulative effects were predicted to occur to fish and shellfish species (marine mammal prey) as a result of the operation and maintenance phase of the Transmission Assets in combination with the Morecambe Offshore Windfarm: Generation Assets (Volume 2, Chapter 3: Fish and shellfish ecology of the ES). Whilst most impacts are considered to be minor adverse there is the potential for some beneficial effects with respect to introduction of hard substrate which could increase prey availability for some species. Therefore, changes in prey availability	○ Impacts from EMFs emitted from subsea electrical cabling has the potential to impact fish and shellfish receptors. ○ Effects of EMFs are expected to be limited to a range of just metres from the cables associated with both projects. ○ The cumulative significance of the effect on fish and shellfish receptors as a result of EMF from subsea electrical cabling was determined to be minor adverse significance for all fish and shellfish ecology receptors, and therefore is unlikely to impact marine mammals. No significant adverse cumulative effects were predicted to occur to fish and shellfish species (marine mammal prey) as a result of the operation and maintenance phase of the Transmission Assets in combination with the Morgan Offshore Wind Project: Generation Assets (Volume 2, Chapter 3: Fish and shellfish ecology of the ES). Whilst most impacts are considered to be adverse there is the potential for some beneficial effects with respect to introduction of hard substrate which could increase prey availability for some species. Therefore, changes in prey availability	impact fish and shellfish receptors. ○ Effects of EMFs are expected to be limited to a range of metres from the cables associated with Generation Assets and Transmission Assets projects. ○ The cumulative significance of the effect on fish and shellfish receptors as a result of EMF from subsea electrical cabling was determined to be minor adverse significance for all fish and shellfish ecology receptors, and therefore is unlikely to impact marine mammals. No significant adverse cumulative effects were predicted to occur to fish and shellfish species (marine mammal prey) as a result of the operation and maintenance of the Transmission Assets in combination with the Generation Assets (Volume 2, Chapter 3: Fish and shellfish ecology of the ES). Whilst most impacts are considered to be minor adverse there is the potential for some beneficial effects with respect to introduction of hard substrate which could increase prey availability for some species. Therefore, changes in prey availability on marine mammals were predicted to be of local spatial extent, medium-term duration, continuous and high reversibility. The

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	on marine mammals were predicted to be of local spatial extent, medium-term duration, continuous and high reversibility. The magnitude was therefore, considered to be **low**.	on marine mammals were predicted to be of local spatial extent, medium-term duration, continuous and high reversibility. The magnitude was therefore, considered to be **low**.	magnitude was therefore, considered to be **low**.
Significance of effect	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approach was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approach was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approach was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.
Decommissioning phase			
Sensitivity of receptor	The sensitivity of marine mammals to changes in prey availability is as described for the construction phase and in **paragraph 4.11.5.4** *et seq.* for the Transmission Assets alone assessment. Most marine mammals, except for minke whale, are deemed to be able to tolerate changes in prey availability, have high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **low**.		

<table>
<tr><th></th><th>Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets</th><th>Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets</th><th>Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets</th></tr>
<tr><td></td><td colspan="3">For minke whale, due to their reliance on herring, sprat and sandeel as a primary food source in the Irish Sea, minke whale may be more sensitive than other marine mammal species to changes in prey resources. Therefore this receptor is deemed to have some resilience to changes in prey availability, high recoverability and international value. The sensitivity of the receptor is therefore considered to be medium.</td></tr>
<tr><td>Magnitude of impact</td><td>The cumulative effects assessment for Scenario 1 considers the following.
• Potential cumulative impacts on marine mammals as a result of changes to the fish and shellfish community may occur as a result of the decommissioning of Transmission Assets alongside Morecambe Offshore Windfarm: Generation Assets.
• Potential cumulative impacts from Transmission Assets and Morecambe Offshore Windfarm: Generation Assets on marine mammal prey species during the decommissioning phase of Transmission Assets have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, which identified the following.
– <u>Temporary habitat loss or disturbance.</u>
○ The expected magnitude of temporary habitat loss or disturbance will be less than for the construction phase due to some construction-related activities not being</td><td>The cumulative effects assessment for Scenario 2 considers the following.
• Cumulative impacts on marine mammals as a result of changes to the fish and shellfish community may occur as a result of the decommissioning of Transmission Assets alongside Morgan Offshore Wind Project: Generation Assets.
• Potential cumulative impacts from Transmission Assets and Morgan Offshore Wind Project: Generation Assets on marine mammal prey species during the decommissioning phase of Transmission Assets have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of ES, which identified the following.
– <u>Temporary habitat loss or disturbance.</u>
○ The expected magnitude of temporary habitat loss or disturbance will be less than for the construction phase due to some construction-related activities not being</td><td>The cumulative effects assessment for Scenario 3 considers the following.
• Potential cumulative impacts on marine mammals as a result of changes to the fish and shellfish community may occur as a result of the decommissioning of Transmission Assets alongside the Generation Assets.
• The approach to assessing the cumulative impact due to changes in prey availability is as per Scenario 1 and 2 Potential cumulative impacts from Transmission Assets and Generation Assets on marine mammal prey species during the decommisisonign phase of Transmission Assets have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, which identified the following.
– <u>Temporary habitat loss or disturbance.</u>
○ The expected magnitude of temporary habitat loss or disturbance will be less than for the construction phase due to some construction-</td></tr>
</table>

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	required (e.g., sandwave clearance). ○ The cumulative significance of the effect on fish and shellfish receptors as a result of temporary habitat loss or disturbance was determined as minor adverse, and therefore this is unlikely to impact marine mammals. – <u>Long term habitat loss.</u> ○ The expected magnitude of long term habitat loss will be less than for the construction and operation and maintenance phases due to the removal of some infrastructure. ○ The cumulative significance of the effect on fish and shellfish receptors as a result of long term habitat loss was estimated as minor adverse and therefore this is unlikely to impact marine mammals. – <u>Increased SSC and associated sediment deposition.</u> ○ The expected magnitude of increased SSCs and associated sediment deposition will be less than for the construction phase	required (e.g., sandwave clearance). ○ The cumulative significance of the effect on fish and shellfish receptors as a result of temporary habitat loss or disturbance was determined as minor adverse, and therefore this is unlikely to impact marine mammals. – <u>Long term habitat loss.</u> ○ The expected magnitude of long term habitat loss will be less than for the construction and operation and maintenance phases due to the removal of some infrastructure. ○ The cumulative significance of the effect on fish and shellfish receptors as a result of long term habitat loss was estimated as **minor adverse** and therefore this is unlikely to impact marine mammals. – <u>Increased SSC and associated sediment deposition.</u> ○ Volume 2, Chapter 3: Fish and shellfish ecology of the ES identified that limited information is currently available for	related activities not being required. ○ The cumulative significance of the effect on fish and shellfish receptors as a result of temporary habitat loss or disturbance was determined as minor adverse, and therefore this is unlikely to impact marine mammals. – <u>Long term habitat loss.</u> ○ The expected magnitude of long term habitat loss will be less than for the construction and operation and maintenance phases due to the removal of some infrastructure. – The cumulative significance of the effect on fish and shellfish receptors as a result of long term habitat loss was estimated as **minor adverse** and therefore this is unlikely to impact marine mammals. – <u>Increased SSC and associated sediment deposition.</u> ○ The expected magnitude of increased SSCs and associated sediment deposition will be less than for

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	due to some construction-related activities not being required (e.g., sandwave clearance) ○ The cumulative significance of the effect on fish and shellfish receptors as a result of increased SSC and associated sediment deposition was estimated as minor adverse for all fish and shellfish ecology receptors and therefore this is unlikely to impact marine mammals. • An Offshore Decommissioning Programme (CoT55) (**Table 4.12**) for the Transmission Assets will be developed prior to decommissioning in consultation with stakeholders, at the time of decommissioning. No significant adverse cumulative effects were predicted to occur to fish and shellfish species (marine mammal prey) as a result of the decommissioning phase of the Transmission Assets in combination with the Morecambe Offshore Windfarm: Generation Assets (Volume 2, Chapter 3: Fish and shellfish ecology of the ES). Whilst most impacts are considered to be adverse there is the potential for some beneficial effects with respect to introduction of hard substrate which could increase prey availability for some species.	decommissioning the Morgan Offshore Wind Project: Generation Assets regarding increased SSC and sediment deposition, however, The expected magnitude of increased SSC and sediment deposition will be less than the construction phase. ○ The cumulative significance of the effect on fish and shellfish receptors as a result of increased SSC and associated sediment deposition was estimated as minor adverse for all fish and shellfish ecology receptors and therefore this is unlikely to impact marine mammals. • An Offshore Decommissioning Programme (CoT55) (**Table 4.12**) for the Transmission Assets will be developed prior to decommissioning in consultation with stakeholders, at the time of decommissioning. No significant adverse cumulative effects were predicted to occur to fish and shellfish species (marine mammal prey) as a result of the decommissioning phase of the Transmission Assets in combination with the Morgan Offshore Wind Project: Generation Assets (Volume 2, Chapter 3: Fish and shellfish	the construction phase due to some construction-related activities not being required. ○ The, the cumulative significance of the effect on fish and shellfish receptors as a result of increased SSC and associated sediment deposition was estimated as minor adverse for all fish and shellfish ecology receptors and therefore this is unlikely to impact marine mammals. • An Offshore Decommissioning Programme (CoT55) (**Table 4.12**) for the Transmission Assets will be developed prior to decommissioning in consultation with stakeholders, at the time of decommissioning. No significant adverse cumulative effects were predicted to occur to fish and shellfish species (marine mammal prey) as a result of the decommissioning phase of the Transmission Assets in combination with the Generation Assets (Volume 2, Chapter 3: Fish and shellfish ecology of the ES). Whilst most impacts are considered to be adverse there is the potential for some beneficial effects with respect to introduction of hard substrate which could increase prey availability for some species. Therefore, changes in prey availability on marine mammals were predicted to be of local

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
	Therefore, changes in prey availability on marine mammals were predicted to be of local spatial extent, medium-term duration, continuous and high reversibility. The magnitude was therefore, considered to be **low**.	ecology of the ES). Whilst most impacts are considered to be adverse there is the potential for some beneficial effects with respect to introduction of hard substrate which could increase prey availability for some species. Therefore, changes in prey availability on marine mammals were predicted to be of local spatial extent, medium-term duration, continuous and high reversibility. The magnitude was therefore, considered to be **low**.	spatial extent, medium-term duration, continuous and high reversibility. The magnitude was therefore, considered to be **low**.
Significance of effect	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approach was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approach was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approach was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.

Table 4.48: Effects on marine mammals due to changes in prey availability (Scenario 4a, Scenario 4b, Scenario 4c)

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
Construction phase			
Sensitivity of receptor	The sensitivity of marine mammals to changes in prey availability is as described for the construction phase and in **paragraph 4.11.5.4** *et seq.* for the Transmission Assets alone assessment. Most marine mammals, except for minke whale, are deemed to be able to tolerate changes in prey availability, have high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **low**. For minke whale, due to their reliance on herring, sprat and sandeel as a primary food source in the Irish Sea, minke whale may be more sensitive than other marine mammal species to changes in prey resources. Therefore this receptor is deemed to have some resilience to changes in prey availability, high recoverability and international value. The sensitivity of the receptor is therefore considered to be **medium**		
Magnitude of impact	The cumulative effects assessment for Scenario 4a which, includes the Transmission Assets and Generation Assets (Scenario 3) (**Table 4.47**) and Tier 1 projects identified in **Table 4.38**, considers the following: • The construction of the Transmission Assets and Generation Assets together with activities at Tier 1 projects (offshore wind farms, oil and gas projects, dredging activities and deposit and removal projects/plans) may lead to potential cumulative impacts as a result of changes to the fish and shellfish community. • The approach to assessing the cumulative impact of changes in prey availability with vessels is as per Scenario 1 (see **Table 4.47**). • Project details for the Generation Assets are set out in **Table 4.47** and are not reiterated here. • The potential cumulative impacts identified in Volume 2, Chapter 3: Fish and shellfish ecology of the ES,	The cumulative effects assessment for Scenario 4b considers the following. • The construction of the Transmission Assets and Generation Assets together with activities at Tier 1 and Tier 2 projects (offshore wind farms and deposit and removal projects/plans) may lead to potential cumulative impacts as a result of changes to the fish and shellfish community. • The potential cumulative impacts identified in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, which have the potential to effect marine mammal prey, are as per Tier 1 (see Scenario 4a). • For all Tier 2 projects, EIA Scoping Reports do not provide sufficient detailed information to undertake a quantitative assessment (set out in **Table 4.39**). Volume 2, Chapter 3: Fish and shellfish ecology of ES has therefore presented a magnitude of impact, for all impacts, in line with the cumulative assessment	The cumulative effects assessment for Scenario 4c considers the following. • The construction of the Transmission Assets and Generation Assets together with activities at Tier 1, Tier 2 and Tier 3 projects (cables and pipelines) may lead to potential cumulative impacts as a result of changes to the fish and shellfish community. • The only Tier 3 projects identified in Volume 2, Chapter 3: Fish and shellfish ecology of the ES are MaresConnect and the Isle of Man to UK Interconnector 2. • For all Tier 3 projects, there was not sufficient detailed information to undertake a quantitative assessment (set out in **Table 4.39**). Volume 2, Chapter 3: Fish and shellfish ecology of ES has therefore presented a magnitude of impact, for all impacts, in line with the cumulative assessment for Tier 1 projects.

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	which have the potential to effect marine mammal prey, are as per Scenario 1 (see **Table 4.47**). • Potential cumulative impacts from Transmission Assets and Generation Assets alongside Tier 1 projects, on marine mammal prey species during the construction phase of Transmission Assets have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of ES (as per Scenario 1), which identified the following: – Temporary habitat loss. ○ Total cumulative temporary habitat loss and disturbance: up to 155.31 km^2. ○ The significance for temporary habitat loss for fish and shellfish was assessed as **negligible** to **minor adverse**, and therefore is unlikely to result in changes in prey availability in marine mammals. – Long term habitat loss. ○ Total cumulative area of permanent hard structures (equating to long term habitat loss): up to 6.19 km^2 (excluding Isle of Man Crogga). ○ Long term habitat loss may commence within the 30-month sequential construction phase (noting that there is potential for a gap between the construction periods for Morgan and	for Tier 1 projects. The cumulative magnitude of impact for marine mammals, as a result of changes in fish and shellfish communities affecting prey availability for Tier 1 and Tier 2 projects is therefore not expected to differ from the cumulative assessment for Tier 1 projects (Scenario 4a). • The cumulative magnitude of impact for marine mammals, as a result of changes in fish and shellfish communities affecting prey availability for Transmission Assets and Generation Assets alongside Tier 1 and Tier 2 projects is therefore not expected to differ from the cumulative assessment for Scenario 4a. No significant adverse cumulative effects were predicted to occur to fish and shellfish species (marine mammal prey) as a result of the construction phase of the Transmission Assets and Generation Assets in combination with Tier 1 and Tier 2 projects (Volume 2, Chapter 3: Fish and shellfish ecology of the ES). Whilst most impacts are considered to be adverse there is the potential for some beneficial effects with respect to introduction of hard substrate which could increase prey availability for some species. Therefore, changes in prey availability on marine mammals were predicted to be of local spatial extent, medium-term duration, continuous and high reversibility. The magnitude was therefore, considered to be **low**.	• The cumulative magnitude of impact for marine mammals, as a result of changes in fish and shellfish communities affecting prey availability for Transmission Assets and Generation Assets alongside Tier 1, Tier 2 and Tier 3 projects is therefore not expected to differ from the cumulative assessment for Scenario 4a. No significant adverse cumulative effects were predicted to occur to fish and shellfish species (marine mammal prey) as a result of the construction phase of the Transmission Assets and Generation Assets in combination with Tier 1. Tier 2 and Tier 3 (Volume 2, Chapter 3: Fish and shellfish ecology of the ES). Whilst most impacts are considered to be adverse there is the potential for some beneficial effects with respect to introduction of hard substrate which could increase prey availability for some species. Therefore, changes in prey availability on marine mammals were predicted to be of local spatial extent, medium-term duration, continuous and high reversibility. The magnitude was therefore, considered to be **low**.

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	Morecambe), and continue into the operation and maintenance phase. ○ The significance for long-term habitat loss for fish and shellfish was assessed as **minor adverse**, therefore resulting effects due to prey availability on marine mammals are minimal. – Increase in SSCs and associated sediment deposition. ○ Sediment plumes generated at Awel y Môr are expected to be of limited spatial extent and are therefore unlikely to interact with sediment plumes from the Transmission Assets. ○ Sediment plumes from the Mona Offshore Wind Project may interact with those generated by the Transmission Assets, however high levels of SSC are expected to be limited to immediately adjacent to the release point for each project, with rapid assimilation into natural tidal cycles. ○ The significance for increased SSCs and associated sediment deposition for fish and shellfish was assessed as **minor adverse**, therefore resulting effects due to prey availability on marine mammals are minimal. No significant adverse cumulative effects were predicted to occur to fish and shellfish species		

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	(marine mammal prey) as a result of the construction phase of the Transmission Assets and Generation Assets in combination with Tier 1 projects (Volume 2, Chapter 3: Fish and shellfish ecology of the ES). Whilst most impacts are considered to be adverse there is the potential for some beneficial effects with respect to introduction of hard substrate which could increase prey availability for some species. Therefore, changes in prey availability on marine mammals were predicted to be of local spatial extent, medium-term duration, continuous and high reversibility. The magnitude was therefore, considered to be **low**.		
Significance of effect	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approached was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approached was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approached was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
Operation and maintenance phase			
Sensitivity of receptor	The sensitivity of marine mammals to changes in prey availability is as described for the construction phase and in **paragraph 4.11.5.4** *et seq.* for the Transmission Assets alone assessment. Most marine mammals, except for minke whale, are deemed to be able to tolerate changes in prey availability, have high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **low**. For minke whale, due to their reliance on herring, sprat and sandeel as a primary food source in the Irish Sea, minke whale may be more sensitive than other marine mammal species to changes in prey resources. Therefore this receptor is deemed to have some resilience to changes in prey availability, high recoverability and international value. The sensitivity of the receptor is therefore considered to be **medium**		
Magnitude of impact	The cumulative effects assessment for Scenario 4a (Scenario 3 (**Table 4.47**) and Tier 1 projects) considers the following. • The operation and maintenance of the Transmission Assets and Generation Assets together with activities at Tier 1 projects (offshore wind farms, oil and gas projects, dredging activities and deposit and removal projects/plans) may lead to potential cumulative impacts as a result of changes to the fish and shellfish community. • Project details for the Generation Assets are set out in **Table 4.47** and are not reiterated here. • The potential cumulative impacts identified in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, which have the potential to effect marine mammal prey, are as per Scenario 1 (see **Table 4.47**). • Potential cumulative impacts from Transmission Assets and Generation Assets alongside Tier 1 projects, on marine mammal prey species during	The cumulative effects assessment for Scenario 4b considers the following. • The operation and maintenance of the Transmission Assets and Generation Assets together with activities at Tier 1 and Tier 2 projects (offshore wind farms and deposit and removal projects/plans) may lead to potential cumulative impacts as a result of changes to the fish and shellfish community. • The potential cumulative impacts identified in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, which have the potential to effect marine mammal prey, are as per Tier 1 (see Scenario 4a). • For all Tier 2 projects, EIA Scoping Reports do not provide sufficient detailed information to undertake a quantitative assessment (set out in **Table 4.39**). Volume 2, Chapter 3: Fish and shellfish ecology of ES has therefore presented a magnitude of impact, for all impacts, in line with the cumulative assessment for Tier 1 projects. The	The cumulative effects assessment for Scenario 4c considers the following. • The operation and maintenance of the Transmission Assets and Generation Assets together with activities at Tier 1, Tier 2 and Tier 3 projects (offshore export cables and pipelines) may lead to potential cumulative impacts as a result of changes to the fish and shellfish community. • The only Tier 3 projects identified in Volume 2, Chapter 3: Fish and shellfish ecology of the ES are MaresConnect and the Isle of Man to UK Interconnector 2. • For all Tier 3 projects, there was not sufficient detailed information to undertake a quantitative assessment (set out in **Table 4.39**). Volume 2, Chapter 3: Fish and shellfish ecology of ES has therefore presented a magnitude of impact, for all impacts, in line with the cumulative assessment for Tier 1 projects. • The cumulative magnitude of impact for marine mammals, as a result of changes in fish and

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	the operation and maintenance phase of Transmission Assets have been assessed in Volume 2, Chapter 3: Fish and shellfish ecology of ES (as per Scenario 1), which identified the following. – <u>Introduction and colonisation of hard substrata</u>. ○ Total footprint of introduced habitat of 7.17 km^2 (excluding Isle of Man Crogga). When compared to the total area of the cumulative fish and shellfish ecology study area for this impact, this represents a relatively small area of change. ○ The significance for introduction and colonisation of hard substrata for fish and shellfish was assessed as **minor adverse**, therefore resulting effects due to prey availability on marine mammals are minimal. • For all other impacts considered in the cumulative scenario of Transmission Assets alongside Tier 1 projects, the assessment is as per Scenario 1 (see **Table 4.47**). No significant adverse cumulative effects were predicted to occur to fish and shellfish species (marine mammal prey) as a result of the operation and maintenance phase of the Transmission Assets and Generation Assets in combination with the Tier 1 projects (Volume 2, Chapter 3: Fish and shellfish ecology of the ES). Whilst most impacts are considered to be minor adverse there is the potential for some beneficial effects with respect to introduction of hard substrate which could increase prey availability for some species.	cumulative magnitude of impact for marine mammals, as a result of changes in fish and shellfish communities affecting prey availability for Tier 1 and Tier 2 projects is therefore not expected to differ from the cumulative assessment for Tier 1 projects (Scenario 4a). No significant adverse cumulative effects were predicted to occur to fish and shellfish species (marine mammal prey) as a result of the operation and maintenance phase of the Transmission Assets and Generation Assets in combination with the Tier 1 and Tier 2 projects (Volume 2, Chapter 3: Fish and shellfish ecology of the ES). Whilst most impacts are considered to be minor adverse there is the potential for some beneficial effects with respect to introduction of hard substrate which could increase prey availability for some species. Therefore, changes in prey availability on marine mammals were predicted to be of local spatial extent, medium-term duration, continuous and high reversibility. The magnitude was therefore, considered to be **low**.	shellfish communities affecting prey availability for Tier 1, Tier 2 and Tier 3 projects is therefore not expected to differ from the cumulative assessment for Tier 1 projects (Scenario 4a). No significant adverse cumulative effects were predicted to occur to fish and shellfish species (marine mammal prey) as a result of the operation and maintenance phase of the Transmission Assets and Generation Assets in combination with the Tier 1, Tier 2 and Tier 3 projects (Volume 2, Chapter 3: Fish and shellfish ecology of the ES). Whilst most impacts are considered to be minor adverse there is the potential for some beneficial effects with respect to introduction of hard substrate which could increase prey availability for some species. Therefore, changes in prey availability on marine mammals were predicted to be of local spatial extent, medium-term duration, continuous and high reversibility. The magnitude was therefore, considered to be **low**.

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	Therefore, changes in prey availability on marine mammals were predicted to be of local spatial extent, medium-term duration, continuous and high reversibility. The magnitude was therefore, considered to be **low**.		
Significance of effect	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approached was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approached was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approached was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.
Decommissioning phase			
Sensitivity of receptor	The sensitivity of marine mammals to changes in prey availability is as described for the construction phase and in **paragraph 4.11.5.4** *et seq.* for the Transmission Assets alone assessment. Most marine mammals, except for minke whale, are deemed to be able to tolerate changes in prey availability, have high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **low**. For minke whale, due to their reliance on herring, sprat and sandeel as a primary food source in the Irish Sea, minke whale may be more sensitive than other marine mammal species to changes in prey resources. Therefore this receptor is deemed to have some resilience to changes in prey availability, high recoverability and international value. The sensitivity of the receptor is therefore considered to be **medium**		

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
Magnitude of impact	The cumulative effects assessment for Scenario 4a (Scenario 3 (**Table 4.47**) and Tier 1 projects) considers the following: • The decommissioning of the Transmission Assets and Generation Assets together with decommissioning activities at Tier 1 projects (offshore wind farms, oil and gas projects, dredging activities and deposit and removal projects/plans) that have the potential to overlap and may lead to potential cumulative impacts as a result of changes to the fish and shellfish community. • Project details for the Generation Assets are set out in **Table 4.47** and are not reiterated here. • The potential cumulative impacts identified in Volume 2, Chapter 3: Fish and shellfish ecology of the ES, which have the potential to effect marine mammal prey, are as per Scenario 1 (see **Table 4.47**). • As per Scenario 1, 2 and 3 (see **Table 4.47**) (Volume 2, Chapter 3: Fish and shellfish ecology of the ES) the expected magnitude of potential cumulative impacts identified will be less than for construction phase due to the absence of some construction-related activities. • An Offshore Decommissioning Programme (CoT55) (**Table 4.12**) for the Transmission Assets will be	The cumulative effects assessment for Scenario 4b considers the following: • No Tier 2 projects were identified under Scenario 4b with potential for cumulative effects with the decommissioning of the Transmission Assets and therefore no assessment is provided for Scenario 4b.	The cumulative effects assessment for Scenario 4b considers the following: • No Tier 3 projects were identified under Scenario 4c with potential for cumulative effects with the decommissioning of the Transmission Assets and therefore no assessment is provided for Scenario 4c.

	Scenario 4a: Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	developed prior to decommissioning in consultation with stakeholders. No significant adverse cumulative effects were predicted to occur to fish and shellfish species (marine mammal prey) as a result of the decommissioning phase of the Transmission Assets and Generation Assets in combination with the Tier 1 projects (Volume 2, Chapter 3: Fish and shellfish ecology of the ES). Whilst most impacts are considered to be minor adverse there is the potential for some beneficial effects with respect to introduction of hard substrate which could increase prey availability for some species. Therefore, changes in prey availability on marine mammals were predicted to be of local spatial extent, medium-term duration, continuous and high reversibility. The magnitude was therefore, considered to be **low**.		
Significance of effect	Overall, the magnitude of the impacts is deemed to be **low** for all species, and the sensitivity of the receptor is considered to be **low** for all species except minke whale, which is **medium**. There would be no change to the international value of these species. The cumulative significance of the effect will, therefore, be of **minor adverse** significance for all species, which is not significant in EIA terms. Although the conclusion of significance for all species (except minke whale) could have been concluded as either negligible or minor adverse in line with the matrix approach set out in **Table** 4.16, (both of which are not significant in EIA terms) a precautionary approached was adopted based on expert judgement, and therefore the significance was concluded to be minor adverse.	N/A	N/A

4.13.6 Injury and disturbance from underwater sound generated from pre-construction survey sources

4.13.6.1 Pre-construction site investigation surveys will be undertaken to provide detailed information on seabed conditions and morphology, to identify the presence/absence of any potential obstructions or hazards and to verify the seabed geology layers. Pre-construction site investigation surveys are likely to include geophysical and geotechnical surveys which will be conducted within, and in the vicinity of, the footprint of the Offshore Order Limits and for those projects outlined in **Table 4.38**.

4.13.6.2 Geophysical and geotechnical surveys for the Transmission Assets alone are detailed in **section 4.11.6**, presenting those commonly undertaken as best practice for offshore wind projects (note that the frequencies and sound levels for sonar equipment have been included based on Volume 1, Annex 5.2: Underwater sound technical report of the ES).

4.13.6.3 The risk of injury to marine mammal receptors in terms of PTS as a result of underwater sound due to site investigation surveys would be expected to be localised to within the close vicinity of the respective projects. The assessment for the Transmission Assets found that the injury ranges are expected to be relatively small, and the magnitude of the impact has been conservatively assessed to be low (**section 4.11.6**). Therefore, there is very low potential for cumulative impacts for injury from elevated underwater sound due to site investigation surveys and the cumulative assessment provided in **Table 4.49** focuses on disturbance only. Since the cumulative assessment focuses on behavioural disturbance as a result of site-investigation activities (with animals likely to recover within hours from the disturbance), where surveys were completed prior to the commencement of construction at the Transmission Assets, these were screened out from further consideration.

4.13.6.4 The Morecambe Offshore Windfarm: Generation Assets ES marine mammal chapter (Morecambe Offshore Wind Ltd, 2024) did not assess the potential for injury and disturbance from underwater sound generated from pre-construction survey sources. As such, the cumulative assessment has not considered the Transmission Assets alongside the Morecambe Offshore Windfarm: Generation Assets. As such, an assessment of the potential for cumulative impacts as a result of disturbance from underwater sound generated from pre-construction survey sources has been presented for Transmission Assets alongside the Morgan Generations Assets (Tier 1 project) in **Table 4.49** and alongside other relevant Tier 1 projects, and Tier 2 and Tier 3 projects in **Table 4.50** below.

Table 4.49: Injury and disturbance from underwater sound generated from pre-construction survey sources (Scenario 1, Scenario 2, Scenario 3)

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
Construction phase			
Sensitivity of receptor	The Morecambe Offshore Windfarm: Generation Assets did not present an assessment of the impact *Injury and disturbance from underwater sound generated from pre-construction survey sources*, and therefore no CEA has been presented for Scenario 1.	Marine mammal receptors are deemed to have some resilience, high recoverability and international value. The sensitivity of the receptors to disturbance from elevated underwater sound during pre-construction site investigation surveys is therefore considered to be **medium**.	As per Scenario 1, the Morecambe Offshore Windfarm: Generation Assets did not present an assessment of the impact *Injury and disturbance from underwater sound generated from pre-construction survey sources*, and therefore no CEA has been presented for Scenario 3.

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
Magnitude of impact	The Morecambe Offshore Windfarm: Generation Assets did not present an assessment of the impact *Injury and disturbance from underwater sound generated from pre-construction survey sources*, and therefore no CEA has been presented for Scenario 1.	The cumulative effects assessment for Scenario 2 considers the following: • The distance from the Transmission Assets to the Morgan Offshore Wind Project: Generation Assets; based on the overlap of the two projects, if pre-construction site investigation surveys were to temporally overlap, spatial overlap of disturbance ranges would occur. As such, animals are likely to be displaced from an area comparable to disturbance contours at the Transmission Assets alone. • Although the duration of site-investigation surveys is considered to be short term and localised for each project, surveys will occur intermittently over a number of years. The impact of site investigation surveys leading to behavioural effects is predicted to be of local to regional spatial extent, medium term duration, intermittent and high reversibility (elevated underwater sound occurs only during surveys). The effect of behavioural disturbance is reversible (with behavioural characteristics returning to baseline levels soon after surveys have ceased). It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.	As per Scenario 1, the Morecambe Offshore Windfarm: Generation Assets did not present an assessment of the impact *Injury and disturbance from underwater sound generated from pre-construction survey sources*, and therefore no CEA has been presented for Scenario 3.
Significance of effect	N/A	Overall, the magnitude of the impact of disturbance is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to	N/A

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets + Morgan Offshore Wind Project: Generation Assets
		the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	

Table 4.50: Injury and disturbance from underwater sound generated from pre-construction survey sources (Scenario 4a, Scenario 4b, Scenario 4c)

	Scenario 4a: Scenario 3 (Transmission Assets + Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
Construction phase The Morecambe Offshore Windfarm: Generation Assets did not present an assessment of the impact *Injury and disturbance from underwater sound generated from pre-construction survey sources*, and therefore this project is not included in the assessment for Scenario 4a, 4b or 4c.			
Sensitivity of receptor	The sensitivity of marine mammals to Injury and disturbance from elevated underwater sound generated from site investigation survey sources injury and disturbance from elevated underwater sound during site investigation surveys is as described in **paragraph 4.11.6.4** for the Transmission Assets alone. Marine mammal receptors are deemed to have some resilience, high recoverability and international value. The sensitivity of the receptors to disturbance from elevated underwater sound during pre-construction site investigation surveys is therefore considered to be **medium**.	There is no spatial or temporal overlap of site investigation surveys during the construction phase of Transmission Assets and Generation Assets with survey activities associated with Tier 2 projects listed in **Table 4.38**, and therefore Tier 2 projects have been excluded from further consideration.	There is no spatial or temporal overlap of site investigation surveys during the construction phase of Transmission Assets and Generation Assets with survey activities associated with Tier 2 and Tier 3 projects listed in **Table 4.38**, and therefore Tier 3 projects have been excluded from further consideration.
Magnitude of impact	The cumulative effects assessment for Scenario 4a which, includes the Transmission Assets and Generation Assets (Scenario 3) and Tier 1 projects identified in **Table 4.38**, considers the following. • Up to 12 Tier 1 site investigation surveys were identified in the CEA screening area for marine mammals, alongside Mona Offshore Wind Project.	There is no spatial or temporal overlap of site investigation surveys during the construction phase of Transmission Assets and Generation Assets with survey activities associated with Tier 2 projects listed in **Table 4.38**, and therefore Tier 2 projects have been excluded from further consideration.	There is no spatial or temporal overlap of site investigation surveys during the construction phase of Transmission Assets and Generation Assets with survey activities associated with Tier 2 and Tier 3 projects listed in **Table 4.38**, and therefore Tier 3 projects have been excluded from further consideration.

	Scenario 4a: Scenario 3 (Transmission Assets + Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	• Surveys typically occur over short durations (up to two months). As a conservative approach it is assumed as a worst case scenario that up to two additional surveys could overlap with the Transmission Assets and Generation Assets site-investigation surveys at any one point. There are limitations on the number of survey vessels that could carry out such surveys at one time and therefore highly unlikely that all would overlap temporally. • Disturbance ranges for Transmission Assets alone for most site investigation equipment types was modelled at within 100s of meters. The greatest range was predicted for SBPs (17.3 km). • Based on the distance from the Transmission Assets and Generation Assets to the Mona Offshore Wind Project (9.73 km) if pre-construction site investigation surveys were to temporally overlap, spatial overlap of disturbance ranges could occur. As such, animals have the potential to be displaced from an area greater than the Transmission Assets		

	Scenario 4a: Scenario 3 (Transmission Assets + Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	and Generation Assets alone. Based on the distance from the Transmission Assets and Generation Assets to the identified 12 site investigation surveys (**Table 4.38**; minimum distance is 104.2 km at Mainstream Renewable Power Ltd- Site Investigations, off County Dublin), if pre-construction site investigation surveys were to temporally coincide with the Transmission Assets and Generation Assets disturbance contours are unlikely to overlap. This assumes the same disturbance ranges as Transmission Assets and does not take into account differences in water column depth, pressure, temperature gradients, salinity as well as water surface and seabed conditions at the different site-investigation survey locations (see Volume 1, Annex 5.2: Underwater sound technical report of the ES for detail). • The duration of site-investigation surveys is considered to be short term and localised for each project. Surveys will occur intermittently over a number of years with isolated surveys occurring at		

	Scenario 4a: Scenario 3 (Transmission Assets + Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	different points in time throughout CEA screening area, though up to two are assumed to be occurring in addition to Transmission Assets and Generation Assets at the same time. The impact of site investigation surveys leading to behavioural effects is predicted to be of local to regional spatial extent, medium term duration, intermittent and high reversibility (elevated underwater sound occurs only during surveys). The effect of behavioural disturbance is reversible (with animals returning to baseline levels soon after surveys have ceased). It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.		
Significance of effect	Overall, the magnitude of the impact of disturbance is deemed to be **low** and the sensitivity of the receptor is considered to be **medium**. There would be no change to the international value of these species. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	N/A	N/A

4.13.7 Future monitoring

4.13.7.1 Other than the impact of Injury and disturbance from elevated underwater sound during UXO clearance, the CEA on marine mammals as a result of the construction, operation and maintenance, and decommissioning phases of the Transmission Assets, are predicted to be not significant in EIA terms. For the impact of Injury and disturbance from elevated underwater sound during UXO clearance, mitigation measures (CoT64, **Table 4.12**) will be implemented to reduce the magnitude of underwater sound levels associated with residual significant impacts from the Transmission Assets alone, such that there will be no residual significant effect (in this case, on harbour porpoise), as set out in **Table 4.41** and **Table 4.42**. Based on these conclusions, and as per **section 4.11.7** above, marine mammal monitoring to test the predictions made within

4.14 Transboundary effects

4.14.1.1 A screening of transboundary impacts has been carried out and has identified that there was potential for significant transboundary effects with regard to marine mammals from the Transmission Assets upon the interests of other states. This was due to the highly mobile nature of marine mammal species.

4.14.1.2 A screening of transboundary impacts has been carried out and any potential for significant transboundary effects with regard to marine mammals from the Transmission Assets upon the interests of other states has been assessed as part of this ES.

4.14.1.3 The potential transboundary impacts assessed within Volume 1, Annex 5.4: Transboundary screening of the ES are summarised below.

- Injury and disturbance from elevated underwater sound during UXO clearance (**section 4.11.2**).
- Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities (**section 4.11.3**).
- injury and disturbance from underwater sound generated from pre-construction survey sources (**section 4.11.2**).

4.14.1.4 Potential transboundary effects could occur where elevations in underwater sound, particularly during UXO clearance, could ensonify large areas causing wide-ranging disturbance of marine mammals. UXO clearance could lead to large ranges over which elevations in underwater sound occur where there is high order detonation of the largest charge size. For example, injury in the form of PTS was predicted up to 15.37 km (for harbour porpoise) whilst a moving away response, using the TTS metric, was predicted up to 34.36 km (for minke whale). Ranges of this extent could affect individuals in transboundary nations. These predictions are, however, highly precautionary since low order clearance techniques may be used, which would considerably reduce the potential injury and/or disturbance ranges. Embedded mitigation measures (CoT64) (**Table 4.12**) will also be applied to reduce the risk of injury (**Table 4.12**) and with these in place the assessment concluded the magnitude for the Transmission Assets alone for most species, with respect to the relevant MUs, would be negligible. For harbour porpoise, there may be a risk of PTS from high order clearance, and therefore the magnitude was medium for this species only. Marine mammals are considered to be of high sensitivity to PTS and therefore the significance of effects for PTS and TTS for all species (except harbour porpoise) are of minor adverse significance. For harbour porpoise, the significance of effects for PTS was of moderate adverse significance which is significant in EIA terms. Therefore, the significance of both auditory injury and disturbance from UXO clearance at a transboundary level is considered to be minor adverse for all species, except harbour porpoise, which is not significant in terms of EIA Regulations. For harbour porpoise, there is a potential significant effect from UXO clearance. However, it must be noted that the Applicants have committed to the development of detailed MMMPs (CoT64) (**Table 4.12**) (which will be developed in accordance with the Outline MMMP (document reference: J18) to remove the risk of auditory injury to marine mammals and therefore reduce the magnitude of underwater sound levels associated with residual significant impacts from the Transmission Assets alone. As such, any potential for transboundary effects will be reduced. Therefore, the significance of injury from UXO clearance at a transboundary level is considered to be **minor adverse** with the application of embedded mitigation (CoT64) (**Table 4.12**) (with further detail in the Outline MMMP (document reference: J18)), which is not significant in terms of EIA Regulations.

4.14.1.5 Geophysical and geotechnical surveys, vessel use and other sound producing activities could also lead to large disturbance ranges. For SBP (chirp/pinger) disturbance could extend out to 17.3 km (all species). For vessels such as survey and support vessels, crew transfer vessels, and installation vessels the range of disturbance could extend out to 4.02 km and for offshore export cable trenching the range of disturbance could extend out to 3.43 km. For all other vessels and offshore export cable activities, disturbance ranges extended to below 3 km. Individuals transiting between transboundary nations could potentially be disturbed within these ranges. These predictions are, however, highly precautionary since the modelled ranges represent the distance beyond which no animals would be disturbed. Given that ranges for disturbance for non-impulsive sound sources are presented up to the 120 dB re 1 µPa (rms) threshold, and there is only a single available threshold (120 dB re 1 µPa (SPL_{rms})), (the Level B harassment threshold) (NMFS, 2005), (no distinction between mild and strong disturbance), it can be assumed that not all animals found within those ranges would be disturbed at the same level. Moreover, for those animals disturbed, there is likely to be a proportional response (i.e. not all animals will be disturbed to the same extent). The assessment concluded the magnitude for the Transmission Assets alone, with respect to the relevant MUs, would be low, and the significance of the effect to be of minor adverse significance. Therefore, the significance of disturbance from geophysical and geotechnical surveys at a transboundary level is considered to be **minor adverse** which is not significant in terms of EIA Regulations.

4.14.1.6 For other potential impacts, including elevated underwater sound from vessel use and other sound producing activities, increased likelihood of injury due to collision with vessels and changes in prey availability, the effects on marine mammals were predicted to be very localised (within the close vicinity of the project), and are therefore considered unlikely to result in significant transboundary effects on marine mammal key receptors.

4.15 Inter-related effects

4.15.1.1 Inter-relationships are the impacts and associated effects of different aspects of the Transmission Assets on the same receptor. These are as follows.

- Transmission Assets lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the Transmission Assets (construction, operation and maintenance, and decommissioning), to interact to potentially create a more significant effect on a receptor than if just one phase were assessed in isolation (e.g., construction sound effects from operational vessel sound, and decommissioning disturbance).
- Receptor led effects: Assessment of the scope for all relevant effects across multiple topics (including inter-relationships between environmental topics) to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on marine mammals, such as injury and disturbance from underwater sound generated from UXO, and increased likelihood of injury due to collision with vessels may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects may be short term, temporary or transient effects, or incorporate longer term effects.

4.15.1.2 A description of the likely interactive effects arising from the Transmission Assets on marine mammals is provided in Volume 4, Chapter 5: Inter-relationships of the ES. There is no change in the significance of effects resulting from the inter-related assessment for marine mammals.

4.16 Summary of impacts, mitigation measures and monitoring

4.16.1.1 Information on marine mammals within the study area was collected through desktop review, site surveys and consultation with the EWG.

4.16.1.2 **Table 4.51** presents a summary of the potential impacts, commitments made as part of the Transmission Assets and residual effects in respect to marine mammals. The impacts assessed include:

- injury and disturbance from elevated underwater sound during UXO clearance;
- injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities;
- increased likelihood of injury due to collision with vessels;
- effects on marine mammals due to changes in prey availability; and

- injury and disturbance from underwater sound generated from pre-construction survey sources.

4.16.1.3 A single **potential significant effect** was identified for harbour porpoise for the impact of injury due to elevated underwater sound during **UXO clearance** (see **paragraph 4.16.1.4** below). For all other potential impacts, it is concluded that there will be **no significant effects** arising from the Transmission Assets alone during the construction, operation and maintenance, or decommissioning phases.

4.16.1.4 As highlighted in **paragraph 4.16.1.3**, for harbour porpoise only, a **potential significant effect** was concluded for the impact of injury due to elevated underwater sound during **UXO clearance** when assessed using high order clearance of a 907 kg UXO (the absolute maximum). Therefore, whilst the assessment is based upon the absolute maximum UXO as per the MDS, it is acknowledged that this is very precautionary. Detailed surveys post-consent will inform the Applicant’s understanding of the type and size of UXO that require clearance and consequently the most appropriate method for clearance. There is a general hierarchy of preferred mitigation with regard to UXO: avoid UXO, clear UXO with low order techniques and then clear with high order techniques where low order is not possible (dependent upon the individual situations surrounding each UXO). The Applicants have committed to the development of and adherence to a detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) (which will be developed in accordance with the Outline MMMP)which is secured as a requirement within the draft DCO.

4.16.1.5 Specifically, the Outline MMMP (document reference: J18) will secure the embedded mitigation measures (CoT64) (**Table 4.12**) (e.g. low order clearance, use of ADDs and soft start charges), with an Outline MMMP included as part of the application (document reference: J18).

4.16.1.6 **Table 4.52** presents a summary of the potential cumulative impacts, mitigation measures and residual effects. The cumulative impacts assessed include:

- injury and disturbance from elevated underwater sound during UXO clearance;
- injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities;
- increased likelihood of injury due to collision with vessels;
- effects on marine mammals due to changes in prey availability; and
- injury and disturbance from underwater sound generated from pre-construction survey sources.

4.16.1.7 Overall, it is concluded that **for most impacts** there will be **no significant cumulative effects** from the Transmission Assets alongside other projects/plans, except the **potential injury from UXO clearance for harbour porpoise**, where a **potential significant cumulative effect** has been identified if high order detonation is required.

4.16.1.8 As a result of UXO clearance, on the basis of the MDS (absolute maximum 907 kg UXO) of high order detonation, there may be a residual effect cumulatively with other projects with a small number of animals potentially exposed to sound levels that could elicit PTS. However, the likelihood of UXO clearance being undertaken simultaneously with other projects is considered to be very low.

4.16.1.9 No potential for significant transboundary effects have been identified with regards to effects of the Transmission Assets.

Table 4.51: Summary of environmental effects, mitigation and monitoring

C=construction, O=operation and maintenance, D=decommissioning

Description of impact	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual significance of effect	Proposed monitoring
Injury and disturbance from elevated underwater sound during UXO clearance	✓	×	×	CoT68	Harbour porpoise	Medium (injury)[5] Low (disturbance)	High (injury) Low (disturbance)	Moderate adverse (injury) Minor adverse (disturbance)	Further details on UXO requiring clearance will be available post consent. On the basis that details are not available at this time the residual effect remains the same, however, with appropriate measures as agreed with the EWG and secured for the DCO it is anticipated that the magnitude of effect would reduce.	Moderate adverse (injury) Minor adverse (disturbance)	None
					Bottlenose dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Short-beaked common dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Risso's dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Minke whale	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Grey seal	Negligible (injury)	High (injury)	Minor adverse (injury)		Minor adverse (injury)	

[5] Based on the absolute maximum UXO size of 907 kg, noting that for the most likely maximum UXO size of 130 kg, with project designed-in measures the risk of injury could be mitigated.

Description of impact	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual significance of effect	Proposed monitoring
						Low (disturbance)	Low (disturbance)	Minor adverse (disturbance)		Minor adverse (disturbance)	
					Harbour seal	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities	✓	✓	✓	CoT64, CoT65, CoT69	Harbour porpoise	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)	None proposed beyond existing commitments	Minor adverse (injury) Minor adverse (disturbance)	None
					Bottlenose dolphin	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Short-beaked common dolphin	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Risso’s dolphin	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Minke whale	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	

Description of impact	Phase C	O	D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual significance of effect	Proposed monitoring
					Grey seal	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Harbour seal	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
Increased likelihood of injury due to collision with vessels	✓	✓	✓	CoT64, CoT69	Harbour porpoise	Low	Medium	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Medium	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Medium	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Effects on marine	✓	✓	✓	None	Harbour porpoise	Low	Low	Minor adverse		Minor adverse	None

Description of impact	Phase			Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual significance of effect	Proposed monitoring
	C	O	D								
mammals due to changes in prey availability					Bottlenose dolphin	Low	Low	Minor adverse	None proposed beyond existing commitments	Minor adverse	
					Short-beaked common dolphin	Low	Low	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Low	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Low	Minor adverse		Minor adverse	
					Harbour seal	Low	Low	Minor adverse		Minor adverse	
Injury and disturbance from underwater sound generated from pre-construction survey sources	✓	×	×	CoT64	Harbour porpoise	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)	None proposed beyond existing commitments	Minor adverse (injury) Minor adverse (disturbance)	None
					Bottlenose dolphin	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Short-beaked common dolphin	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	

Description of impact	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual significance of effect	Proposed monitoring
					Risso's dolphin	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Minke whale	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Grey seal	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Harbour seal	Negligible (injury) Low (disturbance)	High (injury) Medium (disturbance)	Minor adverse (injury) Minor adverse (disturbance)		Minor adverse (injury) Minor adverse (disturbance)	

[3] Based on the absolute maximum UXO size of 907 kg, noting that for the most likely maximum UXO size of 130 kg, with project designed-in measures the risk of injury could be mitigated.

Table 4.52: Summary of cumulative environmental effects, mitigation and monitoring.

Description of effect	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Transmission Assets together with Morecambe Offshore Windfarm: Generation Assets (Scenario 1)											
Injury and disturbance from elevated underwater sound during UXO clearance	✓	×	×	CoT64	Harbour porpoise	Medium (injury) Low (disturbance)	High (injury) Low (disturbance)	Moderate adverse (injury) Minor adverse (disturbance)	Further details on UXO requiring clearance will be available post consent. On the basis that details are not available at this time the residual effect remains the same, however, with appropriate measures as agreed with the EWG and secured for the DCO it is anticipated that the magnitude of effect would reduce, such that there will be no residual significant effect.	Moderate adverse (injury) Minor adverse (disturbance)	None
					Bottlenose dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Short-beaked common dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Risso's dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Minke whale	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Grey seal	Negligible (injury)	High (injury)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	

Description of effect	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
						Low (disturbance)	Low (disturbance)				
					Harbour seal	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities	✓	✓	✓	CoT64, CoT65, CoT69	Harbour porpoise	Low	Medium	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Medium	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Medium	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Increased likelihood of injury due to collision with vessels	✓	✓	✓	CoT64, CoT69	Harbour porpoise	Low	Medium	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Medium	Minor adverse		Minor adverse	
					Short-beaked	Low	Medium	Minor adverse		Minor adverse	

Description of effect	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
					common dolphin						
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Effects on marine mammals due to changes in prey availability	✓	✓	✓	None	Harbour porpoise	Low	Low	Minor adverse	None	Minor adverse	None
					Bottlenose dolphin	Low	Low	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Low	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Low	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Low	Minor adverse		Minor adverse	
					Harbour seal	Low	Low	Minor adverse		Minor adverse	
Transmission Assets together with Morgan Offshore Windfarm: Generation Assets (Scenario 2)											

Description of effect	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Injury and disturbance from underwater sound generated from UXO clearance	✓	×	×	CoT64	Harbour porpoise	Medium (injury) Low (disturbance)	High (injury) Low (disturbance)	Moderate adverse (injury) Minor adverse (disturbance)	Further details on UXO requiring clearance will be available post consent. On the basis that details are not available at this time the residual effect remains the same, however, with appropriate measures as agreed with the EWG and secured for the DCO it is anticipated that the magnitude of effect would reduce.	Moderate adverse (injury) Minor adverse (disturbance)	None
					Bottlenose dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Short-beaked common dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Risso's dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Minke whale	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Grey seal	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	

Description of effect	Phase C	O	D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
					Harbour seal	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities	✓	✓	✓	CoT64, CoT65, CoT69	Harbour porpoise	Low	Medium	Minor adverse	None proposed beyond existing commitments.	Minor adverse	None
					Bottlenose dolphin	Low	Medium	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Medium	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Increased likelihood of injury due to	✓	✓	✓	CoT64, CoT69	Harbour porpoise	Low	Medium	Minor adverse	None proposed beyond existing commitments.	Minor adverse	None
					Bottlenose dolphin	Low	Medium	Minor adverse		Minor adverse	

Description of effect	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
collision with vessels					Short-beaked common dolphin	Low	Medium	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Effects on marine mammals due to changes in prey availability	✓	✓	✓	None	Harbour porpoise	Low	Low	Minor adverse	None proposed beyond existing commitments.	Minor adverse	None
					Bottlenose dolphin	Low	Low	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Low	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Low	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Low	Minor adverse		Minor adverse	

Description of effect	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
					Harbour seal	Low	Low	Minor adverse		Minor adverse	
Injury and disturbance from underwater sound generated from pre-construction survey sources	✓	×	×	CoT64	Harbour porpoise	Low	Medium	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Medium	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Medium	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Transmission Assets together with the Generation Assets (Scenario 3)											
Injury and disturbance from underwater sound generated from UXO clearance	✓	×	×	CoT64	Harbour porpoise	Medium (injury) Low (disturbance)	High (injury) Low (disturbance)	Moderate adverse (injury) Minor adverse (disturbance)	Further details on UXO requiring clearance will be available post consent. On the basis that details are not available	Moderate adverse (injury) Minor adverse (disturbance)	None
					Bottlenose dolphin	Negligible (injury)	High (injury)	Minor adverse (injury/disturbance)		Minor adverse (injury)	

Description of effect	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
						Low (disturbance)	Low (disturbance)		at this time the residual effect remains the same, however, with appropriate measures as agreed with the EWG and secured for the DCO it is anticipated that the magnitude of effect would reduce.	Minor adverse (disturbance)	
					Short-beaked common dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Risso's dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Minke whale	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Grey seal	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
					Harbour seal	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury) Minor adverse (disturbance)	
Injury and disturbance to	✓	✓	✓	CoT64, CoT65, CoT69	Harbour porpoise	Low	Medium	Minor adverse		Minor adverse	None

Description of effect	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
marine mammals from elevated underwater sound due to vessel use and other sound-producing activities					Bottlenose dolphin	Low	Medium	Minor adverse	None proposed beyond existing commitments	Minor adverse	
					Short-beaked common dolphin	Low	Medium	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Increased likelihood of injury due to collision with vessels	✓	✓	✓	CoT64, CoT69	Harbour porpoise	Low	Medium	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Medium	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Medium	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	

Description of effect	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Effects on marine mammals due to changes in prey availability	✓	✓	✓	None	Harbour porpoise	Low	Low	Minor adverse	None	Minor adverse	
					Bottlenose dolphin	Low	Low	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Low	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Low	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Low	Minor adverse		Minor adverse	
					Harbour seal	Low	Low	Minor adverse		Minor adverse	
Scenario 3 (Transmission Assets and Generation Assets) together with Tier 1 projects											
Injury and disturbance	✓	×	×	CoT68	Harbour porpoise	Medium (injury)	High (injury)	Moderate adverse (injury)	Further details on UXO requiring	Moderate adverse (injury)	None

Description of effect	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
from elevated underwater sound during UXO clearance						Low (disturbance)	Low (disturbance)	Minor adverse (disturbance)	clearance will be available post consent. On the basis that details are not available at this time the residual effect remains the same, however, with appropriate measures as agreed with the EWG and secured for the DCO it is anticipated that the magnitude of effect would reduce.	Minor adverse (disturbance)	
					Bottlenose dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Short-beaked common dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Risso's dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Minke whale	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Grey seal	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	

Description of effect	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
					Harbour seal	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
Injury and disturbance to marine mammals from elevated underwater sound due to vessel use and other sound-producing activities	✓	✓	✓	CoT64, CoT65, CoT69	Harbour porpoise	Low	Medium	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Medium	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Medium	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Increased likelihood of injury due to	✓	✓	✓	CoT64, CoT69	Harbour porpoise	Low	Medium	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Medium	Minor adverse		Minor adverse	

Description of effect	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
collision with vessels					Short-beaked common dolphin	Low	Medium	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Effects on marine mammals due to changes in prey availability	✓	✓	✓	None	Harbour porpoise	Low	Low	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Low	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Low	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Low	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Low	Minor adverse		Minor adverse	

Description of effect	Phase C	O	D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
					Harbour seal	Low	Low	Minor adverse		Minor adverse	
Injury and disturbance from underwater sound generated from pre-construction survey sources	✓	×	×	None	Harbour porpoise	Low	Medium	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Medium	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Medium	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Scenario 3 (Transmission Assets and Generation Assets) together with Tier 1 and Tier 2 projects											
Injury and disturbance from elevated underwater sound during UXO clearance	✓	×	×	CoT68 CoT64	Harbour porpoise	Medium (injury) Low (disturbance)	High (injury) Low (disturbance)	Moderate adverse (Injury) Minor adverse (disturbance)	Further details on UXO requiring clearance will be available post consent. On the basis that details are not available	Moderate adverse (Injury) Minor adverse (disturbance)	None
					Bottlenose dolphin	Negligible (injury)	High (injury)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	

Description of effect	Phase			Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D								
						Low (disturbance)	Low (disturbance)		at this time the residual effect remains the same, however, with appropriate measures as agreed with the EWG and secured for the DCO it is anticipated that the magnitude of effect would reduce.		
					Short-beaked common dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Risso's dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Minke whale	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Grey seal	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
Injury and disturbance to marine mammals from elevated underwater sound due to	✓	✓	✓	CoT64, CoT65, CoT69	Harbour porpoise	Low	Medium	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Medium	Minor adverse		Minor adverse	
					Short-beaked	Low	Medium	Minor adverse		Minor adverse	

Description of effect	Phase			Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D								
vessel use and other sound-producing activities					common dolphin						
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Increased likelihood of injury due to collision with vessels	✓	✓	✓	CoT64, CoT69	Harbour porpoise	Low	Medium	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Medium	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Medium	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	

Description of effect	Phase			Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D								
Effects on marine mammals due to changes in prey availability	✓	✓	✓	None	Harbour porpoise	Low	Low	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Low	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Low	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Low	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Low	Minor adverse		Minor adverse	
					Harbour seal	Low	Low	Minor adverse		Minor adverse	
Scenario 3 (Transmission Assets and Generation Assets) together with Tier 1, Tier 2 and Tier 3 projects											
Injury and disturbance from elevated underwater sound during UXO clearance	✓	×	×	CoT68, CoT64	Harbour porpoise	Medium (injury) Low (disturbance)	High (injury) Low (disturbance)	Moderate adverse (injury) Minor adverse (disturbance)	Further details on UXO requiring clearance will be available post consent. On the basis that details are not available at this time the	Moderate adverse (injury) Minor adverse (disturbance)	
					Bottlenose dolphin	Negligible (injury)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	

Description of effect	Phase C	Phase O	Phase D	Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
						Low (disturbance)			residual effect remains the same, however, with appropriate measures as agreed with the EWG and secured for the DCO it is anticipated that the magnitude of effect would reduce.		
					Short-beaked common dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Risso's dolphin	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Minke whale	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Grey seal	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse (injury/disturbance)		Minor adverse (injury/disturbance)	
					Harbour seal	Negligible (injury) Low (disturbance)	High (injury) Low (disturbance)	Minor adverse		Minor adverse (injury/disturbance)	
Injury and disturbance to	✓	✓	✓	CoT64, CoT65, CoT69	Harbour porpoise	Low	Medium	Minor adverse		Minor adverse	None

Description of effect	Phase			Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D								
marine mammals from elevated underwater sound due to vessel use and other sound-producing activities					Bottlenose dolphin	Low	Medium	Minor adverse	None proposed beyond existing commitments	Minor adverse	
					Short-beaked common dolphin	Low	Medium	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Increased likelihood of injury due to collision with vessels	✓	✓	✓	CoT64, CoT69	Harbour porpoise	Low	Medium	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Medium	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Medium	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Medium	Minor adverse		Minor adverse	

Description of effect	Phase			Commitment number (Table 4.12)	Species	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D								
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Medium	Minor adverse		Minor adverse	
					Harbour seal	Low	Medium	Minor adverse		Minor adverse	
Effects on marine mammals due to changes in prey availability	✓	✓	✓	None	Harbour porpoise	Low	Low	Minor adverse	None proposed beyond existing commitments	Minor adverse	None
					Bottlenose dolphin	Low	Low	Minor adverse		Minor adverse	
					Short-beaked common dolphin	Low	Low	Minor adverse		Minor adverse	
					Risso's dolphin	Low	Low	Minor adverse		Minor adverse	
					Minke whale	Low	Medium	Minor adverse		Minor adverse	
					Grey seal	Low	Low	Minor adverse		Minor adverse	
					Harbour seal	Low	Low	Minor adverse		Minor adverse	

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Appendix A: Cumulative effects assessment

A.1 Injury and disturbance from elevated underwater sound during elevated underwater sound during UXO clearance

A.1.1 Scenario 1: Transmission Assets together with Morecambe Offshore Windfarm: Generation Assets

Construction phase

Sensitivity of receptor

A.1.1.1.1 The sensitivity of marine mammals to PTS from elevated underwater sound due to UXO clearance is as described in paragraph 4.11.2.4 et seq. for the Transmission Assets alone, whilst behavioural disturbance (using TTS-onset as a proxy) is described in paragraph 4.11.2.10 et seq.

A.1.1.1.2 For a given marine mammal hearing group, exceedance of the threshold for the onset of PTS may result in a permanent hearing loss which in turn could inhibit ecological functioning, such as communication, foraging, navigation and predator avoidance. The inability to continue with these important activities could eventually lead to a decline in vital rates of an individual, including growth, reproduction and subsequently survival. Depending on the type of detonation and size of UXO, UXO clearance activities may have residual effects in respect to marine mammals and PTS injury.

A.1.1.1.3 Species-specific behavioural responses must also be taken into account. For example, it is likely that harbour porpoise would move away from the area upon hearing vessel sound and thus be further from the UXO source before any detonation has begun. Further mitigation measures such as ADD are designed to emit sound levels that cause marine mammals to move away and thus reduce the potential for a PTS to occur due to UXO clearance.

PTS

A.1.1.1.4 As a result of UXO clearance, all marine mammals are deemed to have limited resilience, low recoverability and international value. The sensitivity of the receptors to PTS is therefore, considered to be high.

Behavioural disturbance (using TTS-onset as a proxy)

A.1.1.1.5 As a result of UXO clearance, all marine mammals are deemed to have some resilience, high recoverability and international value. The sensitivity of the receptor to TTS is therefore, considered to be low.

Magnitude of impact

A.1.1.1.6 The Morecambe Offshore Wind Project: Generation Assets ES set out that the number of UXO would be determined following a detailed UXO survey, which would be completed prior to construction. Although the Morecambe

Offshore Wind Project: Generation Assets ES presents a range of impacts for low order clearance and high order clearance (plus donor charges) the assessment is based on the high order clearance of the maximum 354 kg NEQ, without mitigation.

A.1.1.1.7 An explosive mass of 354 kg NEQ (high order explosion) yielded the largest PTS ranges for all species, with the greatest injury range (11 km) seen for harbour porpoise, based on the SPL_{pk} metric (**Table A. 1**). An explosive mass of 354 kg NEQ (high order explosion) also yielded the largest TTS ranges (as a proxy for behavioural disturbance) for all species, with the greatest injury range (16 km) seen for minke whale, based on the SEL_{cum} metric. The Morecambe Offshore Wind Project: Generation Assets ES identified that the implementation of mitigation measures within the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) for UXO clearance would reduce the risk of any PTS during UXO clearance, and would also reduce the risk of TTS. The proposed mitigation measures for consideration in the detailed MMMPs for UXO clearance include the use of low-order clearance techniques such as deflagration, potential use of bubble curtains, establishing a monitoring zone and surveying prior to UXO clearance (MMObs and potentially PAMs), and the use of ADDs.

A.1.1.1.8 The number of animals predicted to experience PTS as a result of high-order detonation at the Morecambe Offshore Wind Project: Generation Assets, based on the SPL_{pk} metric is 616 harbour porpoise, less than one individual for all dolphin species and harbour seal, and one grey seal (**Table A. 1**). Based on the SEL_{cum} metric, less than one minke whale is predicted to experience PTS. This is based on high-order clearance of an absolute maximum of 354 kg, whereas the Morecambe Offshore Wind Project: Generation Assets ES, identified that clearance of UXO with low order techniques (0.5 kg NEQ) would result in significantly lower numbers of animals (e.g. 7 harbour porpoise over a maximum range of 1.2 km, based on low-order clearance of 0.5 kg NEQ). As such, the numbers presented in **Table A. 1** are expected to be highly precautionary.

A.1.1.1.9 For TTS, based on high-order clearance of 907 kg, large impact ranges were predicted for minke whale (89 km; SEL_{cum} metric), harbour porpoise (20 km; SPL_{pk} metric), and grey seal and harbour seal (16 km; SEL_{cum} metric), with the potential to affect up to 0.4 minke whale, up to 2,037 harbour porpoise, up to 5 grey seal and less than 1 harbour seal (**Table A. 1**). This is based on high-order clearance of an absolute maximum of 354 kg, whereas the Morecambe Offshore Wind Project: Generation Assets ES, identified that clearance of UXO with low order techniques (0.5 kg NEQ) would result in significantly lower numbers of animals (e.g. 27 harbour porpoise over a maximum range of 2.3 km, based on low-order clearance of 0.5 kg NEQ). As such, the numbers presented in **Table A. 1** are expected to be highly precautionary.

Table A. 1: Number of animals with the potential to experience onset PTS and disturbance (using TTS-onset as a proxy) during high-order UXO clearance as presented in the Morecambe Offshore Wind Project: Generation Assets ES.

Species	Maximum charge size leading to highest impact (kg)	Metric	Maximum range (km)	Estimated number of animals within impact area
PTS				
Harbour porpoise	354	SPL_{pk}	11	616
Bottlenose dolphin			0.64	0.013
Short-beaked common dolphin				0.0004
Risso's dolphin				0.004
Minke whale		SEL_{cum}	7.9	0.01
Grey seal		SPL_{pk}	2.1	1
Harbour seal				0.002
Behavioural disturbance (TTS/moving away response as a proxy)				
Harbour porpoise	354	SPL_{pk}	20	2,037
Bottlenose dolphin			1.1	0.04
Short-beaked common dolphin				0.0004
Risso's dolphin				0.01
Minke whale		SEL_{cum}	89	0.4
Grey seal			16	5
Harbour seal				0.006

A.1.1.1.10 The Morecambe Offshore Wind Project: Generation Assets ES also included the maximum number of harbour porpoise predicted to be disturbed from UXO clearance, based on a maximum potential impact area based on a 26 km EDR and the maximum number of all marine mammal species predicted to be disturbed from UXO clearance based on a 5 km disturbance range.

A.1.1.1.11 For the 26 km EDR, the maximum number of harbour porpoise that could potentially be disturbed, based on a species-specific density was set out as 3,443 animals (5.51% of the CIS MU).

A.1.1.1.12 Finally, the Morecambe Offshore Wind Project: Generation Assets ES also included the maximum number of all marine mammal species (based on species-specific densities) predicted to be disturbed during ADD activation over 80 minutes for high order UXO clearance.

A.1.1.1.13 The number of animals that could potentially be disturbed within the 5 km disturbance ranges, and during ADD activation for high-order UXO clearance, based on species-specific densities are set out in **Table A. 2**.

Table A. 2: Number of animals with the potential to be disturbed within (i) a 5 km disturbance range and (ii) during activation of an ADD for high order UXO clearance, as presented in the Morecambe Offshore Wind Project: Generation Assets ES.

Species	Maximum range (km)	Estimated number of animals	Maximum range (km)	Estimated number of animals
	5 km disturbance area		80 minute activation of ADD for high order clearance	
Harbour porpoise	5	122.5	7.2 (1.5 m/s swimming speed)	264
Bottlenose dolphin		0.8		2
Short-beaked common dolphin		2		5
Risso's dolphin		0.002		0.02
Minke whale		0.02	15.6 (3.5 m/s swimming speed)	7
Grey seal		8	7.2 (1.5 m/s swimming speed)	16
Harbour seal		0.009		0.02

A.1.1.1.14 Adopting a precautionary approach, and assuming application of standard industry measures (such as MMObs, PAM and ADDs), the assessment considered the magnitude of impact for a high order detonation.

A.1.1.1.15 A spatial MDS would occur where UXO clearance activities coincide at both projects. This is, however, highly unlikely, as UXO clearance activities would likely take place before other construction activities commence, and whilst there may be some overlap in pre-construction activities UXO clearance at each project will occur as a discrete stage within the overall construction phase. Furthermore, each clearance event results in a very short duration of sound emission (seconds) (as mentioned in **paragraph 4.11.2.1**) and therefore the impact will be short in duration and unlikely to overlap. Sequential UXO clearance is therefore more likely. Production of underwater sound during detonation of UXOs at both projects has the potential to cause behavioural disturbance in marine mammal receptors, however, this effect will be short-lived and reversible. Since behavioural disturbance is a recoverable and the duration of impact will be very short, the potential for cumulative impact is considered to be limited.

PTS

A.1.1.1.16 The magnitude of the cumulative impact is predicted to be of local to regional spatial extent, very short-term duration, intermittent and, although the impact itself is reversible (i.e. elevated underwater sound during the detonation event only), the effect of injury on sensitive receptors is permanent. It is predicted that the impact will affect the receptor directly. In line with UXO guidance, assuming the application of standard industry measures, it is anticipated that for most species animals would be deterred from the injury zone and therefore the risk of PTS would be removed. The magnitude is therefore considered to be negligible for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal.

A.1.1.1.17 For harbour porpoise the PTS ranges are large (**Table A. 1**). Whilst the Morecambe Offshore Wind Project: Generation Assets ES identified that the implementation of mitigation measures within the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) for UXO clearance would reduce the risk of any PTS during UXO clearance, there is considered to be a residual risk of PTS to a small number of individuals at the Transmission Assets, even with the application of standard industry measures. Therefore, the magnitude is considered to be medium for harbour porpoise.

Behavioural disturbance (TTS-onset as a proxy)

A.1.1.1.18 The magnitude of cumulative impact (elevated underwater sound due to UXO clearance) resulting from a high order detonation is predicted to be of regional spatial extent, short-term duration, intermittent and both the impact itself (i.e. elevated underwater sound during the detonation event only) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be low for all species.

Significance of effect

PTS

A.1.1.1.19 With standard industry measures applied, for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptors is considered to be high. There is not anticipated to be any effect on the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

A.1.1.1.20 For harbour porpoise, with embedded mitigation applied at the Transmission Assets (CoT64) (**Table 4.12**), and mitigation measures identified in the Morecambe Offshore Wind Project: Generation Assets ES, the magnitude of the cumulative impact is deemed to be medium, and the sensitivity of the receptor is considered to be high. On the basis of high order detonation, whilst the Morecambe Offshore Wind Project: Generation Assets ES identified that the implementation of mitigation measures within the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) for UXO clearance would reduce the risk of any PTS during UXO clearance, there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS. The cumulative effect will, therefore, be of **moderate adverse** significance, which is significant in EIA terms. The effect could be concluded to be of either minor adverse or moderate adverse significance, in line with the matrix approach set out in

A.1.1.1.21 **Table** 4.16. Whilst there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS, based on expert judgement it is considered that this would not manifest to population level effects, and is unlikely to affect the international value of the species.

Behavioural disturbance (using TTS-onset as a proxy)

A.1.1.1.22 With standard industry measures applied, the magnitude of the cumulative impact for all species is deemed to be low and the sensitivity of the receptor is considered to be low. There is not anticipated to be any effect on the international value of any marine mammal species. The effect could be concluded to be of either negligible or minor adverse significance. The effect is concluded to be of **minor adverse** significance rather than negligible, as there is evidence of an effect. This is not significant in EIA terms.

Further mitigation measures

A.1.1.1.23 The cumulative impact assessment of injury from elevated underwater sound from UXO clearance concludes a significant effect in EIA terms, for harbour porpoise only. As the Transmission Assets assessment determined there would be a significant effect in EIA terms, the Transmission Assets may contribute to the cumulative impact in the context of the CIS MU, and therefore the Applicants have committed to the development of detailed MMMPs (with an Outline MMMP (CoT64) (**Table 4.12**) included as part of the application document reference: J18) which is secured as a requirement within the draft DCO to reduce the magnitude of impacts, such that there will be no residual significant effect for the Transmission Assets and therefore no contribution to cumulative effects.

A.1.1.1.24 Development of the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) post-consent (in consultation with the licensing authority and SNCBs) will present options for relevant mitigation measures (such as temporal restrictions, low order clearance methods, soft start) in order to reduce the magnitude for the Transmission Assets . Further details on the numbers and type of UXO requiring clearance will be available post consent. In this case, if required, further mitigation measures would be applied to reduce potential underwater sound impacts to a level whereby a non-significant effect for harbour porpoise could be concluded. These mitigation measures would also result in a reduction of potential underwater sound impacts to other marine mammal receptors.

A.1.2 Scenario 2: Transmission Assets together with Morgan Offshore Wind Project: Generation Assets

Construction phase

Sensitivity of receptor

A.1.1.1.25 The sensitivity of marine mammals to PTS and behavioural disturbance from elevated underwater sound due to UXO clearance is as described in in **paragraph A.1.1.1.1** *et seq.* and is not reiterated here.

PTS

A.1.1.1.26 As a result of UXO clearance, all marine mammals are deemed to have limited resilience, low recoverability and international value. The sensitivity of the receptors to PTS is therefore, considered to be high.

Behavioural disturbance (TTS-onset as a proxy)

A.1.1.1.27 As a result of UXO clearance, all marine mammals are deemed to have some resilience, high recoverability and international value. The sensitivity of the receptor to TTS is therefore, considered to be low.

Magnitude of impact

A.1.1.1.28 The Morgan Offshore Wind Project: Generation Assets ES assumed there may be up to 13 UXOs requiring clearance. Although the Morgan Offshore Wind Project: Generation Assets ES presents a range of impacts for low order clearance as well as low-yield donor charges, the assessment is based on the high order clearance of the maximum 907 kg. An explosive mass of 907 kg (high order explosion) yielded the largest PTS ranges for all species, with the greatest injury range (15,370 m) seen for harbour porpoise (**Table A. 3**). With primary measures in place the assessment found that there would be a residual risk of injury over a range of 2,290 m that would require additional tertiary measures and therefore the Morgan Offshore Wind Project: Generation Assets will be adopting standard industry practice (JNCC, 2010b) tertiary measures as part of detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18), discussed and agreed with consultees post-consent. Behavioural disturbance (using TTS-onset as a proxy) could affect harbour porpoise and minke whale across the largest ranges of up to 28.23 km (SPL_{pk} metric) and 34.36 km (SEL_{cum} metric), respectively (**Table A. 3**). Construction is expected from 2026 to 2029 and therefore there may be four years of overlap with the Transmission Assets, though the exact dates are uncertain at this stage. Impacts including PTS and disturbance are similar to those identified for the Transmission Assets and given the overlap of the two projects, there is potential for cumulative effects to occur with Morgan Offshore Wind Project: Generation Assets.

A.1.1.1.29 The number of animals predicted to experience PTS as a result of high-order detonation at the Morgan Offshore Wind Project: Generation Assets, based on the SPL_{pk} metric is 195 harbour porpoise, less than one individual for dolphin species and harbour seal, and 2 grey seal (**Table A. 3**). Based on the SEL_{cum} metric, one minke whale is predicted to experience PTS. For TTS, based on high-order clearance of 907 kg, large impact ranges were predicted for minke whale (34.36 km; SEL_{cum} metric), harbour porpoise (28.23 km; SPL_{pk} metric), and grey seal and harbour seal (6.47 km; SEL_{cum} metric), with the potential to affect up to 65 minke whale, up to 661 harbour porpoise, up to 6 grey seal and less than 1 harbour seal (**Table A. 3**). This is based on high-order clearance of an absolute maximum of 907 kg, whereas the Morgan Offshore Wind Project: Generation Assets ES, in line with the Transmission Assets identified that clearance of UXO with an NEQ of 130 kg is considered the more likely (common) scenario. As such, the numbers presented are expected to be highly precautionary. Proposed mitigation measures for UXO clearance include the application of a UXO-specific detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18), using low order techniques, where possible, as the primary mitigation measure alongside other measures as may be agreed with Natural England and the MMO (such as including the use of MMObs, PAM and ADDs).

Table A. 3: Number of animals with the potential to experience onset PTS and disturbance (using TTS-onset as a proxy) during high-order UXO clearance at Morgan Offshore Wind Project: Generation Assets.

Species	Maximum charge size leading to highest impact (kg)	Metric	Maximum range (m)	Estimated number of animals within impact area
PTS				
Harbour porpoise	907	SPL_{pk}	15,370	195
Bottlenose dolphin, short-beaked common dolphin, Risso's dolphin			890	<1
Minke whale		SEL_{cum}	4,215	1
Grey seal		SPL_{pk}	3,015	2
Harbour seal				<1
Behavioural disturbance (TTS/moving away response as a proxy)				
Harbour porpoise	907	SPL_{pk}	28,230	661
Bottlenose dolphin, short-beaked common dolphin, Risso's dolphin			1,635	<1
Minke whale		SEL_{cum}	34,365	65
Grey seal			6,470	6
Harbour seal				<1

A.1.1.1.30 Adopting a precautionary approach, and assuming application of standard industry measures (such as MMObs, PAM and ADDs) measures, the assessment considered the magnitude of impact for a high order detonation.

A.1.1.1.31 A spatial MDS would occur where UXO clearance activities coincide at both projects. This is, however, highly unlikely, as UXO clearance activities would likely take place before other construction activities commence, and whilst there may be some overlap in pre-construction activities UXO clearance at each project will occur as a discrete stage within the overall construction phase. Furthermore, each clearance event results in a very short duration of sound emission (seconds) (as mentioned in **paragraph 4.11.2.1**) and therefore the impact will be short in duration and unlikely to overlap. Sequential UXO clearance is therefore more likely. Production of underwater sound during detonation of UXOs at both projects has the potential to cause behavioural disturbance in marine mammal receptors, however, this effect will be short-lived and reversible. Since behavioural disturbance is a recoverable and the duration of impact will be very short, the potential for cumulative impact is considered to be limited.

PTS

A.1.1.1.32 The magnitude of the cumulative impact is predicted to be of local to regional spatial extent, very short-term duration, intermittent and, although the impact itself is reversible (i.e. elevated underwater sound during the detonation event only), the effect of injury on sensitive receptors is permanent. It is predicted that the impact will affect the receptor directly. In line with UXO guidance, assuming the application of standard industry measures, it is anticipated that for most species animals would be deterred from the injury zone and therefore the risk of PTS would be removed. The magnitude is therefore considered to be negligible for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal.

A.1.1.1.33 For harbour porpoise the PTS ranges are large (**Table A. 3**) and there is considered to be a residual risk of PTS to a small number of individuals, even with the application of standard industry measures therefore the magnitude is considered to be medium for harbour porpoise.

Behavioural disturbance (using TTS-onset as a proxy)

A.1.1.1.34 The magnitude of cumulative impact (elevated underwater sound due to UXO clearance) resulting from a high order detonation is predicted to be of regional spatial extent, short-term duration, intermittent and both the impact itself (i.e. elevated underwater sound during the detonation event only) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be low for all species.

Significance of effect

PTS

A.1.1.1.35 With standard industry measures applied, for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptors is considered to be high. There is not anticipated to be any effect on the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

A.1.1.1.36 For harbour porpoise, with embedded mitigation applied at the Transmission Assets and mitigation measures identified in the Morgan Offshore Wind Project: Generation Assets ES, the magnitude of the cumulative impact is deemed to be medium, and the sensitivity of the receptor is considered to be high. On the basis of high order detonation, there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS. The cumulative effect will, therefore, be of **moderate**

adverse significance, which is significant in EIA terms. The effect could be concluded to be of either minor adverse or moderate adverse significance, in line with the matrix approach set out in **Table 4.16**.Whilst there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS, based on expert judgement it is considered that this would not manifest to population level effects, and is unlikely to affect the international value of the species.

Behavioural disturbance (using TTS-onset as a proxy)

A.1.1.1.37 With standard industry measures applied, the magnitude of the cumulative impact for all species is deemed to be low and the sensitivity of the receptor is considered to be low. There is not anticipated to be any effect on the international value of any marine mammal species. The effect could be concluded to be of either negligible or minor adverse significance. The effect is concluded to be of **minor adverse** significance rather than negligible, as there is evidence of an effect. This is not significant in EIA terms.

Further mitigation measures

A.1.1.1.38 The cumulative impact assessment of injury from elevated underwater sound from UXO clearance concludes a significant effect in EIA terms, for harbour porpoise only. As the Transmission Assets alone assessment determined there would be a significant effect in EIA terms, the Transmission Assets may contribute to the cumulative impact in the context of the CIS MU, and therefore the Applicants have committed to the development of detailed MMMPs (with an Outline MMMP (CoT64) (**Table 4.12**) included as part of the application document reference: J18) which is secured as a requirement within the draft DCO to reduce the magnitude of impacts, such that there will be no residual significant effect for the Transmission Assets alone and therefore no contribution to cumulative effects.

A.1.1.1.39 Development of the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) post-consent (in consultation with the licensing authority and SNCBs) will present options for relevant mitigation measures (such as temporal restrictions, low order clearance methods, soft start) in order to reduce the magnitude for the Transmission Assets alone. Further details on the numbers and type of UXO requiring clearance will be available post consent. In this case, if required, further mitigation measures would be applied to reduce potential underwater sound impacts to a level whereby a non-significant effect for harbour porpoise could be concluded. These mitigation measures would also result in a reduction of potential underwater sound impacts to other marine mammal receptors.

A.1.3 Scenario 3: Transmission Assets together with Generation Assets

Construction phase

Sensitivity of receptor

A.1.1.1.40 The sensitivity of marine mammals to PTS and behavioural disturbance from elevated underwater sound due to UXO clearance is as described in in **paragraph A.1.1.1.1** *et seq.* and is not reiterated here.

PTS

A.1.1.1.41 As a result of UXO clearance, all marine mammals are deemed to have limited resilience, low recoverability and international value. The sensitivity of the receptors to PTS is therefore, considered to be high.

Behavioural disturbance (TTS-onset as a proxy)

A.1.1.1.42 As a result of UXO clearance, all marine mammals are deemed to have some resilience, high recoverability and international value. The sensitivity of the receptor to TTS is therefore, considered to be low.

Magnitude of impact

A.1.1.1.43 Project details for potential UXO clearance for the Morecambe Offshore Wind Project: Generation Assets, as presented in the Morecambe Offshore Wind Project: Generation Assets ES are set out in **paragraph A.1.1.1.6** *et seq.* and are not reiterated here. Project details for potential UXO clearance for the Morgan Offshore Wind Project: Generation Assets, as presented in the Morgan Offshore Wind Project: Generation Assets are set out in **paragraph A.1.1.1.28** *et seq.* and are not reiterated here. The number of animals predicted to be affected (PTS and TTS as a proxy for disturbance) by all three projects are set out in **Table A. 4** and **Table A. 5**, respectively.

Table A. 4: Maximum number of animals with the potential to experience PTS during high-order UXO clearance at the Transmission Assets and Generation Assets.

Project	Species	Maximum charge size (kg)	Metric	Maximum PTS range (km)	Estimated number within impact area
Transmission Assets	Harbour porpoise	907	SPL_{pk}	15.37	169
	Bottlenose dolphin, short-beaked common dolphin, Risso's dolphin			0.89	<1
	Minke whale		SEL_{cum}	4.22	2
	Grey seal		SPL_{pk}	3.02	4

Project	Species	Maximum charge size (kg)	Metric	Maximum PTS range (km)	Estimated number within impact area
	Harbour seal				<1
Morecambe Offshore Windfarm: Generation Assets	Harbour porpoise	354	SPL_{pk}	11	616
	Bottlenose dolphin			0.64	0.013
	Short-beaked common dolphin				0.0004
	Risso's dolphin				0.004
	Minke whale		SEL_{cum}	7.9	0.01
	Grey seal		SPL_{pk}	2.1	1
	Harbour seal				0.002
Morgan Offshore Wind Project: Generation Assets	Harbour porpoise	907	SPL_{pk}	15.37	195
	Bottlenose dolphin, short-beaked common dolphin, Risso's dolphin			0.89	<1
	Minke whale		SEL_{cum}	4.22	1
	Grey seal		SPL_{pk}	3.02	2
	Harbour seal				<1

Table A. 5: Maximum number of animals with the potential to experience disturbance (using TTS-onset as a proxy) during high-order UXO clearance at the Transmission Assets and Generation Assets.

Project	Species	Maximum charge size (kg)	Metric	Maximum TTS range (km)	Estimated number within impact area
Transmission Assets	Harbour porpoise	907	SPL_{pk}	28.32	572
	Bottlenose dolphin, short-beaked common dolphin, Risso's dolphin			1.64	<1
	Minke whale		SEL_{cum}	34.37	79
	Grey seal			6.47	15
	Harbour seal				<1
Morecambe Offshore Windfarm: Generation Assets	Harbour porpoise	354	SPL_{pk}	20	2,037
	Bottlenose dolphin			1.1	0.04
	Short-beaked common dolphin				0.0004

Project	Species	Maximum charge size (kg)	Metric	Maximum TTS range (km)	Estimated number within impact area
	Risso's dolphin				0.01
	Minke whale		SEL_{cum}	89	0.4
	Grey seal		SPL_{pk}	16	5
	Harbour seal				0.006
Morgan Offshore Wind Project: Generation Assets	Harbour porpoise	907	SPL_{pk}	28.32	661
	Bottlenose dolphin, short-beaked common dolphin, Risso's dolphin			1.64	<1
	Minke whale		SEL_{cum}	34.37	65
	Grey seal			6.47	6
	Harbour seal				<1

A.1.1.1.44 Adopting a precautionary approach, and assuming application of standard industry measures (such as MMObs, PAM and ADDs) measures, the assessment considered the magnitude of impact for a high order detonation.

A.1.1.1.45 A spatial MDS would occur where UXO clearance activities coincide at all three projects. The maximum number of harbour porpoise that could be disturbed if all three projects coincided would be 3,270 (5.23% of the CIS MU). This is, however, highly unlikely, as UXO clearance activities would likely take place before other construction activities commence, and whilst there may be some overlap in pre-construction activities, UXO clearance at each project will occur as a discrete stage within the overall construction phase. Furthermore, each clearance event results in a very short duration of sound emission (seconds) (as mentioned in **paragraph 4.11.2.1**) and therefore the impact will be short in duration and unlikely to overlap. Sequential UXO clearance is therefore more likely. Production of underwater sound during detonation of UXOs at all three projects has the potential to cause behavioural disturbance in marine mammal receptors, however, this effect will be short-lived and reversible. Since behavioural disturbance is a recoverable and the duration of impact will be very short, the potential for cumulative impact is considered to be limited.

PTS

A.1.1.1.46 The magnitude of the cumulative impact is predicted to be of local to regional spatial extent, very short-term duration, intermittent and, although the impact itself is reversible (i.e. elevated underwater sound during the detonation event only), the effect of injury on sensitive receptors is permanent. It is predicted that the impact will affect the receptor directly. In line with UXO guidance, assuming the application of standard industry measures, it is anticipated that for most species animals would be deterred from the injury zone and therefore the risk of PTS would be removed. The magnitude is therefore considered to be negligible for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal.

A.1.1.1.47 For harbour porpoise the PTS ranges are large (**Table A. 1** and **Table A. 3**) Whilst the Morecambe Offshore Wind Project: Generation Assets ES identified that the implementation of mitigation measures within the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) for UXO clearance would reduce the risk of any PTS during UXO clearance, there is considered to be a residual risk of PTS to a small number of individuals at both the Morgan Offshore Wind Project: Generation Assets and the Transmission Assets, even with the application of standard industry measures. Therefore, the magnitude is considered to be medium for harbour porpoise.

Behavioural disturbance (TTS-onset as a proxy)

A.1.1.1.48 The magnitude of cumulative impact (elevated underwater sound due to UXO clearance) resulting from a high order detonation is predicted to be of regional spatial extent, short-term duration, intermittent and both the impact itself (i.e. elevated underwater sound during the detonation event only) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be low for all species.

Significance of effect

PTS

A.1.1.1.49 With standard industry measures applied, for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptors is considered to be high. There is not anticipated to be any effect on the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

A.1.1.1.50 For harbour porpoise, with embedded mitigation applied at the Transmission Assets (CoT64) (**Table 4.12**), and mitigation measures identified in the Morecambe Offshore Wind Project: Generation Assets ES and Morgan Offshore Wind Project: Generation Assets ES, the magnitude of the cumulative impact is deemed to be medium, and the sensitivity of the receptor is considered to be high. On the basis of high order detonation, whilst the Morecambe Offshore Wind Project: Generation Assets ES identified that the implementation of mitigation measures within the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) for UXO clearance would reduce the risk of any PTS during UXO clearance, both the Morgan Offshore Wind Project: Generation Assets and the Transmission Assets identified a residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS. The cumulative effect will, therefore, be of **moderate adverse** significance, which is significant in EIA terms. The effect could be concluded to be of either minor adverse or moderate adverse significance, in line with the matrix approach set out **Table 4.16**.Whilst there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS, based on expert judgement it is considered that this would not manifest to population level effects, and is unlikely to affect the international value of the species.

Behavioural disturbance (using TTS-onset as a proxy)

A.1.1.1.51 With standard industry measures applied, the magnitude of the cumulative impact for all species is deemed to be low and the sensitivity of the receptor is considered to be low. There is not anticipated to be any effect on the international value of any marine mammal species. The effect could be concluded to be of either negligible or minor adverse significance. The effect is concluded to be of **minor adverse** significance rather than negligible, as there is evidence of an effect. This is not significant in EIA terms.

Further mitigation measures

A.1.1.1.52 The cumulative impact assessment of injury from elevated underwater sound from UXO clearance concludes a significant effect in EIA terms, for harbour porpoise only. As the Transmission Assets assessment determined there would be a significant effect in EIA terms, the Transmission Assets may contribute to the cumulative impact in the context of the CIS MU, and therefore the Applicants have committed to the development of detailed MMMPs (with an Outline MMMP (CoT64) (**Table 4.12**) included as part of the application document reference: J18) which is secured as a requirement within the draft DCO to reduce the magnitude of impacts, such that there will be no residual significant effect for the Transmission Assets and therefore no contribution to cumulative effects.

A.1.1.1.53 Development of the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) post-consent (in consultation with the licensing authority and SNCBs) will present options for relevant mitigation measures (such as temporal restrictions, low order clearance methods, soft start) in order to reduce the magnitude for the Transmission Assets. Further details on the numbers and type of UXO requiring clearance will be available post consent. In this case, if required, further mitigation measures would be applied to reduce potential underwater sound impacts to a level whereby a non-significant effect for harbour porpoise could be concluded. These mitigation measures would also result in a reduction of potential underwater sound impacts to other marine mammal receptors.

A.1.4 Scenario 4a: Transmission Assets together with Tier 1 projects

Construction phase

A.1.1.1.54 The construction of the Transmission Assets, together with construction of Tier 1 projects identified in **Table 4.38** may lead to injury and/or disturbance to marine mammals during UXO clearance. Tier 1 projects screened into the assessment within the cumulative marine mammal study area include Mona Offshore Wind Project, Awel y Môr Offshore Wind Farm, White Cross Offshore Wind Farm, and Project Erebus Floating Wind Demonstration.

Sensitivity of receptor

A.1.1.1.55 The sensitivity of marine mammals to PTS and behavioural disturbance from elevated underwater sound due to UXO clearance is as described in **paragraph A.1.1.1.1** *et seq.* and is not reiterated here.

PTS

A.1.1.1.56 As a result of UXO clearance, all marine mammals are deemed to have limited resilience, low recoverability and international value. The sensitivity of the receptors to PTS is therefore, considered to be high.

Behavioural disturbance (using TTS-onset as a proxy)

A.1.1.1.57 As a result of UXO clearance, all marine mammals are deemed to have some resilience, high recoverability and international value. The sensitivity of the receptor to TTS is therefore, considered to be low.

Magnitude of impact

A.1.1.1.58 Based on the Mona Offshore Wind Project maximum spatial scenario, as presented in the Mona Offshore Wind Project ES anticipated 22 UXOs requiring clearance. Although the ES presents a range of impacts for low order clearance as well as low-yield donor charges, the assessment is based on the high order clearance of the maximum UXO size of 907 kg. An explosive mass of 907 kg (high order explosion) yielded the largest PTS ranges for all species, with the greatest injury range (15,370 m) seen for harbour porpoise. With primary measures in place the assessment found that there would be a residual risk of injury over a range of 2,290 m that would require additional tertiary measures and therefore the Mona Offshore Wind Project will be adopting standard industry practice (JNCC, 2010b) tertiary measures as part of a detailed MMMP, discussed and agreed with consultees post-consent. Behavioural disturbance (using TTS-onset as a proxy) could affect harbour porpoise and minke whale across the largest ranges of up to 28.23 km (SPL_{pk} metric) and 34.36 km (SEL_{cum} metric), respectively.) (**Table A. 6**). Construction is expected from 2026 to 2029 and therefore there may be three years of overlap with Transmission Assets, though the exact dates are uncertain at this stage. Impacts including PTS and disturbance are similar to those identified for Transmission Assets and given the proximity of the two projects, there is potential for cumulative effects to occur with Mona Offshore Wind Project.

A.1.1.1.59 The number of animals predicted to experience PTS as a result of high-order detonation at the Mona Offshore Wind Project, based on the SPL_{pk} metric is 206 harbour porpoise, less than one individual for dolphin species, six grey seal and less than one harbour seal. Based on the SEL_{cum} metric, one minke whale is predicted to experience PTS. For TTS, based on high-order clearance of 907 kg, large impact ranges were predicted for minke whale (34.36 km), harbour porpoise (28.23 km), and grey seal and harbour seal (6.47 km; SEL_{cum} metric), with the potential to affect up to 65, 245, 26 and less than 1 animal, respectively (**Table A. 7**). This is based on high-order clearance of the MDS of 907 kg NEQ, whereas the Mona Offshore Wind Project ES identified that clearance of UXO with an NEQ of 130 kg is considered the more likely (common) scenario. As such, the numbers presented are expected to be highly precautionary. Proposed mitigation measures for UXO clearance include the application of a UXO-specific detailed MMMPs, using low order techniques, where possible, as the primary mitigation measure alongside other measures as may be agreed through the consenting process (such as including the use of MMObs, PAM and ADDs).

A.1.1.1.60 Awel y Môr Offshore Wind Farm is located 28.87 km from the Offshore Order Limits. The MDS for Awel y Môr Offshore Wind Farm anticipated 10 UXOs requiring clearance, with two clearance events every 24 hours but up to 10 detonations in 10 days. The assessed clearance method was high-order detonation, though low-order is more likely. The ES for Awel y Môr Offshore Wind Farm assessed both PTS and behavioural disturbance as a result of UXO clearance. Awel y Môr used both the EDR approach and TTS-onset thresholds for assessing disturbance, basing the use of the TTS onset threshold on Southall *et al*. (2007) which states *'in the absence of empirical data on responses, the use of the TTS onset threshold may be appropriate for single pulses*'. TTS-onset thresholds were taken as those proposed for different functional hearing groups by Southall *et al.* (2019).

A.1.1.1.61 However, the Awel y Môr Offshore Wind Farm ES does highlight that there is a lack of empirical evidence from UXO detonations using the TTS metric, in particular the range-dependent characteristics of the peak sounds, and consequently challenges whether current propagation models can accurately predict the range at which these thresholds are reached (RWE, 2023). An estimation of the source level and predicted PTS ranges were modelled for a range of expected UXO sizes (5 kg TNT NEQ, 15 kg TNT NEQ and 164 kg TNT NEQ). The source level of each UXO charge weight was calculated in accordance with Soloway and Dahl (2014), Arons (1954) and Barett (1996), using conservative calculation parameters that result in the upper estimate of the source level for each charge size.

A.1.1.1.62 The charge sizes modelled for the Awel y Môr assessment are lower than the maximum modelled for Transmission Assets, and injury ranges are smaller. For the most sensitive species (harbour porpoise) Awel y Môr Offshore Wind Farm assessed the effects using two densities (JCP III 0.13 per km^2 and Sea Watch Foundation 1.0 per km^2), and the maximum number of animals estimated within the ZoI presented was considered to be highly conservative. PTS is a permanent change in hearing threshold and is not recoverable, but the magnitude of this impact was considered to be negligible adverse in the EIA, due to the commitment to implement a UXO-specific detailed MMMPs to reduce the risk of PTS to negligible. Maximum injury ranges from UXO and numbers of animals predicted to be injured as a result of underwater sound from UXO clearance for Tier 1 projects including Awel y Môr Offshore Wind Farm is presented in **Table A. 6** and **Table A. 7**. The exact mitigation measures contained with the UXO-specific detailed MMMPs for Awel y Môr Offshore Wind Farm are yet to be determined and agreed with NRW. Residual impacts for PTS from UXO were therefore considered unlikely for harbour porpoise, minke whale, grey seal and minor adverse significance for bottlenose dolphin, short-beaked common dolphin and Risso's dolphin (RWE, 2022).

A.1.1.1.63 In the absence of agreed thresholds to assess the potential for behavioural disturbance in marine mammals from UXO detonations, the Awel y Môr assessment presented results for various disturbance thresholds, including 26 km EDR for high order detonations, 5 km EDR for low order and TTS-onset thresholds for high-order detonations. JNCC advised that an EDR of 26 km around the source location should be used to determine the ensonified area from UXO clearance with respect to disturbance of harbour porpoise in SACs, but this is applied for all species and should be viewed with caution as there is a lack of evidence to support this range (as per latest guidance (JNCC, Natural England, DAERA, 2020)). As such Awel y Môr Offshore Wind Farm suggested limited confidence for using this approach. Furthermore, Awel y Môr Offshore Wind Farm suggested that there is no evidence of a 5 km EDR being suitable for any species of marine mammal for the low order detonation, and therefore should be treated with caution. As such Awel y Môr Offshore Wind Farm used TTS-onset as a proxy for disturbance but caveated that this is likely to over-estimate true behavioural responses due to UXO comprising a single pulse source sound and not lasting a full diel cycle. Large disturbance (using TTS-onset as a proxy) ranges were predicted for harbour porpoise (16 km using SPL_{pk}) and minke whale (65 km using SEL_{cum}) for a UXO charge size of 164 kg. As highlighted in the Awel y Môr ES, these ranges may be highly over-precautionary as these do not account for an impulsive sound losing impulsive characteristics and becoming non-impulsive as it propagates from the source (RWE, 2023). Based on the predicted disturbance ranges and numbers of animals affected Awel y Môr concluded that the magnitude of the effects of behavioural disturbance (using TTS-onset as a proxy) would be low for all species (**Table A. 7**).

A.1.1.1.64 White Cross Offshore Wind Farm is located 311.28 km from the Offshore Order Limits. The number of UXO requiring clearance and duration of UXO clearance operations at White Cross Offshore Wind Farm was unknown at the time of publication of the ES. A UXO Risk Assessment identified different types of UX that may pose a threat to the study site, with a range NEQs (ranging from 0.06 kg to 309.4 kg). The assessed clearance method modelled was high-order detonation (up to 309 kg NEQ) and low-order clearance (2 kg). The ES for White Cross Offshore Wind Farm assessed PTS and TTS/fleeing response as a proxy for behavioural disturbance, as well as applying a 26 km EDR for harbour porpoise, based on current SNCB guidance.

A.1.1.1.65 The charge sizes modelled for the White Cross Offshore Wind Farm assessment are lower than the maximum modelled for Transmission Assets, and injury ranges are smaller. With the implementation of a detailed MMMPs the significance of effect for all species was considered to be minor adverse for all species for PTS from high-order and low-order detonation. For TTS (and behavioural disturbance), from high-order detonation the significance of effect for harbour porpoise, minke whale and grey seal was considered to be minor adverse, and for HF species was considered to be negligible. For TTS (and behavioural disturbance) from low-order detonation the significance of effect for harbour porpoise was considered to be minor adverse, and for all other species was considered to be negligible. Maximum PTS ranges from UXO and numbers of animals predicted to be injured as a result of underwater sound from UXO clearance for Tier 1 projects including White Cross Offshore Wind Farm is presented in **Table A. 6**, and for TTS is presented in **Table A. 7**. The numbers presented for harbour porpoise are based on the higher APEM summer density estimate, and for short-beaked common dolphin are based on the higher APEM winter density estimate.

A.1.1.1.66 The number of animals predicted to experience PTS as a result of high-order detonation is 349 harbour porpoise, less than one bottlenose dolphin and up to two individuals for both minke whale and grey seal. For low-order detonation up to 11 harbour porpoise, and less than one individual for all other species, were predicted to experience PTS. For TTS, large impact ranges were predicted for minke whale, at 85 km and grey seal at 16 km, with the potential to affect up to 255 and 96 individuals, respectively. For harbour porpoise, for a 20 km disturbance range, up to 1,154 individuals were predicted to be disturbed (see **Table A. 7**). This is based on high-order detonation of the largest UXO size of 309 kg NEQ, whereas the White Cross Offshore Wind Farm ES identified that UXO likely to be found in the site would range from 0.06 kg to 309.4 kg. Proposed mitigation measures for UXO clearance include the use of low-order clearance techniques, such as deflagration; high order clearance would only be undertaken in the event that all other options are not possible, following the identified hierarchy. As such, the numbers presented are expected to be highly precautionary.

A.1.1.1.67 Project Erebus Floating Wind Demonstration anticipated one UXO detonation via low-order deflagration but included assessment for high-order detonations for completeness, highlighting this was not deemed realistic as 'the Project intends to employ deflagration (low-order) as the clearance method' (Blue Gem Wind, 2020). For PTS, Southall *et al.* (2019) was used to assess impacts. Project Erebus Floating Wind Demonstration assessed the number of harbour porpoise predicted to be affected by injury or disturbance based on densities from site-specific surveys (0.04 animals per km^2). Bottlenose dolphin was based on 0.063 animals per km^2 presented by Lohrengel *et al*. (2018), minke whale was based on SCANS-III block D (Hammond *et al.,* 2021) and grey seal was based on habitat preference map grid cells from Carter *et al.* (2022).

A.1.1.1.68 The number of marine mammals expected to experience PTS-onset as a result of low-order detonation was <1 for all species and charge sizes, apart from 0.5 kg and 2 kg NEQ, which could result in PTS in up to two and five harbour porpoises, respectively. For high-order detonation, which is not in the project design for Project Erebus Floating Wind Demonstration, up to 212 harbour porpoises could be affected by PTS (**Table A. 6**). The ES for Project Erebus Floating Wind Demonstration highlighted that for UXO clearance there are no dose-response functions available that describe the magnitude and transient nature of the behavioural effect of UXO detonation on marine mammals and no guidance on thresholds to be used to assess disturbance, therefore they used an EDR of 5 km for low order clearance and 26 km for high-order clearance. Project Erebus Floating Wind Demonstration also used TTS-onset as a proxy for disturbance, and the maximum predicted disturbance range is 103 km for minke whale. It has been suggested in the Erebus ES that TTS-onset as a proxy for disturbance is expected to over-estimate the actual biological consequences (Blue Gem Wind, 2020). This is supported by Southall *et al.* (2007) which states that "*This approach is expected to be precautionary because TTS at onset levels is unlikely to last a full diel cycle or to have serious biological consequences during the time TTS persists*". For disturbance (assessed using TTS-onset as a proxy) from either low-order or high-order UXO detonation, Project Erebus Floating Wind Demonstration concluded that the impact was unlikely to significantly affect marine mammal receptors (Blue Gem Wind, 2020).

A.1.1.1.69 A spatial MDS would occur where UXO clearance activities coincide at the respective projects considered in the CEA. This is, however, highly unlikely, as due to safety reasons UXO clearance activities would take place before other construction activities commence. Sequential UXO clearance is therefore more likely for Tier 1 projects noting, however, that there may be some overlap in pre-construction activities of Mona Offshore Wind Project and Awel y Môr Offshore Wind Farm with Transmission Assets, based on indicative construction timelines (**Table 4.40**). These timelines are, however, indicative and subject to change. UXO clearance at each of these projects will occur as a discrete stage within the overall construction phase and therefore will not coincide continuously over the duration of temporal overlap. Furthermore, each clearance event results in a very short duration of sound emission (seconds) (as mentioned in **paragraph 4.11.2.1**) and therefore the impact will be short in duration and unlikely to overlap. Construction of Project Erebus Floating Wind Demonstration is likely to be completed the year before the commencement of construction activities at Transmission Assets and therefore is not likely to overlap with associated UXO clearance. Given the project design for use of low-order UXO clearance techniques only for Project Erebus Floating Wind Demonstration, cumulative impacts are considered unlikely.

A.1.1.1.70 The assessments provided in the ESs for the Awel y Môr Offshore Wind Farm, White Cross Offshore Wind Farm and Project Erebus Floating Wind Demonstration did not consider effects on harbour seal, as this was not included as a key species in these assessments. Therefore, cumulatively, harbour seal has only been considered for Transmission Assets alongside Mona Offshore Wind Project.

A.1.1.1.71 The maximum cumulative number of animals potentially affected by PTS (harbour porpoise) in the regional marine mammal study area is 1,168 animals, however this is using modelled high-order UXO clearance for Project Erebus Floating Wind Demonstration which is very unlikely to occur in practice (the maximum UXO charge weight expected in the area is 331 kg, and the project is seeking consent for one low-order detonation with a maximum of 2 kg NEQ) and based upon high-order clearance for Mona Offshore Wind Project. Therefore, with measures applied at cumulative projects (i.e. use of low order clearance only for Project Erebus Floating Wind Demonstration and MMMP for Awel y Môr Offshore Wind Farm) the residual risk of injury is likely to be very small.

Table A. 6: Maximum number of animals with the potential to experience PTS during high-order UXO clearance at cumulative Tier 1 projects.

Project	Species	Maximum charge size (kg)	Metric	Maximum PTS range (m)	Estimated number within PTS range	Mitigation included in EIA
Transmission Assets	Harbour porpoise	907	SPL_{pk}	15,370	169	Measures adopted (**Table 4.12**) (including Outline MMMP (document reference: J18)
	Bottlenose dolphin, short-beaked common dolphin and Risso's dolphin			890	<1	
	Minke whale		SEL_{cum}	4,215	2	
	Grey seal		SPL_{pk}	3,015	4	
	Harbour seal			3,015	<1	
Mona Offshore Wind Project	Harbour porpoise	907	SPL_{pk}	15,370	206	MMMP and Underwater sound management strategy
	Bottlenose dolphin, short-beaked common dolphin and Risso's dolphin			890	<1	
	Minke whale		SEL_{cum}	4,215	1	
	Grey seal		SPL_{pk}	3,015	6	
	Harbour seal			3,015	<1	
Awel y Môr Offshore Wind Farm	Harbour porpoise	164	SPL_{pk}	8,600	232	UXO-specific MMMP
	Bottlenose dolphin, short-beaked common dolphin and Risso's dolphin			500	<1	
	Minke whale		SEL_{cum}	5,400	2	
	Grey seal		SPL_{pk}	1,600	3	
White Cross Offshore Wind Farm	Harbour porpoise	309	SPL_{pk}	11,000	349	MMMP (including low-order detonation and ADD)
	Bottlenose dolphin			610	< 1	
	Short-beaked common dolphin			610	7	
	Minke whale			7,400	2	
	Grey seal			2,000	2	
Project Erebus Floating Wind Demonstration	Harbour porpoise	525	SPL_{pk}	13,000	212	Low-order deflagration
	Bottlenose dolphin, short-beaked common dolphin and Risso's dolphin			730	3 (short-beaked common dolphin) <1 (bottlenose dolphin)	

Project	Species	Maximum charge size (kg)	Metric	Maximum PTS range (m)	Estimated number within PTS range	Mitigation included in EIA
	Minke whale		SEL_{cum}	9,500	3	
	Grey seal		SPL_{pk}	2,500	1	

A.1.1.1.72 Production of underwater sound during detonation of UXOs as a part of Tier 1 projects as well as the Transmission Assets have the potential to cause behavioural disturbance (using TTS-onset as a proxy) in marine mammal receptors, however, this effect will be short-lived and reversible. Since behavioural disturbance is a recoverable and the duration of impact will be very short, the potential for cumulative impact is considered to be limited, even for multiple Tier 1 projects within the regional marine mammal study area (**Table A. 7**). It is assumed whilst some ecological functions could be inhibited in the short-term due to behavioural disturbance (e.g. cessation of feeding), these are reversible on recovery of the animal's hearing and therefore not considered likely to lead to any long-term effects on the individual.

Table A. 7: Maximum number of animals with the potential to experience behavioural disturbance (using TTS-onset as a proxy) during high-order UXO clearance at cumulative Tier 1 projects.

Project	Species	Maximum charge size (kg)	Metric	Maximum range (m)	Estimated number within the range
Transmission Assets	Harbour porpoise	907	SPL_{pk}	28,320	572
	Bottlenose dolphin, short-beaked common dolphin and Risso's dolphin			1,635	<1
	Minke whale		SEL_{cum}	34,365	79
	Grey seal		SPL_{pk}	6,470	15
	Harbour seal		SPL_{pk}	6,470	<1
Mona Offshore Wind Project	Harbour porpoise	907	SPL_{pk}	28,230	245
	Bottlenose dolphin, short-beaked common dolphin and Risso's dolphin			1,635	<1
	Minke whale		SEL_{cum}	34,365	65
	Grey seal		SEL_{cum}	6,470	26
	Harbour seal		SEL_{cum}	6,470	<1
	Harbour porpoise	164	SPL_{pk}	16,000	804

Project	Species	Maximum charge size (kg)	Metric	Maximum range (m)	Estimated number within the range
Awel y Môr Offshore Wind Farm	Bottlenose dolphin, short-beaked common dolphin and Risso's dolphin			920	<1
	Minke whale		SEL_{cum}	64,000	226
	Grey seal		SPL_{pk}	310	13
White Cross Offshore Wind Farm	Harbour porpoise	309	SPL_{pk}	20,000	1,154
	Bottlenose dolphin			1,100	<1
	Short-beaked common dolphin			1,100	20
	Minke whale			85,000	255
	Grey seal			16,000	96
Project Erebus Floating Wind Demonstration	Harbour porpoise	525	SPL_{pk}	23,000	665
	Bottlenose dolphin, short-beaked common dolphin and Risso's dolphin			1,300	9 (common dolphin) <1 (bottlenose dolphin)
	Minke whale		SEL_{cum}	103,000	373
	Grey seal			20,000	52

A.1.1.1.73 Adopting a precautionary approach, and assuming application of standard industry measures (such as MMObs, PAM and ADDs), the assessment considered the magnitude of impact for a high order detonation.

PTS

A.1.1.1.74 The magnitude of cumulative impact (elevated underwater sound due to UXO clearance) is predicted to be of local to regional spatial extent, very short-term duration, intermittent and, although the impact itself is reversible (i.e. during the detonation event only), the effect of injury on sensitive receptors (PTS) is permanent. It is predicted that the impact will affect the receptor directly. In line with UXO guidance, assuming standard industry measures applied for each project, it is anticipated that for most species animals would be deterred from the injury zone and therefore the risk of PTS would be reduced. The magnitude is therefore considered to be negligible (for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal). For harbour porpoise the injury ranges are large (**Table A. 6**) and there is considered to be a residual risk of PTS to a small number of individuals, even with the application of standard industry measures. The magnitude is therefore considered to be medium for harbour porpoise.

Behavioural disturbance (using TTS-onset as a proxy)

A.1.1.1.75 The magnitude of cumulative impact (elevated underwater sound due to UXO clearance) resulting from a high order detonation is predicted to be of regional spatial extent, short-term duration, intermittent and both the impact itself (i.e. during the detonation event) and effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be low for all species.

Significance of effect

PTS

A.1.1.1.76 With embedded mitigation applied, for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal, the magnitude of the cumulative impact is deemed to be negligible, and the sensitivity of the receptors is considered to be high. There is not anticipated to be any effect on the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

A.1.1.1.77 For harbour porpoise, with embedded mitigation applied the magnitude of the cumulative impact is deemed to be medium, and the sensitivity of the receptor is considered to be high. On the basis of high order detonation, there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS. The cumulative effect will, therefore, be of **moderate adverse** significance, which is significant in EIA terms. The effect could be concluded to be of either minor adverse or moderate adverse significance, in line with the matrix approach set out in **Table 4.16**.

A.1.1.1.78 Whilst there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS, based on expert judgement it is considered that this would not manifest to population level effects, and is unlikely to affect the international value of the species.

Behavioural disturbance (using TTS-onset as a proxy)

A.1.1.1.79 With standard industry measures applied, the magnitude of the cumulative impact for all species is deemed to be low and the sensitivity of the receptor is considered to be low. There is not anticipated to be any effect on the international value of any marine mammal species. The effect could be concluded to be of either negligible or minor adverse significance. The effect is concluded to be of **minor adverse** significance rather than negligible, as there is evidence of an effect. This is not significant in EIA terms.

Further mitigation measures

A.1.1.1.80 The cumulative impact assessment of injury from elevated underwater sound from UXO clearance concludes a significant effect in EIA terms, for harbour porpoise only. As the Transmission Assets alone assessment determined there would be a significant effect in EIA terms, the Transmission Assets may contribute to the cumulative impact in the context of the CIS MU, and therefore the Applicants have committed to the development of detailed MMMPs (with an Outline MMMP (CoT64) (**Table 4.12**) included as part of the application document reference: J18) which is secured as a requirement within the draft DCO to reduce the magnitude of impacts, such that there will be no residual significant effect for the Transmission Assets alone and therefore no contribution to cumulative effects.

A.1.1.1.81 Development of the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) post-consent (in consultation with the licensing authority and SNCBs) will present options for relevant mitigation measures (such as temporal restrictions, low order clearance methods, soft start) in order to reduce the magnitude for the Transmission Assets alone. Further details on the numbers and type of UXO requiring clearance will be available post consent. In this case, if required, further mitigation measures would be applied to reduce potential underwater sound impacts to a level whereby a non-significant effect for harbour porpoise could be concluded. These mitigation measures would also result in a reduction of potential underwater sound impacts to other marine mammal receptors.

A.1.5 Scenario 4b: Transmission Assets together with Tier 1 and 2 projects

Construction phase

A.1.1.1.82 The construction of Transmission Assets, together with construction of Tier 1 and Tier 2 projects identified in **Table 4.38** may lead to injury and/or disturbance to marine mammals during UXO clearance. Tier 2 projects screened into the assessment within the cumulative marine mammal study area include: Codling Wind Park Extension, Llŷr 2, Llŷr 1, North Celtic Sea Offshore Wind Farm, North Channel Wind 1 and North Channel Wind 2, Shelmalere Offshore Wind Farm, Inis Ealga Marine Energy Park, Dublin Array, Arklow Bank Wind Park Phase 2, ENI Hynet CCS, Oriel Offshore Wind Farm and Simply Blue Emerald.

Sensitivity of receptor

A.1.1.1.83 The sensitivity of marine mammals to PTS and behavioural disturbance from elevated underwater sound due to UXO clearance is as described in in **paragraph A.1.1.1.1** *et seq.* and is not reiterated here.

PTS

A.1.1.1.84 As a result of UXO clearance, all marine mammals are deemed to have limited resilience, low recoverability and international value. The sensitivity of the receptors to PTS is therefore, considered to be high.

Behavioural disturbance (using TTS-onset as a proxy)

A.1.1.1.85 As a result of UXO clearance, all marine mammals are deemed to have some resilience, high recoverability and international value. The sensitivity of the receptor to TTS is therefore, considered to be low.

Magnitude of the impact

A.1.1.1.86 Projects screened in for this cumulative assessment are expected to involve similar construction activities to those described for the Transmission Assets alone, including UXO clearance activities. It is anticipated that, for all projects, impacts associated with this activity will require additional assessment under EPS licensing or marine licenses, however such applications are not yet available in the public domain.

A.1.1.1.87 For Tier 2 projects beyond the EIA Scoping Report there was not sufficient information to conduct a quantitative assessment. The EIA Scoping Reports do not provide detailed information about the impact of sound from UXO clearance. These projects are likely to have effects similar to the Transmission Assets and will likely have similar mitigation (e.g. MMMPs or separate marine licenses) to avoid injury; but at this stage a more detailed assessment cannot be presented. Dublin Array Offshore Wind Farm, North Irish Sea Array Offshore Wind Farm, Codling Wind Park Extension Offshore Wind Farm, Oriel Offshore Wind Farm, ENI Hynet CCS and Arklow Bank Wind Park Phase 2 scoped out UXO in their respective Scoping Reports.

A.1.1.1.88 The EIA Scoping Report for Inis Ealga Marine Energy Park proposed that UXO is scoped into the EIA, and the assessment of potential underwater sound produced by UXO detonation will be based upon a range of potential charge weights (until detailed data on the UXOs detected on site becomes available) (Inis Ealga Marine Energy Park Ltd., 2022Construction is planned in 2028, therefore it is unlikely there will be overlap in UXO clearance with the Transmission Assets as it will be carried out after the Transmission Assets construction period. This, in combination with the distance from the Transmission Assets (326.54 km; **Table 4.38**) means that minimal spatial overlap in UXO PTS and behavioural disturbance ranges and limited potential for cumulative effects are unlikely.

A.1.1.1.89 The Llŷr Projects (Llŷr 1/Llŷr 2) EIA Scoping Report confirms UXO surveys will be undertaken before construction and suggested the potential for UXO clearance will be high due to the proximity of the inshore part of the study area to Castlemartin Range (Llŷr Floating Wind Ltd., 2022). The Llŷr 1 and Llŷr 2 construction period is planned from 2024 to 2025 and therefore it is unlikely there will be overlap in UXO clearance with the Transmission Assets. This, in combination with the distance from the Transmission Assets (291.76 km and 286.98 km; **Table 4.38**) mean minimal spatial overlap in UXO PTS and behavioural disturbance ranges, and limited potential for cumulative effects.

A.1.1.1.90 The North Celtic Sea Offshore Wind Farm EIA Scoping Report assumes that UXO clearance may result in injury and/or disturbance to marine mammals from underwater sound (North Celtic Sea Wind Limited, 2023). However, the timeline for the construction phase of the North Celtic Sea Offshore Wind

Farm is unknown and therefore the temporal overlap with the Transmission Assets UXO clearance is not possible to assess. However, given that the North Celtic Sea Offshore Wind Farm will be located 276.90 km (**Table 4.38**) from the Transmission Assets, the spatial overlap of sound contours and therefore cumulative impacts are unlikely.

A.1.1.1.91 Injury and disturbance due to UXO clearance has also been scoped in for further consideration as a potential impact to marine mammals in North Channel Wind 1 and 2 Projects EIA Scoping Report (North Channel Wind Limited, 2023). The use of low order clearance techniques (deflagration) was acknowledged as preferred approach and the project committed to appropriate mitigation measures, e.g., ADDs and soft starts (North Channel Wind Limited, 2023). The construction of North Channel Wind 1 and 2 Projects is planned to take place in 2029 and since UXO clearance is assumed to take place at the onset of the construction phase (commencing in 2026 at Transmission Assets), temporal overlap and therefore cumulative impacts are unlikely.

A.1.1.1.92 The EIA Scoping Report for Shelmalere Offshore Wind Farm concluded that a detailed UXO survey would be undertaken post-consent, ahead of construction activities (planned for 2023), and therefore UXO clearance activities will not overlap with the Transmission Assets. No further information on UXO clearance method was given. Construction activities are planned from 2028, therefore it is unlikely there will be overlap in UXO clearance with the Transmission Assets. This, in combination with the distance from the Transmission Assets (approximately 200.89 km; **Table 4.38**) means minimal spatial overlap in UXO PTS and behavioural disturbance ranges and limited potential for cumulative effects.

A.1.1.1.93 The Simply Blue Emerald EIA Scoping Report assumes that if UXO clearance will be required, disposal could be a significant source of underwater sound depending on the selected disposal methods and this impact has been scoped in for further consideration in the EIA process (Emerald Floating Wind, 2023). The EIA Scoping Report anticipated that a number of mitigation measures could be applied, including methods to reduce underwater sound from the project, such as the use of low order detonation for UXO disposal. Nevertheless, the timeline for the construction phase of the Simply Blue Emerald project is unknown and therefore temporal overlap with the Transmission Assets UXO clearance is not possible to assess. However, considering that Simply Blue Emerald will be located approximately 359.16 km (**Table 4.38**) from the Transmission Assets, spatial overlap of sound contours and therefore cumulative impacts are unlikely.

A.1.1.1.94 Codling Wind Park EIA Scoping Report does not explicitly scope in sound from UXO clearance but does identify that detailed MMMPs will be considered for any potential UXO clearance work (Codling Wind Park Limited, 2020) The construction phase is planned to be complete by 2027 and therefore some temporal overlap with Transmission Assets construction is possible. Despite the lack of information, the smaller proposed extent (fewer UXOs within the area) and location to the east of Ireland (approximately 141.23 km from the Transmission Assets) means there is limited potential for spatial overlap of sound contours and therefore cumulative effects with Codling Wind Park.

A.1.1.1.95 ENI Hynet CCS Scoping report mentioned that UXO clearance was scoped out as the potential for displacement and disturbance to marine mammal species from UXO clearance was scoped out due to the historical oil and gas developments in the area. They mentioned it would be unlikely that UXO's needed to be removed and/or detonated had not already been encountered as the area has been utilised for decades. (Liverpool Bay CCS Ltd., 2022)

A.1.1.1.96 Adopting a precautionary approach, and assuming application of standard industry measures (such as MMObs, PAM and ADDs) measures, the assessment considered the magnitude of impact for a high order detonation.

PTS

A.1.1.1.97 The magnitude of the cumulative impact is predicted to be of local to regional spatial extent, very short-term duration, intermittent and, although the impact itself is reversible (i.e. elevated underwater sound during the detonation event only), the effect of injury on sensitive receptors is permanent. It is predicted that the impact will affect the receptor directly. In line with UXO guidance, assuming standard industry measures applied for each project, it is anticipated that for most species animals would be deterred from respective injury zones and therefore the risk of PTS would be reduced. The magnitude is therefore considered to be negligible (for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal).

A.1.1.1.98 For harbour porpoise, whilst predicted PTS ranges are not available for Tier 2 projects, PTS ranges are expected to be similar to those identified for Tier 1 projects (**Table A. 6**). There is therefore considered to be a residual risk of PTS to a small number of individuals for Tier 1 and Tier 2 projects combined. The magnitude is therefore considered to be medium for harbour porpoise.

Behavioural disturbance (using TTS-onset as a proxy),

A.1.1.1.99 The magnitude of the cumulative impact is predicted to be of regional spatial extent, short-term duration, intermittent and both the impact itself (i.e. elevated underwater sound during the detonation event only) and the effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be low for all species.

Significance of effect

PTS

A.1.1.1.100 With standard industry measures applied, for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptors is considered to be high. There is not anticipated to be any effect on the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

A.1.1.1.101 For harbour porpoise, with tertiary mitigation applied, the magnitude of the cumulative impact is deemed to be medium, and the sensitivity of the receptors is considered to be high. On the basis of high order detonation, there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS. The cumulative effect will, therefore, be of **moderate adverse** significance, which is significant in EIA terms. The effect could be concluded to be of either minor adverse or moderate adverse significance, in line with the matrix approach set out in **Table 4.16**.

A.1.1.1.102 Whilst there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS, based on expert judgement it is considered that this would not manifest to population level effects, and is unlikely to affect the international value of the species. As discussed in **paragraph A.1.1.1.38**, mitigation measures will be adopted via the detailed MMMPs (CoT64) (**Table 4.12**) (developed in accordance with the Outline MMMP (document reference: J18)) to reduce any residual risk of injury to harbour porpoise as a result of Transmission Assets alone.

Behavioural disturbance (using TTS-onset as a proxy)

A.1.1.1.103 In terms of TTS, with standard industry measures applied, the magnitude of the cumulative impact for all species is deemed to be low and the sensitivity of the receptor is considered to be low. There is not anticipated to be any effect on the international value of any marine mammal species. The effect could be concluded to be of either negligible or minor adverse significance. The effect is concluded to be of **minor adverse** significance rather than negligible, as there is evidence of an effect. This is not significant in EIA terms.

Further mitigation measures

A.1.1.1.104 The cumulative impact assessment of injury from elevated underwater sound from UXO clearance concludes a significant effect in EIA terms, for harbour porpoise only. As the Transmission Assets alone assessment determined there would be a significant effect in EIA terms, the Transmission Assets may contribute to the cumulative impact in the context of the CIS MU, and therefore the Applicants have committed to the development of detailed MMMPs (with an Outline MMMP (CoT64) (**Table 4.12**) included as part of the application document reference: J18) which is secured as a requirement within the draft DCO to reduce the magnitude of impacts, such that there will be no residual significant effect for the Transmission Assets alone and therefore no contribution to cumulative effects.

A.1.1.1.105 Development of the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) post-consent (in consultation with the licensing authority and SNCBs) will present options for relevant mitigation measures (such as temporal restrictions, low order clearance methods, soft start) in order to reduce the magnitude for the Transmission Assets alone. Further details on the numbers and type of UXO requiring clearance will be available post consent. In this case, if required, further mitigation measures would be applied to reduce potential underwater sound impacts to a level whereby a non-significant effect for harbour porpoise could be concluded. These mitigation measures would also result in a reduction of potential underwater sound impacts to other marine mammal receptors.

A.1.6 Scenario 4c: Transmission Assets together with Tier 1, 2 and Tier 3 projects

Construction phase

A.1.1.1.106 The construction of the Transmission Assets, together with construction phase of Tier 1, Tier 2 and Tier 3 projects may lead to cumulative injury and disturbance to marine mammals from underwater sound generated during UXO clearance. Tier 3 projects screened into the assessment within the cumulative marine mammal study area are set out in **Table 4.39**.

Magnitude of impact

4.17.1.1 As described in **paragraph 4.12.1.1** data for Tier 3 projects available at the time of writing is limited. Tier 3 projects were screened in precautionarily based on their location within the CEA screening area, though there is limited/no information on the construction/operation dates or whether UXO clearance will be considered in respective EIA assessments. It should be acknowledged that there is a potential for UXO clearance activities to be taking place intermittently across the Irish Sea and wider Celtic Sea, however, the impacts are anticipated to be of very short duration (i.e. elevated underwater sound during the detonation event only). As such, although temporal and/or spatial overlap with Tier 3 projects cannot be discounted, at the current time it is not possible to undertake any kind of meaningful assessment. As such the magnitude for Tier 1, Tier 2 and Tier 3 projects combined is concluded to be no different to the magnitude for Tier 1 and Tier 2 projects combined.

A.1.1.1.107 Adopting a precautionary approach, and assuming application of standard industry measures (such as MMObs, PAM and ADDs), the assessment considered the magnitude of impact for a high order detonation.

PTS

A.1.1.1.108 The magnitude of the cumulative impact is predicted to be of local to regional spatial extent, very short-term duration, intermittent and, although the impact itself is reversible (i.e. elevated underwater sound during the detonation event only), the effect of injury on sensitive receptors is permanent. It is predicted that the impact will affect the receptor directly. In line with UXO guidance, assuming standard industry measures applied for each project, it is anticipated that for most species animals would be deterred from respective injury zones and therefore the risk of PTS would be reduced. The magnitude is therefore considered to be negligible (for bottlenose dolphin, short-beaked common dolphin, Risso’s dolphin, minke whale, grey seal and harbour seal). The magnitude is considered to be medium for harbour porpoise.

Behavioural disturbance (using TTS-onset as a proxy),

A.1.1.1.109 The magnitude of the cumulative impact is predicted to be of regional spatial extent, short-term duration, intermittent and both the impact itself (i.e. elevated underwater sound during the detonation event only) and the effect of behavioural disturbance is reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be low for all species.

Sensitivity of receptor

A.1.1.1.110 The sensitivity of marine mammals to PTS and behavioural disturbance from elevated underwater sound due to UXO clearance is as described in in **paragraph A.1.1.1.1** *et seq.* and is not reiterated here.

PTS

A.1.1.1.111 As a result of UXO clearance, all marine mammals are deemed to have limited resilience, low recoverability and international value. The sensitivity of the receptors to PTS is therefore, considered to be high.

Behavioural disturbance (using TTS-onset as a proxy)

A.1.1.1.112 As a result of UXO clearance, all marine mammals are deemed to have some resilience, high recoverability and international value. The sensitivity of the receptor to TTS is therefore, considered to be low.

Significance of effect

PTS

A.1.1.1.113 With standard industry measures applied, for bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, grey seal and harbour seal the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptors is considered to be high. There is not anticipated to be any effect on the international value of these species. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

A.1.1.1.114 For harbour porpoise, with embedded mitigation applied (CoT64) (**Table 4.12**), the magnitude of the cumulative impact is deemed to be medium, and the sensitivity of the receptors is considered to be high. On the basis of high order detonation, there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS. The cumulative effect will, therefore, be of **moderate adverse** significance, which is significant in EIA terms. The effect could be concluded to be of either minor adverse or moderate adverse significance, in line with the matrix approach set out in **Table 4.16**.

A.1.1.1.115 Whilst there may be some residual effect with a small number of animals potentially exposed to sound levels that could elicit PTS, based on expert judgement it is considered that this would not manifest to population level effects, and is unlikely to affect the international value of the species. As discussed in **section A.1.1.1.38**, mitigation measures (CoT64) (**Table 4.12**) will be adopted via the detailed MMMPs (developed in accordance with the Outline MMMP (document reference: J18)) to reduce any residual risk of injury to harbour porpoise as a result of Transmission Assets alone.

Behavioural disturbance (using TTS-onset as a proxy)

A.1.1.1.116 In terms of TTS, with standard industry measures applied, the magnitude of the cumulative impact for all species is deemed to be low and the sensitivity of the receptor is considered to be low. There is not anticipated to be any effect on the international value of any marine mammal species. The effect could be concluded to be of either negligible or minor adverse significance. The effect is concluded to be of **minor adverse** significance rather than negligible, as there is evidence of an effect. This is not significant in EIA terms.

Further mitigation measures

A.1.1.1.117 The cumulative impact assessment of injury from elevated underwater sound from UXO clearance concludes a significant effect in EIA terms, for harbour porpoise only. As the Transmission Assets alone assessment determined there would be a significant effect in EIA terms, the Transmission Assets may contribute to the cumulative impact in the context of the CIS MU, and therefore the Applicants have committed to the development of a detailed MMMPs (with an Outline MMMP (CoT64) (**Table 4.12**) included as part of the application document reference: J18) which is secured as a requirement within the draft DCO to reduce the magnitude of impacts, such that there will be no residual significant effect for the Transmission Assets alone and therefore no contribution to cumulative effects.

A.1.1.1.118 Development of the detailed MMMPs (CoT64) (**Table 4.12**) (document reference: J18) post-consent (in consultation with the licensing authority and SNCBs) will present options for relevant mitigation measures (such as temporal restrictions, low order clearance methods, soft start) in order to reduce the magnitude for the Transmission Assets alone. Further details on the numbers and type of UXO requiring clearance will be available post consent. In this case, if required, further mitigation measures would be applied to reduce potential underwater sound impacts to a level whereby a non-significant effect for harbour porpoise could be concluded. These mitigation measures would also result in a reduction of potential underwater sound impacts to other marine mammal receptors.