XLINKS MOROCCO-UK POWER PROJECT

Preliminary Environmental Information Report

Volume 3, Chapter 2: Fish and Shellfish Ecology

FOR ISSUE
April 2024

xlinks.co

Contents

Tables

Figures (See Volume 3, Figures)

Glossary

Term	Meaning
Benthic	Occurring on the bottom of the seabed.
Berried	Crustaceans with attached eggs.
Demersal	Living on or near the seabed.
Diadromous	Migrates between freshwater and the marine environment.
Elasmobranch	Fish whose skeletal structure is composed of cartilage. Includes sharks, rays and skates.
Flatfish	Fish in the order Pleuronectiformes.
Folk	Classification system for sediments.
MARPOL	The International Convention for the Prevention of Pollution from Ships (MARPOL, 1973 as modified by the Protocol of 1978) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.
Pelagic	Of or relating to the open sea.
Nursery grounds	Areas occupied by young fish or shellfish.
Spawning grounds	An area where fish and shellfish deposit eggs.
Species complex	Closely related organisms that are so similar in appearance that the boundaries between them are often unclear.
Wentworth	Classification system for sediment grain size.

Acronyms

Acronym	Meaning
AC	Alternating Current
CITES	Convention on International Trade in Endangered Species
CMS	Convention on the Conservation of Migratory Species
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
DC	Direct Current
DEFRA	Department for Environment, Food & Rural Affairs
EA	Environment Agency
EMF	Electromagnetic Fields
EMODnet	European Marine Observation and Data Network
ICES	International Council for the Exploration of the Sea
IEF	Important Ecological Features
INNS	Invasive Non-Native Species
IUCN	International Union for Conservation of Nature
MarESA	Marine Evidence based Sensitivity Assessment
MCZ	Marine Conservation Zone
MDS	Maximum Design Scenario
MMO	Marine Management Organisation
NFPD	The National Fish Populations Database
NERC	Natural Environment Research Council

Acronym	Meaning
NFPD	National Fish Populations Database
PSA	Particle Size Analysis
SAC	Special Area of Conservation
SSC	Suspended Sediment Concentration
OWF	Offshore Wind Farm
UNCLOS	United Nations Convention on the Law of the Sea
VMP	Vessel Management Plan
ZoI	Zone of Influence

Units

Units	Meaning
cm	Centimetre
km	Kilometres
m	Metres
m^2	Meters Squared
m/s	Meters per Second
mG	Milligauss
mT	Millitesla
nm	Nautical Miles
UV/cm	Microvolts per Centimetre
Uv/m	Microvolts per Metre
uT	Microtesla
V	Volts
V/m	Volts per Metre

2 FISH AND SHELLFISH ECOLOGY

2.1 Introduction

2.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the preliminary findings of the Environmental Impact Assessment (EIA) work undertaken to date for the United Kingdom (UK) elements of the Xlinks Morocco-UK Power Project. For ease of reference, the UK elements of the Xlinks Morocco-UK Power Project are referred to in this chapter as the 'Proposed Development'.

2.1.2 This chapter considers the potential impacts and effects of the Proposed Development on fish and shellfish during the construction, operation and maintenance and decommissioning phases. Specifically, it relates to the offshore elements of the Proposed Development seaward of Mean High Water Springs (MHWS).

2.1.3 In particular, this PEIR 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 fish and shellfish ecology arising from the Proposed Development, 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.

2.1.4 The assessment presented is informed by the following technical chapters:

- Volume 3, Chapter 1: Benthic Ecology
- Volume 3, Chapter 3: Commercial Fisheries
- Volume 3, Chapter 5: Shipping and Navigation
- Volume 3, Chapter 8: Physical Processes

2.1.5 This chapter also draws upon information contained within Volume 3, Appendix 4.1: Underwater Noise Assessment, of the PEIR.

2.1.6 The PEIR will inform pre-application consultation. Following consultation, comments on the PEIR and any refinements in design will be reviewed and taken into account, where appropriate, in preparation of the Environmental Statement that will accompany the application to the Planning Inspectorate for development consent.

2.2 Legislative and Policy Context

Legislation

2.2.1 The following section provides information regarding key legislation that applies to fish and shellfish ecology, and which has been considered within the assessment process in this chapter of the PEIR.

International

- The Convention on the Conservation of Migratory Species of Wild Animals (the 'Bonn Convention');
- The Convention on the Conservation of European Wildlife and Natural Habitats (the 'Bern Convention');
- The OSPAR Convention;
- EU Directive 2008/56/EC – Marine Strategy Framework Directive;
- Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (the Habitats and Species Directive);
- The European Biodiversity Strategy to 2030;
- Ramsar Convention (1976);
- Espoo Convention (1997); and
- International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM).

National

- Conservation (Natural Habitats, &c.) Regulations 1994;
- The Salmon and Freshwater Fisheries Act 1975;
- The Conservation of Habitats and Species Regulations 2017 (as amended by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019);
- Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended);
- Marine Strategy Regulations 2010;
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017;
- Planning Act 2008 (as amended);
- Marine and Coastal Access Act 2009;
- Infrastructure Planning (EIA) Regulations 2017 (as amended);
- Marine Works (EIA) Regulations 2007 (as amended);
- Environment Act 2021;
- The Eels (England and Wales) Regulations 2009;
- Natural Environment and Rural Communities (NERC) Act 2006 (England); and

- Wildlife and Countryside Act (1981 as amended).

Planning Policy Context

2.2.2 The Proposed Development will be located within UK inshore waters and the UK EEZ offshore waters - beyond 12 nautical miles (nm) from the English coast (with the onshore infrastructure located wholly within Devon, England). As set out in Volume 1, Chapter 1: Introduction, of the PEIR, the Secretary of State for the Department for Energy Security and Net Zero (DESNZ) has directed that elements of the Proposed Development are to be treated as development for which development consent is required under the Planning Act 2008, as amended.

National Policy Statements

2.2.3 There are currently six energy National Policy Statements (NPSs), three of which contain policy relevant to the Proposed Development, 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);
- NPS for Renewable Energy Infrastructure (NPS EN-3) (Department for Energy Security & Net Zero 2023b); and
- NPS for Electricity Networks Infrastructure (NPS EN-5) (Department for Energy Security & Net Zero 2023c).

2.2.4 **Table 2.1** sets out key aspects from the NPSs relevant to the Proposed Development, with particular reference to the need for and approach to consenting such infrastructure.

Table 2.1: Summary of relevant NPS policy

Summary of NPS requirement	How and where considered in the PEIR
NPS EN-1	
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 (paragraph 5.4.22).	Migratory species which may pass through the Proposed Development have been identified in **section 2.5**. Through this a number of migratory species have been identified as Important Ecological Features (IEFs) and assessed within **sections 2.8, 2.9** and **2.10**.
The ES should in particular describe any impacts of the proposed project on water bodies or protected areas (including shellfish protected areas) under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (paragraph 5.16.7).	Protected areas, including shellfish protected area, and their associated features have been identified in **section 2.5.** These features (IEFs) have been assessed within **sections 2.8, 2.9** and **2.10**.
NPS EN-3	

Summary of NPS requirement	How and where considered in the PEIR
Fish in the context of this NPS also includes elasmobranchs (sharks and rays) and shellfish (e.g., crabs) (paragraph 2.8.147).	Species which may occur within the Proposed Development have been identified in **section 2.5**. Through this, a number of species have been identified as IEFs, including species of elasmobranch and shellfish.
The applicant should identify fish species that are the most likely receptors of impacts with respect to feeding areas; spawning grounds; nursery grounds; overwintering areas for crustaceans and migration routes (paragraph 2.8.150).	Species which may occur within the Proposed Development have been identified in **section 2.5**. This has included consideration of area usage (spawning, nursery etc.) and migratory routes.
There are potential impacts associated with energy emissions into the environment (e.g. noise or electromagnetic fields (EMF)), as well as potential interaction with seabed sediments (paragraph 2.8.149).	The impacts of noise have been assessed within **sections 2.8, 2.9** and **2.10**. The impacts of EMF has been assessed within **section 2.9**.
Applicant assessments should identify the potential implications of underwater noise from construction and unexploded ordnance including, where possible, implications of predicted construction and soft start noise levels in relation to mortality, permanent threshold shift (PTS), temporary threshold shift (TTS) and disturbance, and addressing both sound pressure and particle motion) and EMF on sensitive fish species (paragraph 2.8.151).	

Marine Policy

UK Marine Policy Statement

2.2.5 The UK Marine Policy Statement was adopted in 2011 and provides the policy framework for the preparation of marine plans and establishes how decisions affecting the marine area should be made (HM Government, 2011).

2.2.6 The high-level marine objective “Living within environmental limits” includes the following requirements which are relevant to fish and shellfish:

- Biodiversity is protected, conserved and where appropriate recovered and loss has been halted;
- Healthy marine and coastal habitats occur across their natural range and are able to support strong, biodiverse biological communities and the functioning of healthy, resilient and adaptable marine ecosystems;
- Our oceans support viable populations of representative, rare, vulnerable, and valued species.

South West Inshore and South West Offshore Marine Plans

2.2.7 **Table 2.2** sets out a summary of the specific policies set out in the South West Inshore and South West Offshore Marine Plans (MMO, 2021) relevant to this chapter.

Table 2.2: Summary of inshore and offshore marine plan policies relevant to this chapter

Policy	Key provisions	How and where considered in the PEIR
SW-MPA-1	Proposals that may have adverse impacts on the objectives of marine protected areas must demonstrate that they will, in order of preference: avoid, minimise or mitigate adverse impacts.	MPAs and their associated fish and shellfish features have been identified in **section 2.5** and assessed in **sections 2.8, 2.9** and **2.10**.
SW-BIO-1	Proposals that may have significant adverse impacts on the distribution of priority habitats and priority species must demonstrate that they will, in order of preference: avoid, minimise, mitigate adverse impacts or compensate for significant adverse impacts that cannot be mitigated.	Impacts on fish and shellfish species, including priority species, have been assessed in **sections 2.8, 2.9** and **2.10**.
SW-BIO-2	Proposals that may cause significant adverse impacts on native species or habitat adaptation or connectivity, or native species migration, must demonstrate that they will, in order of preference: avoid, minimise, mitigate adverse impacts or compensate for significant adverse impacts that cannot be mitigated.	Impacts on native fish and shellfish species have been assessed in **sections 2.8, 2.9** and **2.10**.
SW-FISH-3	Proposals that may have significant adverse impacts on essential fish habitat, including spawning, nursery and feeding grounds, and migratory routes, must demonstrate that they will, in order of preference: avoid, mitigate or minimise adverse impacts so that are no longer significant.	Spawning grounds, nursery ground and potential migration routes have been identified in **section 2.5** and assessed in **sections 2.8, 2.9** and **2.10**.
SW-UWN-2	Proposals that result in the generation of impulsive or non-impulsive noise must demonstrate that they will, in order of preference: avoid, minimise or mitigate adverse impacts.	The potential impacts of underwater noise on fish and shellfish has been assessed in **sections 2.8, 2.9** and **2.10**.
SW-INNS-1	Proposals must put in place appropriate measures to avoid or minimise significant adverse impacts that would arise through the introduction and transport of invasive non-native species.	Mitigation measures adopted are provided in **section 2.7**. The potential impacts of Invasive Non-Native Species (INNS) on fish and shellfish has been assessed in **sections 2.8, 2.9** and **2.10**.

Local Planning Policy

2.2.8 The onshore elements of the Proposed Development are located within the administrative area of Torridge District Council. The relevant local planning policies applicable to fish and shellfish based on the extent of the study areas for this assessment are summarised in **Table 2.3**.

Table 2.3: Summary of local planning policy relevant to this chapter

Policy	Key provisions	How and where considered in the PEIR
North Devon and Torridge Local Plan 2011-2031		
ST09: Coast and Estuary strategy	The integrity of the coast and estuary as an important wildlife corridor will be protected and enhanced. The importance of the undeveloped coastal, estuarine and marine environments, including the North Devon Coast Areas of Outstanding Natural Beauty, will be recognised through supporting designations, plans and policies. The undeveloped character of the Heritage Coasts will be protected.	Impacts from the Proposed Development on fish and shellfish has been assessed in **sections 2.8, 2.9** and **2.10.**
ST14: Enhancing Environmental Assets	The quality of northern Devon's natural environment will be protected and enhanced by ensuring that development contributes to: (a) providing a net gain in northern Devon's biodiversity where possible, through positive management of an enhanced and expanded network of designated sites and green infrastructure, including retention and enhancement of critical environmental capital; (b) protecting the hierarchy of designated sites in accordance with their status; (c) conserving European protected species and the habitats on which they depend; … (h) recognising the importance of the undeveloped coastal, estuarine and marine environments through supporting designations, plans and policies that aim to protect and enhance northern Devon's coastline; (i) conserving and enhancing the robustness of northern Devon's ecosystems and the range of ecosystem services they provide.	Impacts from the Proposed Development on fish and shellfish has been assessed in **sections 2.8, 2.9** and **2.10.**
North Devon Marine Nature Recovery Plan 2022-2027		
North Devon Marine Nature Recovery Plan	This Marine Nature Recovery Plan covers the biodiversity found in the coastal, estuarine and marine areas of the North Devon Biosphere Reserve and has been developed in order to deliver against relevant international, national and local policies and initiatives. The plan highlights species of importance which includes crawfish, European lobster, brown crab, cod, herring, European bass, Salmon, trout and a number of ray and flatfish species, and recommends actions that need to be taken forward to support their recovery.	A range of IEFs have been identified in **section 2.5.** Impacts from the Proposed Development on fish and shellfish has been assessed in **sections 2.8, 2.9** and **2.10.**

North Devon Biosphere Reserve

2.2.9 The Proposed Development is located within the North Devon Biosphere Reserve, which is recognised under UNESCO's Man and the Biosphere (MAB) Programme and designated as an area for testing and demonstrating sustainable development on a sub-regional scale.

2.2.10 The North Devon Biosphere Reserve consists of three zones; a core zone centred around Braunton Burrows SAC / SSSI, a buffer zone consisting of the Taw Torridge Estuary (as far as Barnstaple and Bideford), and a transition zone formed by the catchment area of the rivers and streams that drain to the North Coast of Devon in addition to an area of sea as far out as Lundy.

2.2.11 The Biosphere Reserve is overseen by the North Devon Biosphere Reserve Partnership, which is a collaboration of 26 partnership organisations who work to deliver sustainable development through direct action, through advocacy and providing advice. The non-statutory 'North Devon Biosphere Reserve Strategy for Sustainable Development 2014 to 2024' (NDB undated) provides a context for stakeholders to deliver programmes and plans in support of the sustainable development of the Biosphere Reserve.

2.2.12 Within the North Devon Biosphere Reserve, non-statutory programmes and plans relevant to fish and shellfish include:

- North Devon Nature Improvement Area (based on the Torridge River catchment) - chosen by Defra as one of 12 national pilots for important landscape scale wildlife schemes across England
- Marine wildlife watching code of conduct
- Taw River Improvement Project
- North Devon Marine Natural Capital Plan
- North Devon Marine Nature Recovery Plan 2022-2027

2.2.13 The extent to which the Proposed Development impacts on the North Devon Biosphere Reserve and its relevant programmes / plans has been considered in this fish and shellfish ecology chapter, and consultation will take place with the North Devon Biosphere Reserve Partnership ahead of ES stage to further characterise any potential impacts. **Table 2.4** presents a summary of the specific policies set out in the North Devon Marine Natural Capital plan (North Devon UNESCO Biosphere Reserve, 2020) and the Strategy for Sustainable Development (NDB undated) relevant to this chapter.

Table 2.4 Summary of North Devon Biosphere Marine Natural Capital Plan and Strategy for Sustainable Development policies relevant to this chapter

Policy	Description	How and where considered in the PEIR
Marine Natural Capital Plan PL02: *Development or activities that will maintain and / or increase the cultural and economic value of inshore fisheries, including diversification, should demonstrate consideration of and compatibility with thresholds for sustainable*	*North Devon inshore fisheries hold important cultural, societal and economic value. PL02 seeks to support growth in this sector within sustainable exploitation limits and to promote innovative approaches to fisheries*	A number of IEFs have been identified in **section 2.5** which include species of fish and shellfish that utilise the habitats present within the Study Area (i.e. for spawning and nursery). These IEFs have been assessed in **sections 2.8, 2.9** and **2.10**, with area usage (spawning, nursery) being

Policy	Description	How and where considered in the PEIR
use and be designed to maintain and, where possible, enhance ecosystems services and functions.	*management that integrates with a 'whole-site' approach to marine biodiversity conservation. Protection and enhancement of ecological connectivity will benefit fish and shellfish populations that utilise multiple habitats as nursery areas or across different life stages.*	considered within the impact assessment.
Strategy for Sustainable Development ENV3	*Ensure that development should not be permitted that removes critical natural sites and land-take by development is subjected to a programme that ensures no net loss of ecosystem services and biodiversity through on site design and offsite offsetting.*	The impacts upon fish and shellfish receptors from the Proposed Development have been assessed within **sections 2.8, 2.9** and **2.10**.
Strategy for Sustainable Development ENV6	*Implement programmes to control invasive species.* *Target: Extent of invasive species is known and area reduced by 15% by 2020*	The impact of the introduction of invasive non-native species on fish and shellfish receptors has been assessed within **sections 2.8, 2.9** and **2.10.**

2.3 Consultation and Engagement

2.3.1 In January 2024, the Applicant 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, operational and decommissioning phases of the Proposed Development. 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 Proposed Development would not have the potential to give rise to significant environmental effects in these areas.

2.3.2 Following consultation with the appropriate statutory bodies, the Planning Inspectorate (on behalf of the Secretary of State) provided a Scoping Opinion on 07 March 2024. Key issues raised during the scoping process specific to fish and shellfish ecology are listed in **Table 2.5**, together with details of how these issues have been addressed within the PEIR.

Table 2.5: Summary of Scoping Responses

Comment	How and where considered in the PEIR
Planning Inspectorate	
The ES should ensure the study area for each aspect reflects the Proposed Development's ZoI and the impact assessment should be based on the ZoI from the Proposed Development with reference to potential effect pathways. Clear justification should be provided to support any distances applied.	The Study Area is presented in Volume 3, Figure 2.1, of the PEIR. A fixed distance of 30 km has been used, which fully encompasses the ZoI for both underwater noise and suspended sediment dispersion and has allowed for the robust

Comment	How and where considered in the PEIR
	characterisation of the mobile fish and shellfish species.
The Inspectorate acknowledges that data and knowledge regarding the baseline environment exists for the offshore area in which the Proposed Development would be located. The Inspectorate understands the benefits of utilising this information to supplement site-specific survey data but advises that suitable care should be taken to ensure that the information in the ES remains representative and fit for purpose. The Applicant should make effort to agree the suitability of information used for the assessments in the ES with relevant consultation bodies.	The data and knowledge used to determine the baseline environment submitted in the Scoping Report was reviewed to ensure suitability of the information for the PEIR. It will also be reviewed for the ES to ensure that the most up to date information is taken into account, with the suitability of baseline data sources for the ES to be agreed with relevant consultation bodies.
It is noted that the Scoping Report includes consideration of potential transboundary effects in relation to fish and shellfish ecology. The Inspectorate recommends that the ES should identify whether the Proposed Development has the potential for significant transboundary effects, and if so, what these are, and which EEA States would be affected. The Inspectorate will undertake a transboundary screening on behalf of the SoS in due course.	Transboundary impacts on fish and shellfish are presented in **section 2.12**.
The Inspectorate advises that, in addition to the receptors identified in the Scoping Report, the ES should identify, describe and assess any likely significant effects to the following receptors: • Westward Ho! designated bathing water; • Permitted sites, discharges and/ or abstractions, reflecting data available from the EA's public register; • Jennetts Reservoir and Gammaton Lower Reservoir, in terms of their designated nitrate vulnerable zones; and • Torridge Estuary designated shellfish water	Shellfish waters are a Water Framework Directive (WFD) protected area. The effects of the Proposed Development on shellfish water protected areas have been assessed separately within the preliminary WFD Report (Volume 3, Appendix 1.1). Reference has also been made to the Taw-Torridge shellfish water protected area throughout the PEIR impact assessment (**sections 2.8, 2.9** and **2.10**), particularly with respect to the distance from the ZoI for those impacts that are not restricted to the Offshore Cable Corridor (i.e. propagation of underwater noise and suspended solids). (The other listed receptors here are not relevant to the Fish and Shellfish assessment.)
The Scoping Report suggests that crossings of sensitive watercourses may be required. The ES should describe the nature of any proposed works within or in proximity of sensitive watercourses (ie main rivers and Ordinary watercourses). Information should be provided regarding the location, scale, and dimensions of any proposed watercourse crossings/ instream structures, as well as the nature of any associated construction works (eg dewatering, trenching, and HDD). The ES should consider the potential of such works to negatively impact watercourses within the study area, including the ecological status of any watercourses protected under the WFD such as the Torridge Estuary	The effects of the Proposed Development on shellfish water protected areas has been considered separately within the preliminary WFD Report (Volume 3, Appendix 1.1). Reference has also been made to the Taw-Torridge shellfish water protected area throughout the impact assessment (**sections 2.8, 2.9** and **2.10**), particularly with respect to the distance from the ZoI for those impacts that are not restricted to the Offshore Cable Corridor (i.e. propagation of underwater noise and suspended solids). The onshore elements will be considered in Volume 2, Chapter 1: Onshore Ecology and Nature

Comment	How and where considered in the PEIR
designated shellfish water. The results of the WFD Assessment should inform the ES.	Conservation and Volume 2, Chapter 3: Hydrology and Flood Risk, of the PEIR.
The Scoping Report states that changes [hydrodynamic regime (scour and accretion)] could occur from presence of rock berms, which may be required for cable protection at crossings or in isolated hard seabed areas during operation. The Inspectorate notes the predicted construction timetable and two offshore cable laying phases as described at Paragraphs 4.7.10 to 4.7.12 of the Scoping Report. It appears possible that rock berms would be in place for extended periods of construction activity in advance of the cable becoming operational and that mitigation may also be required during this period. The Inspectorate advises that the potential for change to the hydrodynamic regime due to the presence of cable protection should be assessed for the phases during which it is likely to give rise to significant effects and that the ES should describe any mitigation required and explain how this would be secured in the DCO.	Acknowledging that the separate bipoles / cable bundles may be installed in separate construction years, there is potential for any scour effects to commence prior to completion of the 'construction phase'. However, consistent with the further PINS comment below (*The Inspectorate is content for the effect of the introduction of hard substrate to be considered during operational phase and therefore agrees this matter can be scoped out of the construction stage assessment*) indirect hydrodynamic effects (on fish and shellfish receptors) are not assessed within the construction phase. The Inter-related assessment, **section 2.13,** will at ES stage consider the final Physical Processes assessments and consider any inter-related effects on the hydrodynamic regime between construction phase and operational phase. At this stage it is anticipated that any additional construction phase hydrodynamic regime changes would be equivalent (in significance) to operational phase characterisations (with no associated additional inter-related effects – **section 2.13**).
The CIEEM guidelines for Ecological Impact Assessment for Terrestrial, Freshwater and Coastal Environments (2018) was updated in April 2022 as version 1.2. The assessment should refer to the most recent iteration of the guidelines as relevant.	The updated CIEEM guidelines have been referred to within the PEIR but they are still referenced as 2018 (as specified in the 2022 update). This has been referenced as 'CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine (version 1.2 – Updated April 2022)' within the reference list in **section 2.16.**
On the basis that such effects would not occur in the operation (excluding repair) and decommissioning (where left in situ) stages, as there would be no physical works or significant vessel movements, the Inspectorate agrees that the following matters can be scoped out of the assessment for the operation (excluding repair) and decommissioning (in situ) stages: • Direct habitat loss • Temporary increase in suspended sediments • Injury and disturbance from noise and vibration • Collision risk to basking shark • Changes to water quality from resuspension of sediments • Changes to water quality as a result of accidental pollution • Introduction of INNS	The matters listed in this scoping opinion comment have been scoped out of the operational phase (normal) and decommissioning (in-situ). However, they have been assessed for construction phase, operational phase repair activities and/or decommissioning (cable removal) phase in **sections 2.8, 2.9** and **2.10.**
As the cable would not be in operation during construction or either decommissioning phase options, the Inspectorate agrees that an assessment of EMF and sediment heating can be scoped out of	EMF and sediment heating have been scoped out of the construction and decommissioning phases. However, they have been assessed for the operational phase in **section 2.9.**

Comment	How and where considered in the PEIR
assessment for these phases of the Proposed Development	
The Inspectorate is content for the effect of the introduction of hard substrate to be considered during operational phase and therefore agrees this matter can be scoped out of the construction stage assessment. The ES should however consider the removal of subsequent hard substate in the decommissioning (removal) phase, where likely significant effects could occur, or provide evidence demonstrating agreement with the relevant consultation bodies that significant effects are not likely to occur.	The impacts identified as a result of the introduction of hard substrata (Habitat alteration and long-term habitat loss and change in hydrodynamic regime) have been scoped out of the construction phase. However, they have been assessed for the operational phase in **section 2.9**. At PEIR stage, a precautionary approach to decommissioning (removal) impacts is adopted i.e. to assume equivalent impacts to those associated with the construction phase (despite likely reduced magnitudes in many instances); c.f. Volume 1, Chapter 3 for project description.
The Inspectorate notes the ES will include an assessment of collision risk to basking sharks due to vessel activities and concurs with this position. The Inspectorate also agrees that significant effects on other fish and shellfish as a result of vessel activities are unlikely to occur and agrees this matter can be scoped out of the assessment	Collision risk to basking sharks from vessel activities has been assessed in **sections 2.8, 2.9** and **2.10.** Impacts as a result of vessel activities to other species of fish and shellfish have been scoped out of the assessment.
The Scoping Report identifies baseline data for fish and shellfish available from existing literature and surveys and thus no additional site-specific fish and shellfish surveys are proposed, although the benthic site-specific surveys and samples will be used to inform the assessment. Whilst the Inspectorate acknowledges the various data sources available to inform the fish and shellfish assessment, it notes that a number are over 10 years old, particularly in relation to potential spawning grounds. The Applicant should ensure that the baseline data used in the ES assessments are sufficiently up to date to provide a robust baseline. The ES should provide evidence to justify that the largely desk-based data constitutes a robust characterisation of the receiving environment, with reference to the date, seasonal period and geographic coverage of the data. Effort should be made to agree the approach to baseline characterisation with the relevant consultation bodies and the approach should be sufficiently justified in the ES.	The most recent publicly available survey data sets have been used to characterise the fish and shellfish community, with reference to the date of the surveys and subsequent records given throughout the baseline section (**section 2.5**). Ellis *et al*. (2012) and Coull *et al*. (1998) are key data sets for mapping the spatial extent of nursery and spawning grounds for a number of key species. The limitations of these data sets, including the age, has been recognised and summarised in **paragraph 2.4.20**. Where possible the presence of spawning and/or nursery grounds has been corroborated with recent fish eggs surveys and, in the case of sandeels, using site-specific PSA data to predict habitat suitability. The suitability of baseline data sources will be agreed with relevant consultation bodies prior to the ES.
Paragraphs 8.3.13 to 8.3.18 describe a number of designated sites with fish and shellfish interest features. However, it is unclear from Table 8.3.3 how an assessment of potential effects on designated sites for fish and shellfish will be presented. The table refers predominantly to 'fish and shellfish receptors' and does not specifically reference designated sites. The ES should ensure that all designated sites, including sites for migratory fish, that could interact with the Proposed Development are assessed, where significant effects are likely to occur.	Designated sites with qualifying fish and shellfish features have been identified in **section 2.5.** Through this several SACs, SSSIs, MCZs and shellfish water protected areas have been identified with their qualifying features being assessed as IEFs within **sections 2.8, 2.9** and **2.10.** The effects of the Proposed Development on European sites (including SACs) is specifically assessed within the Habitats Regulations Assessment (HRA) Screening Report (produced alongside the PEIR).

Comment	How and where considered in the PEIR
	The effects of the Proposed Development on Marine Conservation Zones (MCZs) will be considered separately within the MCZ assessment (which will be issued prior to final ES). The effects of the Proposed Development on shellfish water protected areas has been considered separately within the preliminary WFD Assessment (Volume 3, Appendix 1.1).
The Scoping Report describes Shellfish water protected areas at Paragraph 8.3.15, including the Taw-Torridge Estuary, Torridge Estuary and Taw Estuary, to the north of the landfall site. It is unclear whether the ES will include an assessment of potential effects to these designated waters, including from the onshore elements. The ES should include an assessment of effects to shellfish waters from all relevant elements of the Proposed Development, where likely significant effects could occur. The Applicant should seek to agree the scope of the assessment with relevant consultation bodies, such as the EA and the MMO	The effects of the Proposed Development on shellfish water protected areas is specifically considered within the preliminary WFD assessment (Volume 3, Appendix 1.1). Reference has been made to the Taw-Torridge shellfish water protected area throughout the impact assessment (**sections 2.8, 2.9** and **2.10**), particular with respect to the distance from the ZoI for those impacts that are not restricted to the Offshore Cable Corridor (i.e. propagation of underwater noise and suspended solids).
Table 8.3.3 refers to the use or qualitative and/or quantitative modelling; however, no criteria are given as to how the modelling methodology will be decided. The ES should provide details of how the method is chosen, and details of the modelling methodology once undertaken. The Applicant should seek to agree the modelling with the relevant consultation bodies where possible.	Details on the noise modelling methodology can be found within Volume 3, Appendix 4.1: Underwater Noise Assessment, of the PEIR.
The Scoping Report contains very limited information with regards to potential noise modelling that may be undertaken to inform the fish and shellfish ecology assessment. The ES, and/or accompanying appendices, should provide details of any noise modelling used to inform the impact assessment	Details on the noise modelling methodology can be found within Volume 3, Appendix 4.1: Underwater Noise Assessment, of the PEIR. An assessment of the noise modelling outputs in relation to fish and shellfish receptors can be found in **sections 2.8, 2.9** and **2.10.**
The Scoping Report states that impacts on fish and shellfish receptors would affect prey availability for some marine mammal and bird receptors, but the scale of this inter-related effect has already been considered and scoped out at Section 8.5.	The fish and shellfish impact assessment is taken into account within dependent chapters, including Volume 3, Chapter 4: Marine Mammals and Sea Turtles, and Volume 3, Chapter 9: Offshore Ornithology, of the PEIR.
The ES should assess impacts from climate change, including extreme weather events over the construction and decommissioning periods, where significant effects are likely to occur and describe and secure any relevant mitigation measures.	The impacts of climate change have been considered within the future baseline conditions (**section 2.5**).
The ES should set out the methodologies used to explain any departure from the proposed approach where professional judgement is applied. Outputs from other assessments should be clearly explained where these have been applied.	The impact assessment methodology is presented in **section 2.5**. Criteria for sensitivity and magnitude have been informed by several guidance documents.
Where significance criteria are not explicitly defined within the guidance, the ES should clearly set out	The impact assessment methodology is presented in **section 2.5**. Criteria for sensitivity and magnitude

Comment	How and where considered in the PEIR
where deviation from guidance has occurred and professional judgement has been applied.	have been informed by several guidance documents.
The Inspectorate agrees that likely significant effects arising from residues and emissions (eg dust, pollutants, light, noise, vibration) are to be assessed in the relevant aspect chapters of the ES and a standalone aspect chapter for residues and emissions is not required.	This fish and shellfish chapter includes consideration of construction phase 'emissions' of noise and vibration, and suspended sediments (**section 2.8**) and operational phase 'emissions' of EMF, heat and suspended sediments (**section 2.9**).
The Scoping Report confirms that heat generated during the operation and maintenance of the Proposed Development (eg heat generated by offshore and onshore cables) will be considered within the relevant aspect chapters, including Benthic Ecology, Fish and Shellfish Ecology; and Commercial Fisheries. The Inspectorate agrees that activities during construction and decommissioning are unlikely to result in significant environmental effects and can be scoped out of the assessment.	Sediment heating has been scoped in during the operation and maintenance phase and assessed in **section 2.9**.
The Scoping Report confirms that EMFs generated during the operation of the Proposed Development will be considered in relevant aspect chapters, including fish and shellfish ecology, and would not be included in a standalone ES chapter in respect of heat and radiation. The Inspectorate is content with this approach.	Electromagnetic field (EMF) effects have been scoped in during the operation and maintenance phase and assessed in **section 2.9.**
Environment Agency	
The Environment Agency holds data on fish, invertebrates and macrophytes, which are available to view on the EA Ecology & Fish Data Explorer. Additional ecological data can be obtained from the Devon Biological Records Centre, or Devon County Council's 'Environment Viewer'.	The EA NFPD transitional & coastal water fish surveys have been utilised to identify the fish communities present within the Taw-Torridge estuary (**section 2.5**). The EA NFPD freshwater fish surveys have been utilised to identify the presence of diadromous fish species across the Devon and Cornwall coast (**section 2.5**).
Joint Nature Conservation Committee (JNCC)	
We would recommend that the Applicant uses 'Nature conservation considerations and environmental best practice for subsea cables for English inshore and UK offshore waters' (Natural England and JNCC, 2022).	This guidance has been used to inform the assessment of potential impacts.
Natural England	
Natural England would like to sign post the applicant to our joint advice with JNCC on subsea cable projects for high level advice for environmental considerations that are essential for cable operations across English inshore waters and UK offshore waters: Environmental considerations for offshore wind and cable projects - Nature conservation considerations and environmental best practice for subsea cables for English Inshore and UK offshore waters, Sept 22.pdf - All Documents (sharepoint.com)	This guidance has been used to inform the assessment of potential impacts.

Comment	How and where considered in the PEIR
The development site is within or may impact on the following Habitats/internationally designated nature conservation sites: Marine sites: • Bristol Channel Approaches Special Area of Conservation (SAC) • Lundy SAC • Isles of Scilly Complex SAC • Severn Estuary SAC/Ramsar Terrestrial sites: • Braunton Burrows SAC Based on the information provided, Natural England's advice is that the proposed cable route is unlikely to have a significant effect on terrestrial European sites and can therefore be screened out from requiring further assessment. (Discretionary Advice Service 17671-358612 dated 03/08/2021).	The Severn Estuary SAC contains a number of diadromous fish features, which have been identified in **section 2.5** and assessed in **sections 2.8, 2.9** and **2.10.** It should be noted that the Severn Estuary SAC is outside the Study Area and therefore the ZoI. However, the designated features of the Severn Estuary SAC have been considered as IEFs due to a proven level of connectivity. The other marine sites listed are not directly relevant to the Fish and Shellfish assessment. Conservation objective 3 for the Bristol Channel Approaches SAC (i.e. 'The condition of supporting habitats and processes, and the availability of prey is maintained') may be relevant dependent on any effects on fish (prey species to harbour porpoise). The results of the fish and shellfish impact assessment (reported within this PEIR chapter) informs the conservation objective 3 assessment which is presented in the HRA Screening report that accompanies the PEIR.
The development site is within or may impact on the following Sites of Special Scientific Interest: • Mermaid's Pool to Rowden Gut Site of Special Scientific Interest (SSSI) • Taw Torridge Estuary SSSI • Lundy SSSI The Environmental Statement should include a full assessment of the direct and indirect effects of the development on the features of special interest within the SSSI and identify appropriate mitigation measures to avoid, minimise or reduce any adverse significant effects.	A suite of fish and shellfish receptors have been identified as IEFs and assessed in **sections 2.8, 2.9** and **2.10**, including several of which are features of special interest for Taw Torridge Estuary SSSI (i.e. salmon, sea trout, European eel). Reference has been made to the Taw-Torridge Estuary throughout the impact assessment (**sections 2.8, 2.9** and **2.10**), particular with respect to the distance from the ZoI for those impacts that are not restricted to the Offshore Cable Corridor (i.e. propagation of underwater noise and suspended solids).

2.3.3 A summary of the key issues raised during consultation activities undertaken to date is presented in **Table 2.6**, together with how these issues have been considered in the production of this PEIR chapter.

Table 2.6: Summary of consultation relevant to this chapter

Date	Consultee and type of response	Issues raised	How and where considered in the PEIR
14/08/23	North Devon Fisherman's Association and Cornish Fish Producers Organisation – Project introduction meeting and early discussions	None with respect to fish and shellfish.	(c.f. Volume 3, Chapter 3 for discussions regarding commercial fisheries –indirect considerations for fish and shellfish)
09/01/24	JNCC meeting – Project introduction meeting and early discussions	None with respect to fish and shellfish.	(c.f. Volume 3, Chapter 1 for discussions regarding benthic habitats –indirect considerations for fish and shellfish)
22/02/24	Natural England – Project introduction meeting and early discussions	No issues raised with respect to fish and shellfish.	(c.f. Volume 3, Chapter 1 for discussions regarding benthic habitats –indirect considerations for fish and shellfish)
31/01/24	Environment Agency consultation meeting	Introduction to project, non-technical discussion.	Not applicable
21/03/24	MMO - Post Scoping Opinion discussions	No issues raise directly relevant to fish and shellfish.	Discussions included presentation of sediment dispersion characterisation methods – indirect considerations for fish and shellfish (c.f. Volume 3, Chapter 8: Physical Processes).
27/03/24	Natural England – Post Scoping Opinion discussions	No issues raised directly relevant to fish and shellfish.	Discussions included agreement of sediment dispersion characterisation methods – indirect considerations for fish and shellfish (c.f. Volume 3, Chapter 8: Physical Processes).

2.4 Methodology

Relevant Guidance

2.4.1 With respect to fish and shellfish, the following guidance documents have been used to inform the assessment of potential impacts:

- Guidelines for Ecological Impact Assess Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2018);
- Sound exposure guidelines for fish (Popper *et al.,* 2014); and
- Nature conservation considerations and environmental best practice for subsea cables for English Inshore and UK offshore waters (NE and JNCC, 2022).

2.4.2 In addition, the Marine Evidence-based Sensitivity Assessment (MarESA) information hosted by the Marine Life Information Network (MarLIN) was consulted to determine sensitivity of relevant species to a range of anthropogenic pressures.

Scope of the Assessment

2.4.3 The scope of this PEIR has been developed in consultation with relevant statutory and non-statutory consultees as detailed in **Table 2.5** and **Table 2.6**. A range of potential impacts on fish and shellfish have been identified, which may occur during the construction, operation and decommissioning phases of the Proposed Development.

2.4.4 Taking into account the scoping and consultation process, **Table 2.7** summarises the issues considered as part of this assessment.

Table 2.7: Issues considered within this assessment

Activity	Potential effects scoped into the assessment
Construction Phase	
Seabed preparation, route clearance, cable laying, HDD and burial activities.	Temporary habitat loss / disturbance
	Temporary increase in suspended sediments and sediment deposition
	Collision risk to basking shark from vessel activities
	Injury and disturbance from noise and vibration
	Changes to water quality from resuspension of sediments
	Changes to water quality as a result of accidental pollution
	Introduction of invasive non-native species
Operational phase	
Operational phase - normal	
Cable operation and presence of rock protection	Electromagnetic field (EMF) effects
	Habitat alteration and long-term habitat loss

Activity	Potential effects scoped into the assessment
	Change in hydrodynamic regime
	Sediment heating
Operational phase - repair activities	
Cable repairs	Temporary habitat loss / disturbance
	Temporary increase in suspended sediments and sediment deposition
	Injury and disturbance from noise and vibration
	Habitat alteration and long-term habitat loss
	Collision risk to basking shark from vessel activities
	Changes to water quality from resuspension of sediments
	Changes to water quality as a result of accidental pollution
	Introduction of invasive non-native species
Decommissioning phase	
Decommissioning phase - cable removal	
Decommissioning activities	Temporary habitat loss / disturbance
	Temporary increase in suspended sediments and sediment deposition
	Injury and disturbance from noise and vibration
	Habitat alteration and long-term habitat loss
	Collision risk to basking shark from vessel activities
	Changes to water quality from resuspension of sediments
	Changes to water quality as a result of accidental pollution
	Introduction of invasive non-native species

2.4.5 Effects which are not considered likely to be significant have been scoped out of the assessment. A summary of the effects scoped out is presented in **Table 2.8**.

Table 2.8: Issues scoped out of the assessment

Activity	Potential effects scoped out of the assessment
Construction Phase	
UXO clearance	Effects related to any potential UXO clearance works have been excluded, and if required would be subject to a separate licence application.
Injury and/or disturbance to fish and shellfish from vessel activities	Collision risk is only likely to be a risk to species which spend extended periods on the surface (e.g. basking sharks). This impact has therefore been scoped out of the assessment for all fish species, other than basking shark.
Decommissioning phase – in situ	No effects are expected to occur as a result of de-energising and leaving cables in-situ. The scoping out of decommissioning phase – in situ concurs with scoping opinion given in **Table 2.5**: Summary of Scoping Responses

Study Area

2.4.6 The Fish and Shellfish Ecology Study Area (herein referred to as study area) comprises the Offshore Cable Corridor with a 30 km buffer area (Volume 3, Figure 2.1, of the PEIR). It is anticipated that this study area will allow for robust characterisation of the mobile fish and shellfish species, as well as encompassing the Zone of Influence (ZoI) for both underwater noise and suspended sediments.

Methodology for Baseline Studies

Desk Studies

2.4.7 Baseline data collection has been undertaken to obtain information on the extent, distribution and abundance of fish and shellfish species and associated spawning and nursery grounds within the study area. The data sources that have been collected and used to inform the fish and shellfish assessment are summarised in **Table 2.13**.

2.4.8 The baseline data sources identified in this chapter will remain under review and may be updated in response to feedback from relevant statutory and non-statutory consultees during the EIA process, or in response to new sources of information becoming available.

Site-Specific Surveys

2.4.9 Existing data from the desktop study is sufficient for the Proposed Development due to the presence of a number of recent marine and estuarine fish survey data sets (e.g. EA, 2024a and Lynam and Ribeiro, 2022). As such site-specific fish and shellfish surveys are not considered necessary. Site specific data collected as part of benthic characterisations provide further information on the fish and shellfish ecology of the area.

Impact Assessment Methodology

Overview

2.4.10 The approach to determining the significance of effects is a two-stage process that involves defining the sensitivity of the receptor and the magnitude of the impact. This section describes the criteria applied in this chapter to assign values to the magnitude of potential 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: EIA methodology, of the PEIR.

Receptor Sensitivity/Value

2.4.11 The criteria for defining the value of fish and shellfish IEFs are outlined in **Table 2.9** below. To incorporate value into the assessment it has been included as part of the sensitivity criteria outlined in **Table 2.10**. It should be noted, however, that conservation value and high sensitivity are not necessarily linked for a particular effect. For example, a receptor could be of international or national importance (e.g. an interest feature of a protected site) but have a low or negligible physical/ecological sensitivity to an impact and vice versa. Consequently, when determining the sensitivity level taken forward to assessment this taken into account habitat and species-specific considerations and professional judgement.

Table 2.9. Value criteria for fish and shellfish receptors

Value	Definition
International	Internationally designated sites. Species protected under international law (e.g. Annex II species listed as qualifying interests of Special Area of Conservation (SACs)).
National	Nationally designated sites. Species protected under national law. Annex II species which are not listed as qualifying interests of SACs in the study area. Critically Endangered or Endangered on IUCN Red list. Important prey item for other species of conservation or commercial value.
Regional	Spawning and/or nursery grounds within the study area. High commercial importance within the Study Area.
Local	No spawning or nursery grounds within the study area. Some or no commercial importance within the study area.

2.4.12 Definitions for sensitivity have been informed by the Marine Evidence based Sensitivity Assessment (MarESA). Sensitivity is quantified via a consideration of its context (vulnerability and recoverability) and value. **Table 2.10** sets out the criteria used in defining the sensitivity of the identified fish and shellfish IEFs. Definitions of time periods have been defined from the MarESA assessments. Five defined levels of sensitivity have been determined (Very High, High, Medium, Low or Negligible) and where one of the definitions, for a given level, is met then this will determine the level of sensitivity assigned. Where a receptor could reasonably be assigned more than one level of sensitivity, professional judgement has been used to determine which level is applicable.

Table 2.10: Sensitivity criteria for fish and shellfish receptors

Sensitivity	Definition
Very High	Vulnerability: The receptor cannot avoid, adapt or tolerate the impact. Recoverability: The effect on the receptor is anticipated to be permanent. Value: The receptor is of international value.
High	Vulnerability: The receptor cannot or has very low capacity to avoid, adapt or tolerate the impact. Recoverability: Partial recovery is only likely to occur after about 10 years and full recovery may take over 25 years. Value: The receptor is of international or national value.
Medium	Vulnerability: The receptor has limited capacity to avoid, adapt or tolerate the impact. Recoverability: Only partial recovery is likely within 5 years and full recovery is likely to take up to 10 years. Value: The receptor is of national or regional value.
Low	Vulnerability: The receptor has a reasonable capacity to avoid, adapt or tolerate the impact. Recoverability: Full recovery will occur but will take many months (or more likely years) but should be complete within about five years. Value: The receptor is of regional or local value.
Negligible	Vulnerability: The receptor has a high capacity to avoid, adapt or tolerate the impact. Recoverability: The receptor is anticipated to recover immediately (seconds to days). Value: The receptor is of local value.

Magnitude of Impact

2.4.13 The criteria for defining magnitude in this chapter are outlined in **Table 2.11** below. Definitions have been informed by CIEEM (2018). Where one of the definitions, for a given level, is met then this will determine the level of magnitude assigned. Where an impact could reasonably be assigned more than one level of magnitude, professional judgement has been used to determine which level is applicable.

Table 2.11: Impact magnitude criteria for fish and shellfish receptors

Magnitude of impact		Definition
High	Adverse	**Extent:** Impact across the near-field and far-field areas beyond the study area. **Duration:** The impact is anticipated to be permanent or long term (>5 years). **Frequency:** The impact will occur constantly throughout the relevant project phase. **Consequences:** Permanent changes to key characteristics or features of the particular environmental aspect's character or distinctiveness
	Beneficial	**Extent:** Impact across the near-field and far-field areas beyond the study area. **Duration:** The impact is anticipated to be permanent or long term (>5 years). **Frequency:** The impact will occur constantly throughout the relevant project phase.

Magnitude of impact		Definition
		Consequences: Permanent improvement to key characteristics or features of the particular environmental aspect's character or distinctiveness
Medium	Adverse	**Extent:** The maximum extent of the impact is restricted to the far-field (i.e., the defined study area). **Duration:** The impact is anticipated to be medium term (1-5 years) or long term (>5 years). **Frequency:** The impact will occur constantly throughout a relevant project phase. **Consequences:** Noticeable change to key characteristics or features of the particular environmental aspect's character or distinctiveness.
	Beneficial	**Extent:** The maximum extent of the impact is restricted to the far-field (i.e., the defined study area). **Duration:** The impact is anticipated to be medium term (1-5 years) or long term (>5 years). **Frequency:** The impact will occur constantly throughout a relevant project phase. **Consequences:** Noticeable improvement to key characteristics or features of the particular environmental aspect's character or distinctiveness.
Low	Adverse	**Extent:** The maximum extent of the impact is restricted to the near-field and adjacent far-field areas. **Duration:** The impact is anticipated to be short term (<1 year). **Frequency:** The impact will occur frequently throughout a relevant project phase. **Consequences:** Barely discernible to noticeable change to key characteristics or features of the particular environmental aspect's character or distinctiveness.
	Beneficial	**Extent:** The maximum extent of the impact is restricted to the near-field and adjacent far-field areas. **Duration:** The impact is anticipated to be short term (<1 year). **Frequency:** The impact will occur frequently throughout a relevant project phase. **Consequences:** Barely discernible to noticeable improvement to key characteristics or features of the particular environmental aspect's character or distinctiveness.
Negligible	Adverse	**Extent:** The maximum extent of the impact is restricted to the near-field and immediately adjacent far-field areas. **Duration:** The impact is anticipated to be momentary (seconds to minutes) to brief (lasting less than one day). **Frequency:** The impact will occur once or infrequently throughout a relevant project phase. **Consequences:** No discernible to barely discernible change to key characteristics or features of the particular environmental aspect's character or distinctiveness.
	Beneficial	**Extent:** The maximum extent of the impact is restricted to the near-field and immediately adjacent far-field areas. **Duration:** The impact is anticipated to be momentary (seconds to minutes) to brief (lasting less than one day). **Frequency:** The impact will occur once or infrequently throughout a relevant project phase. **Consequences:** No discernible to barely discernible improvement to key characteristics or features of the particular environmental aspect's character or distinctiveness.
No change		Impact is expected to result in no change.

Significance of Effect

2.4.14 The significance of the effect upon fish and shellfish has been determined by taking into account the sensitivity of the receptor and the magnitude of the impact. The method employed for this assessment is presented in **Table 2.12**. Where a range of significance levels is presented, the final assessment for each effect is based upon expert judgement.

2.4.15 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.

2.4.16 For the purpose of this assessment, any effects with a significance level of minor or less are not considered to be significant in terms of the EIA Regulations.

Table 2.12: Assessment Matrix

Sensitivity of Receptor	Magnitude of Impact				
	No Change	**Negligible**	**Low**	**Medium**	**High**
Negligible	No Change	Negligible	Negligible or Minor	Negligible or Minor	Minor
Low	No Change	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	No Change	Negligible or Minor	Minor	Moderate	Moderate or Major
High	No Change	Minor	Minor or Moderate	Moderate or Major	Major
Very High	No Change	Minor	Moderate or Major	Major	Major

2.4.17 Where the magnitude of impact is 'no change', no effect would arise.

2.4.18 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.

Assumptions and Limitations of the Assessment

2.4.19 The data sources used in this chapter are detailed in **Table 2.13**. The desktop data used are the most up to date publicly available information which can be obtained from the applicable data sources as cited. Data that has been collected is based on existing literature, consultation with stakeholders and identification of habitats to inform likely fish and shellfish species.

2.4.20 Coull *et al*. (1998) and Ellis *et al*. (2012) are considered the key references for providing broad scale overviews of the potential extent and distribution of spawning and nursery grounds for a select number of fish species. These publications provide an indication of the general location of spawning and nursery grounds from various sources, do not define precise spatial boundaries and may fail to account for recent spatio-temporal changes in spawning and nursery behaviour. Additionally, the spawning times given in these publications represent the maximum duration of spawning on a species/stock basis. In some cases, the duration of spawning may be much more contracted, on a site-specific basis, than reported in Coull *et al*. (1998) and Ellis *et al*. (2012).

2.4.21 A conservative approach has been taken in terms of spawning and nursery grounds from Coull *et al*. (1998) and Ellis *et al*. (2012), with any species with overlapping spawning and nursery grounds according to either Coull *et al*. (1998) or Ellis *et al*. (2012) being considered as IEFs. For those species with high habitat dependencies and selectivity, the potential extent of their spawning and nursery grounds has also been informed by site specific benthic survey data and existing habitat mapping data sets. For mackerel and horse mackerel, two pelagic species with little dependency on benthic habitats, the International Council for the Exploration of the Sea (ICES) mackerel and horse mackerel egg survey data set was visualised to further confirm the potential presence of their spawning grounds, with survey data available up to 2022. Close *et al*. (2019) dataset of fish egg surveys conducted in 2016 was also utilised to visualise the presence of fish eggs and larvae for several species and to further confirm the potential presence of their spawning grounds.

2.4.22 Lynam and Ribeiro (2022) collated data set of scientific beam and otter trawls has been used as a key reference for defining the likely presence of fish and shellfish species within the Study Area. Otter and beam trawls are considered appropriate methods for surveying benthic and demersal fish species; however, are not as appropriate for characterising pelagic species. Therefore, it is possible that some pelagic species have not been identified as locally abundant within the Study Area. However, the comprehensive desktop study completed across the Study Area has considered additional data sources which have characterised pelagic species, such as the Marine Management Organisation (MMO) landing statistics and scientific publications. Therefore, the IEFs set out are robust for the purposes of the impact assessment.

2.5 Baseline Environment

Desk Study

2.5.1 Information on fish and shellfish ecology within the study area was collected through a detailed review of existing studies and datasets. These are summarised in **Table 2.13**.

Table 2.13: Summary of baseline desk study sources

Title	Source	Year	Author
European Marine Observation and Data Network (EMODnet)	European Marine Observation and Data Network (EMODnet)	2024	European Commission
A data product derived from Northeast Atlantic groundfish data from scientific trawl surveys 1983-2020	CEFAS	2022	Lynam and Ribeiro
The National Fish Populations Database (NFPD)– Transitional & coastal water fish surveys	NFPD	2024a	Environment Agency (EA)
NFPD – Freshwater fish surveys	NFPD	2024b	Environment Agency (EA)
UK sea fisheries annual statistics	Marine Management Organisation (MMO)	2023	MMO
Spawning and nursery grounds of selected fish species in UK waters	CEFAS	2012	Ellis *et al*.,
Spurdog, porbeagle and common skate bycatch and discard reduction. Fisheries Science Partnership 2011–2012, Final Report.	CEFAS	2012	Bendall *et al*.,
Preliminary observations on the biology and movements of porbeagle Lamna nasus around the British Isles.	Bendall *et al*.,2013	2013	Bendall *et al*.,
Short-term movements and diving behaviour of satellite-tracked blue sharks Prionace glauca in the northeastern Atlantic Ocean.	Queiroz *et al*., 2010	2010	Queiroz *et al*.,
The Marine Conservation Society Basking Shark Watch 20-year report (1987-2006).	Marine Conservation Society	2006	Bloomfield and Solandt,
Spatial distribution patterns of basking sharks on the European shelf: preliminary comparison of satellite-tag geolocation, survey and public sightings data.	Southall *et al*., 2005	2005	Southall *et al*.,
Seasonal movements and behaviour of basking sharks from archival tagging: no evidence of winter hibernation.	Sims *et al*., 2003	2003	Sims *et al*.,
Fisheries Sensitivity Maps in British Waters	CEFAS	1998	Coull *et al*.,
Geographic information about the natural environment from across government.	Department for Environment Food and Rural Affairs (Defra) Magic Map	Various	Defra

Physical Environment

2.5.2 From the landfall location south of the Taw-Torridge Estuary, the Offshore Cable Corridor extends North of Devon and Cornwall and West of the Isles of Scilly. The sediment type is predominantly Sand off the coast of the landfall and Taw-Torridge Estuary (Defra, 2016; EMODnet, 2024). The Offshore Cable Corridor consists predominantly of sand, muddy sand, mixed sediment and coarse sediment. However, it contains a broad range of sediment and habitat types, including *Sabellaria spinulosa* tube aggregations and circalittoral rock (Volume 3, Chapter 1: Benthic Ecology). Rocky habitats are also present within adjacent areas such as East of Haig Fras, Bideford to Foreland Point Marine Conservation zone (MCZ) and around Lundy Island (Defra, 2016; Clare *et al*., 2020; EMODnet, 2024).

2.5.3 The water depths along the Offshore Cable Corridor generally range from 100 to 125 m in the south and 75 to 100m in the north. Surface suspended sediment concentrations (SSC) range from averages of approximately 10 mg/l at the landfall site to 1 mg/l at the EEZ (CEFAS, 2016). Wave and current conditions also vary across the Offshore Cable Corridor, with typical wave heights of 0 to 2.5 m in the shallow waters of Bideford Bay and 0 to 6.5 m in deep waters of the Western extent. Currents typically range from 0.58 to 5.83 m/s in the shallow coastal waters and 0.1 to 0.72 m/s in the deep waters (Volume 3, Chapter 8: Physical Processes, of the PEIR).

2.5.4 Further information on the baseline physical environment can be found in Volume 3, Chapter 1: Benthic Ecology and Volume 3, Chapter 8: Physical Processes, of the PEIR.

Finfish

2.5.5 Benthic and demersal finfish of commercial importance within the Study Area include hake *Merluccius merluccius*, megrim *Lepidorhombus whiffiagonis*, anglerfish *Lophius* sp., haddock *Melanogrammus aeglefinus*, lemon sole *Microstomus kitt*, sole *Solea solea*, turbot *Scophthalmus maximus* and plaice *Pleuronectes platessa* (Lynam & Ribeiro 2022; MMO, 2023). Pelagic species of commercial importance include horse mackerel *Trachurus trachurus*, mackerel *Scomber scombrus*, herring *Clupea harengus* and sprat *Sprattus sprattus*.

2.5.6 Beam trawls conducted between 2016 and 2020 within the Study Area identified an abundance of demersal fish species, including poor cod *Trisopterus minutus*, haddock, whiting *Merlangius merlangus* and hake. Abundant benthic fish species included megrim, lemon sole, dab *Limanda limanda*, common dragonet *Callionymus lyra* and grey gurnard *Eutrigla gurnardus*. Flatfish species were noted as particularly diverse with additional flatfish species caught including sole, thickback sole *Microchirus variegatus*, scald fish *Arnoglossus laterna*, Norwegian topknot *Zeugopterus norvegicus*, plaice, witch *Glyptocephalus cynoglossus* and brill *Scophthalmus rhombus* (Lynam & Ribeiro, 2022). Volume 1, Chapter 3, of the PEIR, provides specific assessment of Commercial Fisheries.

2.5.7 Beam trawl, otter trawl and seine net surveys conducted within the Estuarine regions of the Rivers Taw and Torridge (5 km from landfall) between 2007 and 2023 identified an abundance of sea bass *Dicentrarchus labrax,* sand smelt *Atherina presbyter,* lesser sand eel *Ammodytes tobianus,* thicklip grey mullet *Chelon labrosus* and goby (*Pomatoschistus microps* and *Pomatoschistus minutus*). Additionally, otter trawls caught an abundance of herring, sprat and whiting, and beam trawls caught an abundance of plaice. Other species of note included flounder *Platichthys flesus*, horse mackerel, greater sand eel *Hyperplus lanceolatus* and pollack *Pollachius pollachius* (EA, 2024a).

2.5.8 Five species of sandeel exist within UK waters; smooth sandeel *Gymnammodytes semisqumatus*, lesser sand eel, raitts sand eel *Ammodytes marinus*, greater sandeel and corbins sandeel *Hyperoplus immaculatus*. Greater sandeel, corbins sandeel and lesser sand eel have been identified within the Study Area (Lynam & Ribeiro, 2022; EA, 2024a), however given all five species are widely distributed across the UK it is likely that all five species may occur within the Study Area. Sandeels represent an important link between the lower and upper levels of the marine food web, making up a major component of many species' diet, including sea birds, marine mammals and other fish species (Wilson and Hammond, 2019; Rindorf *et al*., 2000).

2.5.9 Atlantic herring is a commercially important pelagic species and numerically abundant in the North Atlantic. In the north east Atlantic, they are found from the northern Bay of Biscay to Greenland and into the Barents Sea (Hauser *et al*., 2001). Atlantic herring were abundant during otter trawls conducted within the Taw-Torridge estuary in September of 2015 and 2018 (EA, 2024a). Furthermore, while MMO landings statistics indicate a lack of commercial Atlantic herring catches across the majority of the Study Area, a high landed weight was recorded in ICES rectangle 30E4 (directly North-West of Padstow) during 2022 (MMO, 2023).

2.5.10 Other commercially important pelagic species within the Study Area include horse mackerel, sprat and mackerel. All three species are highly migratory, migrating from over wintering grounds to spawning grounds. There are records of horse mackerel and mackerel being commercially caught throughout much of the Study Area, with horse mackerel being the highest commercially caught species by weight (MMO, 2023). Furthermore, otter trawls conducted in the Taw-Torridge estuary caught an abundance of horse mackerel during September 2016 and 2018 and an abundance of mackerel during September 2017 (EA, 2024a). The MMO landings statistics indicate little commercial catches of sprat across the Study Area, however trawls within the Taw-Torridge Estuary indicated an abundance of sprat in 2015, 2016 and 2018.

Elasmobranchs

2.5.11 Elasmobranchs are fish with a skeletal structure composed of cartilage, and many are listed on the International Union for Conservation of Nature (IUCN) Red List (IUCN, 2023). Species of skate and ray previously found across the Offshore Cable Corridor include common skate complex *Dipturus batis*, shagreen ray *Leucoraja fullonica*, cuckoo ray *Leucoraja naevus*, blonde ray *Raja brachyura*, thornback ray *Raja clavata*, small eyed ray *Raja microocellata*, spotted ray *Raja montagui* and deep-water ray *Rajella bathyphila* (Lynam & Ribeiro 2022; MMO, 2023). Beam trawls conducted between 2016 and 2020 within the Study Area identified an abundance of common skate and cuckoo ray, and otter trawl surveys conducted in the Taw-Torridge Estuary between 2013 and 2019 noted small eyed ray (EA, 2024a). Of these species, common skate is listed as Critically Endangered on the IUCN Red List, with Shagreen ray, blonde ray, thornback ray and small eyed ray being listed as Near Threatened.

2.5.12 There is evidence that "common skate" is not a single species but represents two genetically distinct species: the flapper skate *Dipturus intermedius* and the common blue skate *D. batis* (Bache-Jeffreys *et al*., 2021; Garbett *et al*., 2021). The two species differ in size and distribution, with *D. intermedius* being more abundant in coastal waters. Both species are listed as Critically Endangered on the IUCN red list. Moreover, although this species is mobile and capable of swimming large distances, research has found that site fidelity is an important aspect of their ecology and life history (Garbett *et al*., 2021). 'Common skate' are located off the coasts of Isle of Scilly, western British Channel, west and north Ireland and west Scotland. They prefer habitats characterised by sands and mud. The adults are typically found at depths between 10 and 600 m whereas juveniles exhibit a preference for shallower waters (Neal and Pizzolla, 2006). There are numerous records of 'common skate' within the Study Area, between 1998 and 2020, from commercial net bycatch records and scientific trawls (Bendall *et al*., 2012; Lynam & Ribeiro *et al*., 2022).

2.5.13 Small catches of undulate rays *Raja undulata* have been recorded across the Study Area (MMO, 2023) and there are records of electric ray *Torpedo marmorata* from trawls conducted off the North coast of Cornwall (Lynam & Ribeiro, 2022). However, records are sparse and as such the Study Area is considered unlikely to support large populations of undulate ray or electric ray.

2.5.14 Shark species recorded in the Study Area include lesser spotted catshark *Scyliorhinus canicula*, tope *Galeorhinus galeus*, spurdog *Squalus acanthias*, nursehound *Scyliorhinus stellaris* and smoothhound *Mustelus* sp. (Bendall *et al*., 2012; Lynam & Ribeiro 2022; MMO, 2023). Lesser spotted catshark was noted as particularly abundant during beam trawls conducted between 2016 and 2020 within the Study Area (Lynam and Ribeiro, 2022). Spurdog is listed as Endangered on the IUCN Red List, nursehound and starry smoothhound *Mustelus asterias* is listed as Near Threatened and Tope and common smoothhound *Mustelus mustelus* are listed as Vulnerable.

2.5.15 Spurdog is a globally distributed species found within inshore and offshore areas of temperate waters (Pawson and Ellis, 2005; Compagno, 1984). They are highly migratory throughout their geographical range (Vince, 1991), however, evidence suggests high site association and residency for some areas (Thorburn *et al*., 2015). Spurdog are listed as Endangered on the IUCN Red List and subpopulations in the northern hemisphere are listed under Appendix II of the Convention on Migratory Species (CMS). There are numerous records of spurdog within the southern end of the Study Area (west and south west of Isles of Scilly), between 1998 and 2020, from commercial net bycatch records and scientific trawls (Bendall *et al*., 2012; Lynam & Ribeiro *et al*., 2022).

2.5.16 Basking sharks are a highly mobile migratory species with migration routes covering large distances from the north of Scotland to North Africa, and occasionally between the UK and America (Johnston *et al.*, 2019). Geolocations from tagged sharks, survey sightings and public sightings indicate an abundance of basking sharks around the coast of Devon and Cornwall and in the East Celtic Sea, including within the Study Area (Southall *et al*., 2005; Bloomfield and Solandt, 2006; Doherty *et al*., 2017; de Boer *et al*., 2018). Basking sharks are listed as Endangered on IUCN Red List and protected under various international conventions including Convention on the Conservation of Migratory Species (CMS) (Bonn Convention) and the United Nations Convention of the Law of the Sea (UNCLOS).

2.5.17 Other species of large migratory shark likely to occur within the Study Area include blue shark *Prionace glauca* and porbeagle *Lamna nasus*. Blue shark and porbeagle are both highly migratory pelagic shark species. Both species have been found within the Study Area. There are multiple records across the years of porbeagle in the Eastern Celtic Sea and off the coasts of North Cornwall and South-West Wales (Pade *et al*., 2009; Bendall *et al.,* 2012; 2013), with Pade *et al*. (2009) finding localised occupation by several sharks during July and August between North Cornwall and South-West Wales. There are multiple records of blue sharks off the South coasts of Cornwall and Devon (Queiroz *et al*., 2010; de Boer *et al*., 2018; MMO, 2023). Neither blue shark or porbeagle spend significant time at the surface, with blue shark occupying mean nighttime depths of 74 m and mean day time depths of 412 m (Campana *et al*., 2011). Porbeagle are listed as Critically Endangered on the IUCN red list and blue shark as Near Threatened. Both species are listed on Appendix II of the CMS and Appendix II of the Convention on International Trade in Endangered Species (CITES).

Shellfish

2.5.18 Shellfish communities contribute to the biodiversity of the benthic ecosystem and are an important link in the marine food web, both as predators and prey. Key commercial species within the study area include common whelk *Buccinum undatum*, brown crab *Cancer pagurus*, king scallops *Pecten maximus,* European lobster *Homarus gammarus* and nephrops *Nephrops norvegicus* (MMO, 2023). Other commercially important species include spider crab *Maja brachydactyla*, cuttlefish (*Sepia* sp.), Octopus (*Eledone cirrhosa* & *Octopus vulgaris*), Squid (various species), crawfish *Palinurus elephas* and velvet swimming crabs *Necora puber* (MMO, 2023)

2.5.19 Beam trawls conducted along the Offshore Cable Corridor between 2016 and 2020 have indicated an abundance of common cuttlefish *Sepia officinalis*, velvet swimming crab, king scallop, brown crab and European lobster within the Study Area (Lynam & Ribeiro, 2022). Other commercially important shellfish species caught during these beam trawls include queen scallop *Aequipecten opercularis*, long-finned squid *Loligo forbesi*, common squid *Alloteuthis subulata* and elegant cuttlefish *Sepia elegans*.

2.5.20 The whelk is an epibenthic mobile gastropod that inhabits a wide range of habitat types. This species is widely distributed across the UK with MMO landings data between 2018 and 2022 for the ICES rectangles that intersect the Proposed Development indicating whelk as the second highest landed species by weight (Volume 3, Chapter 3: Commercial Fisheries, of the PEIR; MMO, 2023).

2.5.21 European lobsters and brown crab are widespread across all British and Irish coasts (Jackson, 2021), with European lobster occupying mainly rocky habitat types and brown crab occupying a range of habitat types. Both species are widespread across the Study Area (Lynam and Ribeiro, 2022; MMO, 2023).

2.5.22 Crawfish are predominantly located off the west coast of Scotland and the extreme south west coasts of England and Wales and the west coast of Ireland (Jackson, 2021), whereby they occupy rocky habitat types. Crawfish were previously overfished in the UK leading to local extinctions in the 1960s and 1970s, however have since shown signs of recovery (Leslie and Shelmerdine, 2012; Jackson, 2021). Crawfish are a listed feature of Bideford to Foreland Point MCZ which overlaps with the Study Area. Records of crawfish are sparse across the Study Area, however the MMO landings statistics and scientific trawls (Lynam and Ribero, 2022) indicate an abundance of crawfish in ICES rectangle 28E3, which encompasses the Isles of Scilly and a proportion of the Study Area.

2.5.23 One record of slipper lobster *Scyllarus arctus* exists from a trawl conducted in 2016. Slipper lobsters are considered rare occurrences within UK waters (Quigley *et al*., 2010) and therefore the Study Area is considered unlikely to be occupied by an abundance of this species.

2.5.24 The king scallop is located along the European Atlantic coast from northern Norway, south to the Iberian Peninsula and has been recorded off West Africa, the Azores, Canary Islands and Madeira. In Britain and Ireland, it is distributed around most UK coasts. They prefer areas of clean sand, fine or sandy gravel and may occasionally be found on muddy sand (Marshall and Wilson, 2008). Records of king scallop are widespread across the Study Area (Lynam and Ribeiro, 2022; MMO, 2023).

2.5.25 Mapped Nephrops grounds can be found approx. 20 km west of the Offshore Cable Corridor at ICES statistical rectangles 28E2 and 29E3 (Doyle *et al*., 2011). Additional records of Nephrops caught in trawls exist 5 km east of the Offshore Cable Corridor in ICES rectangle 28E3 and 28 km West in ICES rectangle 27E2 (Lynam & Ribeiro, 2022) and within the East of Haig Fras MCZ (Clare *et al*., 2020). Nephrops are restricted to muddy habitats in which they create and occupy burrows. Campbell *et al*. (2009) found Nephrops to occur in sediments with a 10-100% mud component (mud – muddy sand), but were absent in areas comprising almost entirely of sand. The Offshore Cable Corridor comprises mostly of sands and gravels, however areas of muddy sand are present along the southern and most offshore half of the Offshore Cable Corridor. Nephrops are likely to occur within discrete areas along the Offshore Cable Corridor, with the Study Area overlapping larger areas of Nephrops habitat.

2.5.26 Cephalopods identified within the area include long finned squid, common squid, common cuttlefish, elegant cuttlefish, European squid *Loligo vulgaris*, curled octopus and common octopus. All these species are highly mobile, which undertake seasonal migrations along the coastline or to and from inshore spawning and offshore foraging grounds (Sims *et al*., 2001; Bloor *et al*., 2013). All these species are short lived and are widely distributed across the UK. However, the common cuttlefish and elegant cuttlefish are mainly found along the south and west coasts of Britain and the common octopus reaches its northern limit in South-West Britain (Tyler-Walters and Hiscock, 2024).

2.5.27 Blue mussel *Mytilus edulis* occur within the Taw-Torridge Estuary (Parkhouse *et al*., 2021). This species can be found in coastal areas as well as estuaries, often forming beds of live mussels and dead shells (Norling and Kautsky, 2007). They occur from the high intertidal to the shallow subtidal, attached to hard substrates (e.g., rocks) or softer sediments (e.g., sand) by fibrous byssus threads (Stounberg *et al*., 2024). Site specific surveys (e.g. benthic grabs and geophysical surveys) have indicated an absence of mussel beds along the Offshore Cable Corridor.

Diadromous

2.5.28 Diadromous species are those which move between the marine environment and freshwater at different stages of their life cycle and thus they may migrate along or through the Study Area. The Severn Estuary and Bristol Channel is home to several diadromous species including allis shad, twaite shad, Atlantic salmon, sea trout, river lamprey, sea lamprey and European eel (Potter *et al*., 2001; Davies *et al*., 2020; EA, 2024b). Atlantic salmon, European eel, brown/sea trout, river lamprey and twaite shad also occur within the Taw-Torridge Estuary and connected tributaries, the mouth of which is located 4.7 km north of the Landfall and is within the Study Area (Davies *et al*., 2020; EA, 2024a; 2023b). With the exception of sea trout and eels, all of these migratory fish species are listed on Annex II of the Habitats Directive (Council Directive 92/43/EEC) which makes provision for their protection through designation of Special Areas of Conservation

(SACs). No SACs designated for diadromous species are within the Study Area, however a number of SACs and Ramsar sites designated for diadromous species exist within the Severn Estuary / Bristol Channel and adjacent areas.

2.5.29 European eel spawn in the Sargasso sea and migrate to European waters, arriving at the coast as glass eels and elvers during the winter and early spring, with upstream migrations into freshwater in spring and early summer (Mann and Welton, 1995; Wright *et al.*, 2022). After spending a number of years in freshwater adult silver eel begin their seaward migration between late summer and early winter to return to the Sargasso sea to spawn, migrating a distance of 5000 to 10,000 km (Lowe, 1952; Wright *et al.*, 2022). Eels have been recorded within the Taw-Torridge Estuary and associated tributaries during electric fishing surveys in 2021, 2022 and 2023, and seine net surveys during 2016 and 2023. Eels in the UK are protected by The Eels (England and Wales) Regulations (2009) which protect eels and ensures that their movement into inland waters is not obstructed. Eels are also included in Section 41 of the NERC Act 2006 and The Salmon and Freshwater Fisheries Act 1975.

2.5.30 Twaite and allis shad spawn in freshwater environments migrating to sea at age-0 during autumn and winter and returning to estuarine and riverine environments during spring to early summer (Maitland and Hatton-Ellis, 2003; Baglinière *et al*., 2003; Hillman, 2003). Twaite shad can migrate distances in excess of 950 km from their birth river, and evidence suggests the use of estuarine and nearshore habitats by a subset of twaite shad year-round, including the Taw-Torridge Estuary within the Study Area (Davies *et al*., 2020). Records of allis and twaite shad exist across the Celtic Sea and south west coast and within many of the Devon and Cornwall rivers, including the Taw-Torridge Estuary (Hillman, 2003; Lynam & Ribeiro, 2022; EA, 2024b). Both Allis and twaite shad are listed in Annexes II, and Annex V of the EU Habitats and Species Directive. Twaite and allis shad are listed in Appendix III of the Bern Convention. Both twaite and allis shad are included in Section 41 of the NERC Act 2006, twaite shad are protected under schedule 3 of the Conservation (Natural Habitats, &c.) Regulations 1994, both species are protected under schedules 5 of the Wildlife and Countryside Act 1981 and Section 1 and 2 of The Salmon and Freshwater Fisheries Act 1975.

2.5.31 Sea lamprey *Petromyzon marinus* spawn in freshwater environments and migrate to sea, usually at a minimum of 5 years old, during summer and autumn months after undergoing metamorphosis (Froese and Pauly, 2023; Renaud, 2011). Sea lamprey return upstream between May and July to spawn (Maitland 2003 as referenced in Davies *et al*., 2021). Similarly to sea lamprey, river lamprey spawn in freshwater environments and migrate to the sea after metamorphosis (Froese and Pauly, 2023). They return to freshwater, often after spending 1 to 2 years in the marine environment, from April to May (Froese and Pauly, 2023; Renaud, 2011). Lamprey (*Lampetra* sp. and Petromyzontidae) have been recorded within the tributaries associated with the Rivers Taw and Torridge in 2021 and 2022 (EA, 2024b). Both sea and river lamprey are protected by Appendix III of the Bern Convention, Annexes II, and Annex V of the EU Habitats and Species Directive, Section 41 of the NERC Act 2006 and The Salmon and Freshwater Fisheries Act 1975.

2.5.32 Atlantic salmon spawn in freshwater environments usually in November and December and migrate to sea between 1 and 7 years old during the spring or early summer (OSPAR, 2010; CSTP, 2016). They return back to the streams between June and November (Thorstad *et al*. 2011), with notable variation between local populations. Sea trout spawn in freshwater environments and migrate to sea between 1 and 5 years old during spring and early summer

(Gargan *et al*. 2006; CSTP, 2016; Thorstad *et al*. 2016). The return upstream from sea may occur over several months of the year. Atlantic salmon and brown/sea trout have been recorded within the Taw-Torridge associated tributaries during electric fishing surveys in 2021, 2022 and 2023. Additionally, Atlantic salmon and sea trout have been recorded with the River Camel Estuary (14 km from the Study Area). Atlantic salmon are protected by Appendix III of the Bern Convention, Annexes II, and Annex V of the EU Habitats and Species Directive. Salmon and trout are listed in Section 41 of the NERC Act 2006 and The Salmon and Freshwater Fisheries Act 1975.

Spawning and Nursery Grounds

2.5.33 A number of fish species are known to have spawning and/or nursery areas in the Study Area. Data from the Centre for Environment, Fisheries and Aquaculture Science (Cefas) (Ellis *et al*., 2012) and fisheries sensitivity maps (Coull *et al*., 1998) provides spatial estimates of the nursery/spawning areas for key species.

2.5.34 Spawning grounds are defined as areas where species produce eggs. The Study Area (and Offshore Cable Corridor) overlaps with spawning grounds for cod, hake *Merluccius merluccius*, horse mackerel, ling *Molva molva*, mackerel, plaice, sand eel, sole, whiting *Merlangius merlangus*, lemon sole, sole and sprat (Coull *et al*., 1998; Ellis *et al*., 2012). All of these species spawn throughout much of their UK range (Coull *et al*., 1998; Ellis *et al*., 2012). Spawning periods and the intensity (broad degree of utilisation) of the spawning grounds for these species are given in **Table 2.14**, with figures showing spatial overlap with the Study Area in Volume 3, Figures 2.2-2.4, of the PEIR.

2.5.35 The presence of mackerel and horse mackerel spawning grounds along the Offshore Cable Corridor is further collaborated by the ICES mackerel and horse mackerel egg surveys (ICES, 2023) and Cefas Ichthyoplankton Analysis Data from 2016 (Close *et al*., 2019), with Cefas Ichthyoplankton Data also collaborating the presence of sprat, whiting, lemon sole and hake spawning grounds.

Table 2.14: Intensity of spawning grounds that overlap the Study Area.

Species	Overlap with Spawning Grounds	Intensity	Spawning period (Peak spawning)
Cod	Offshore Cable Corridor	High	January – April (February – March)
Hake	Offshore Cable Corridor	Low	January – June (February – March)
Horse mackerel	Offshore Cable Corridor	Low	March – August (May – June)
Ling	Offshore Cable Corridor	Low	February - May
Mackerel	Offshore Cable Corridor	High and Low	March – July (May – June)
Plaice	Offshore Cable Corridor	High	December – March (January – February)
Sand eel	Offshore Cable Corridor	High	November – February
Sole	Offshore Cable Corridor	High	March – May (April)

Species	Overlap with Spawning Grounds	Intensity	Spawning period (Peak spawning)
Whiting	Offshore Cable Corridor	Low	February – June
Lemon sole	Offshore Cable Corridor	Undetermined	April - September
Sprat	Offshore Cable Corridor	Undetermined	May – August (May – June)
Nephrops	Study Area	Undetermined	Year round (April – June)

2.5.36 Nursery grounds are defined as areas occupied by young fish or shellfish. The Study Area (and Offshore Cable Corridor) overlaps with nursery grounds for anglerfish *Lophius piscatorius*, blue whiting *Micromesistius poutassou*, common skate, hake, ling, mackerel, plaice, sand eel, sole, spotted ray, spurdog, thornback ray, tope, whiting and lemon sole (Coull *et al*., 1998; Ellis *et al*., 2012). Nursery grounds for these species occur through much of their UK range (Coull *et al*., 1998; Ellis *et al*., 2012). It is noted however that nursery grounds for common skate occur over much of the west coast of Ireland and Scotland, with the Proposed Development only overlapping a small proportion at the southern end of the accepted nursery grounds. Intensity of the nursery grounds are given in **Table 2.15**, with figures of spatial overlap with the Study Area within Volume 3, Figures 2.2-2.6, of the PEIR.

2.5.37 Nephrops spawning and nursery grounds are located 8 km west in ICES rectangle 29E3 within the Study Area, but do not overlap with the Offshore Cable Corridor (Coull *et al*., 1998; Volume 3, Figure 2.4, of the PEIR). As suggested in **paragraph 2.5.25**, the Offshore Cable Corridor is likely to contain discrete areas of Nephrops.

Table 2.15: Intensity of nursery grounds that overlap the Study Area.

Species	Overlap with nursery grounds	Intensity
Angler fish	Offshore Cable Corridor	High and Low
Blue whiting	Offshore Cable Corridor	Low
Common skate	Offshore Cable Corridor	Low
Hake	Offshore Cable Corridor	Low
Lemon sole	Offshore Cable Corridor	Undetermined
Ling	Offshore Cable Corridor	Low
Mackerel	Offshore Cable Corridor	High and Low
Plaice	Offshore Cable Corridor	Low
Sand eel	Offshore Cable Corridor	Low
Sole	Offshore Cable Corridor	Low
Spotted ray	Offshore Cable Corridor	Low
Spurdog	Offshore Cable Corridor	Low
Thornback ray	Offshore Cable Corridor	Low
Tope	Offshore Cable Corridor	Low
Whiting	Offshore Cable Corridor	Low

Species	Overlap with nursery grounds	Intensity
Nephrops	Study Area	Undetermined

2.5.38 Sandeel spawning and nursery grounds overlap with the Study Area (and Offshore Cable Corridor) (Coull *et al*., 1998; Ellis *et al*., 2012). Sandeel have very specific habitat requirements for medium to coarse sand with little mud and gravel content (Wright *et al*., 2000; Holland *et al*., 2005). To further characterise the likely presence of sandeel and the value of the habitats along the Offshore Cable Corridor for sandeel spawning and nursery, potential sandeel habitats were mapped using site specific PSA data. The methodology followed that detailed in Latto *et al*. (2013), to identify areas of preferred, marginal and unsuitable habitat for sand eel. The majority of the habitat types present along the Offshore Cable Corridor were assigned as sand to gravelly sand (Folk classification) and therefore assigned as Preferred habitat for sandeels (Volume 3, Figure 2.7, of the PEIR).

Identification of designated sites

2.5.39 All designated sites within the Study Area with qualifying interest features relevant to fish and shellfish, that could be affected by the Proposed Development are set out in **Table 2.16**. Despite the Severn Estuary SAC falling outside the Study Area, the designated features of this SAC have been included due to a proven level of connectivity with twaite shad in the Severn Estuary and Taw-Torridge Estuary (Davies *et al*., 2020).

Table 2.16: Designated sites and relevant qualifying interests

Designated Site	Distance to the Proposed Development Site	Relevant Qualifying Interest
Bideford to Foreland Point MCZ	0.5 km	Spiny lobster (*Palinurus elephas*)
East of Haig Fras MCZ	0.65 km	Fan mussel (*Atrina fragilis*)
Lundy MCZ	3.5 km	Spiny lobster (*Palinurus elephas*)
Taw-Torridge SSSI	5 km	European eel (*Anguilla anguilla*)
Taw-Torridge shellfish water protected area	5 km	Shellfish
Severn Estuary SAC	78 km	Sea lamprey (*Petromyzon marinus*) River lamprey (*Lampetra fluviatilis*) Twaite shad (*Alosa fallax*)

2.5.40 It is noted that fan mussel *Atrina fragilis* is a designated feature of the East of Haig Fras MCZ (Volume 3, Figure 2.8, of the PEIR). As a non-commercial shellfish species, the impacts of the Construction, Operation and Maintenance and Decommissioning of the Proposed Development on this receptor has been assessed within Volume 3, Chapter 1: Benthic Ecology, of the PEIR.

2.5.41 Pembrokeshire Marine, Carmarthen Bay and Estuaries and Severn Estuary SAC are all designated for diadromous fish species and are located outside of the Study Area (Volume 3, Figure 2.8, of the PEIR).

2.5.42 The results of the fish and shellfish impact assessment (reported within this PEIR chapter) have been used to inform the assessment of potential impacts on conservation objective 3 of the Bristol Channel Approaches SAC (i.e. 'The condition of supporting habitats and processes, and the availability of prey is maintained'). The conservation objective 3 assessment is presented in the HRA Screening report that accompanies the PEIR.

Future Baseline Conditions

2.5.43 Rising sea temperatures, ocean acidification, ocean deoxygenation and rising sea levels have been identified as key stressors that are affecting marine communities and reducing ecosystem resilience (European Environmental Agency, 2023). There are numerous models covering the UK which simulate possible climate change scenarios and the UKCP18 (Defra 2019) Climate Projections indicate there could be increases in mean summer temperatures in the longer term and milder winters (influencing sea water temperature), changes in rainfall distribution and seasonality, more extremes of weather and sea level rise (Defra 2019).

2.5.44 The baseline environment will exhibit some degree of natural change over time, even if the Proposed Development was not to proceed. A key consideration in assessing the future baseline conditions is the influence of climate change on fish and shellfish communities. Climate change has the potential to alter fish and shellfish species distribution and abundance. For example, by altering spawning periods, growth, maturation and migratory cues. There is evidence of an increase in the abundance of Lusitanian fauna (organisms traditionally found in warmer waters such as European anchovy) and a reduction in the abundance of Boreal species such as eelpout due to changes in water temperature (Wright *et al.,* 2020).

2.5.45 In addition to climate change, overfishing is a key pressure affecting fish and ecosystems across the globe, including within the Study Area. Overfishing can reduce the biomass and as a result the spawning population of target and non-target species. Overfishing can therefore lead to reduced resilience and adaptability of a species to other stressors such as climate change (Sumaila and Tai, 2020). Since the mid-1990s, fishing pressures on fish stocks have shown an overall reduction (ICES, 2022). The Study Area falls within the Celtic Seas Ecoregion. According to ICES (2022), species in ICES area VIIf that are considered to either have a poor stock size or are subject to high fishing pressures include bass, cod, haddock, horse mackerel, mackerel, Norway lobster, porbeagle and whiting (ICES, 2022).

2.5.46 Changes in market demand, fish quotas, key legislation, fish availability and technical advancements to the commercial fishing industry can affect population sizes of both target and non-target species. For example, key legislation such as the landings obligations has had a substantial effect on the composition of landed fish over time and unwanted catches (bycatch) can be reduced through using more selective gear types (Catchpole *et al*., 2017). Therefore, even if the Proposed Development was not to proceed, populations of fish and shellfish species are expected to vary over time as a result of the dynamic nature of the commercial fishing industry.

2.5.47 The return of rare or threatened species could occur as a result of improved management and conservation. For example, sturgeon are considered to be a diadromous species inhabiting marine, estuarine and freshwaters around the UK. However, sturgeon sightings around the UK have become increasingly rare, with only two sightings recorded in UK rivers and estuaries and 20 sightings recorded in UK marine waters since 1990 (McCormick *et al*., 2023). Plans to help re-establish the sturgeon populations around the UK and Europe are currently underway through various measures such as re-introduction efforts, bycatch reduction and habitat restoration (McCormick *et al*., 2023).

2.5.48 The establishment of invasive species is a persistent threat that can quickly alter ecosystems and local / regional biodiversity. Invasive species may be transferred to the Study Area through a variety of mechanisms, such as ships ballast waters, imports and exports and natural migration linked to climate change (Hulme, 2009). For example, American lobster *Homarus americanus* predominantly occurs along the east coast of North America and Canada; however, escapes from holding facilities have led to populations establishing across the UK coast (Stebbing *et al*., 2012; Barrett *et al*., 2020). The introduction of American lobster may impact directly upon shellfish species within the Study Area via displacement and competition with native species and via genetic dilution (hybridisation with native European lobster).

Key Receptors

2.5.49 **Table 2.17** identifies the receptors taken forward into the assessment.

Table 2.17: Key receptors taken forward to assessment

Receptor	Description	Value	Justification
Shellfish species	Whelk	Regional	Species of high commercial value.
	Brown crab		
	King Scallops		
	Lobster		
	Cephalopods	Local	Species of commercial value.
	Blue mussels	Local	
	Crawfish	National	Species of commercial value. Listed feature for Bideford to Foreland point and Lundy MCZ.
	Nephrops	Regional	Species of high commercial value. Spawning and nursery ground overlapping Study Area but not Proposed Development.
Pelagic fish species	Horse mackerel	Regional	Species of high commercial value. Spawning grounds overlapping Study Area and Proposed Development.
	Mackerel		Species of commercial value. Spawning and nursery grounds overlapping Study Area and Proposed Development.
	Sprat		Species of commercial value. Spawning grounds overlapping Study Area and Proposed Development.
	Herring	Local	Species of commercial importance
Demersal	Pollack	Regional	Species of commercial value.
	Cod		Species of commercial value. Spawning grounds overlapping Study Area and Proposed Development.
	Hake		Species of commercial value.

Receptor	Description	Value	Justification
	Ling		Spawning and nursery grounds overlapping Study Area and Proposed Development.
	Whiting		
	Blue whiting		Species of commercial value. Nursery grounds overlapping Study Area and Proposed Development.
Benthic	Sand eel	National	Spawning and nursery grounds overlapping Study Area and Proposed Development. Important link in food chain.
	Plaice	Regional	Species of commercial value Spawning and nursery grounds overlapping Study Area and Proposed Development
	Sole		
	Lemon sole		
	Megrim		Species of commercial value
	Anglerfish		Species of commercial value Nursery grounds overlapping Study Area and Proposed Development
	Other benthic species	Local	Species with some or very little commercial value.
Elasmobranchs	Common skate	International	Nursery grounds overlapping Study Area and Proposed Development. Critically Endangered on IUCN red list.
	Spotted ray	Regional	Species of commercial value. Nursery grounds overlapping Study Area and Proposed Development.
	Thornback ray		
	Other skates and rays	Local	Species of commercial value
	Spurdog	Regional	Species of commercial value. Nursery grounds overlapping Study Area and Proposed Development. Endangered on Europe IUCN Red List.
	Tope	International	Species of commercial value. Nursery grounds overlapping Study Area and Proposed Development. Critically endangered on global IUCN Red List.
	Lesser spotted dog fish	Local	Species of commercial value
	Smoothound		
	Basking shark	International	Endangered on IUCN Red List.
	Porbeagle	International	Critically Endangered on IUCN Red List. Listed on Appendix II of the CMS and Appendix II of CITES.
	Blue shark	International	Appendix II of the CMS and CITES.
Diadromous	Atlantic salmon	International	Likely to migrate through the Proposed Development. Listed on Annex II and V of the Habitats Directive. Protected by Appendix III of the Bern Convention.

Receptor	Description	Value	Justification
			Included in Section 41 of the NERC Act. Protected under the Salmon and Freshwater Fisheries Act.
	Sea trout	Local	Likely to migrate through the Proposed Development. Included in Section 41 of the NERC Act. Protected under the Salmon and Freshwater Fisheries Act.
	Sea lamprey	International	Likely to migrate through the Proposed Development. Listed on Annex II and V of the Habitats Directive. Protected by Appendix III of the Bern Convention. Included in Section 41 of the NERC Act. Protected under the Salmon and Freshwater Fisheries Act.
	River lamprey	International	Likely to migrate through the Proposed Development. Listed on Annex II and V of the Habitats Directive. Protected by Appendix III of the Bern Convention. Protected under the Salmon and Freshwater Fisheries Act.
	Twaite shad	International	Likely to migrate through the Proposed Development. Listed on Annex II and V of the Habitats Directive. Listed on Appendix II of the Bern Convention. Included in Section 41 of the NERC Act. Protected under Schedule 3 of the Conservation (Natural Habitats, &c.) Regulations. Protected under schedules 5 of the Wildlife and Countryside Act. Protected under Section 1 and 2 of The Salmon and Freshwater Fisheries Act.
	Allis shad	International	Likely to migrate through the Proposed Development. Listed on Annex II and V of the Habitats Directive. Listed on Appendix II of the Bern Convention. Included in Section 41 of the NERC Act. Protected under schedules 5 of the Wildlife and Countryside Act. Protected under Section 1 and 2 of The Salmon and Freshwater Fisheries Act.
	European Eel	International	Likely to migrate through the Proposed Development. Protected by The Eels Regulations. Included in Section 41 of the NERC Act.

Receptor	Description	Value	Justification
			Protected under The Salmon and Freshwater Fisheries Act.

2.6 Key Parameters for Assessment

Maximum Design Scenario

2.6.1 The maximum design scenarios identified in **Table 2.18** 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 PEIR. 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., lesser disturbance footprint), to that assessed here be taken forward in the final design scheme. Therefore, this comprises a conservative assessment of a worst-case scenario.

Table 2.18: Maximum design scenario considered for the assessment of potential impacts

Potential Impact	Phase[1]					Maximum Design Scenario	Justification
	C	Op	Op repair	D_{insitu}	$D_{removal}$		
Temporary habitat loss / disturbance	Yes	No	Yes	No	Yes	**Construction phase** Temporary habitat loss / disturbance as a result of sandwave clearance, boulder clearance, pre-lay ploughing and seabed debris removal: • 7,400,000 m² footprint for sandwave clearance, use of Mass flow excavation and/or seabed surface plough. Precautionary estimate assuming clearance along 50% of Offshore Cable Corridor (20 [w] x 370,000 [l] x 2 [n] x 50%). Seabed surface plough with swath width of 10-20 m wide. • 6,000,000 m² for boulder clearance, pre-lay plough with swath width of 10-15 m assumed across approximately 200 km of the cable route (15 [w] x 200,000 [l] x 2 [n]). • 740,000 m² for max (precautionary) seabed debris removal, pre-lay grapnel run with 1 m width and at maximum penetration depth of 1 m (1 [w] x 370,000 [l] x 2 [n]). • 11,100,000 m² for max (precautionary) pre-lay trench ploughing with disturbance width of 15 m (15 [w] x 370,000 [l] x 2 [n]). Habitat loss as a result of cable burial / rock protection: • Burial techniques including trench ploughing, trench jetting or mechanical trench excavation. • Mechanical trenching, ROV on seabed with footprint up to 126 m² (10 m width and 12.6 m length) • For water jetting ROV, seabed footprint of up to 55.2 m² (6 m width and 9.2 m length) • Cable spacing 50 – 180 m between the two bundles • Trench width of 0.5 to 1.5 m	Maximum effect of temporary habitat loss / disturbance will occur as result of the maximum area of seabed disturbed. Temporary habitat loss / disturbance does not factor in in-service cables which would be covered in rock protection and therefore has been factored into habitat alteration and long-term habitat loss.

Potential Impact	Phase[1]					Maximum Design Scenario	Justification
	C	Op	Op repair	Dinsitu	Dremoval		
						• Cable burial across entire length, with estimated up to 150 km of the Offshore Cable Corridor requiring potential additional rock protection (i.e. 300 km in total) • Needed at crossing of x21 existing in-service cables Habitat loss as a result of removal of out of service cables and associated rock protection: • 28 out of service cable crossings (cutting and removal of existing cables assumed to be within the maximum construction disturbance footprints above) Habitat loss as a result of the use of jack-up vessels at the HDD • Maximum of two jack-up vessels required (assumed to be less than the associated sediment removal area below). Habitat loss as a result of excavations at HDD exit pits, if required: • Localised excavations using either a back-hoe dredger (long arm barge mounted excavator), mass flow excavation (MFE) or a Trailing Suction Hopper Dredger (TSHD). Sediment will be removed from an area of approximately 15 m x 15 m around the (x4) exit points **Operational phase repair activities** • De-burial and re-burial of cable failure points across two 370 km bundled cables. (Infrequent, isolated repair activities.) **Decommissioning phase (removal)** • Cables would be removed.	
	Yes	No	Yes	No	Yes	**Construction phase**	

Potential Impact	Phase[1]					Maximum Design Scenario	Justification
	C	Op	Op repair	D_{insitu}	$D_{removal}$		
Temporary increase in suspended sediments and sediment deposition						Temporary seabed disturbance as a result of sandwave clearance, boulder clearance, pre-lay ploughing and seabed debris removal: • 7,400,000 m² footprint for sandwave clearance, use of Mass flow excavation and/or seabed surface plough. Precautionary estimate assuming clearance along 50% of Offshore Cable Corridor (20 [w] x 370,000 [l] x 2 [n] x 50%). Seabed surface plough with swath width of 10-20 m wide. • 6,000,000 m² for boulder clearance, pre-lay plough with swath width of 10-15 m assumed across approximately 200 km of the cable route (15 [w] x 200,000 [l] x 2 [n]). • 740,000 m² for max (precautionary) seabed debris removal, pre-lay grapnel run with 1 m width and at maximum penetration depth of 1 m (1 [w] x 370,000 [l] x 2 [n]). • 11,100,000 m² for max (precautionary) pre-lay trench ploughing with disturbance width of 15 m (15 [w] x 370,000 [l] x 2 [n]). Seabed disturbance as a result of cable burial: • Burial techniques including trench ploughing, trench jetting or mechanical trench excavation. • Mechanical trenching, ROV on seabed with footprint up to 126 m² (10 m width and 12.6 m length) • For water jetting ROV, seabed footprint of up to 55.2 m² (6 m width and 9.2 m length) • Cable spacing 50 – 180 m between the two • Trench width of 0.5 to 1.5 m • Cable burial across entire length, with estimated up to 150 km of route requiring potential additional rock protection • Target cable burial depth of 1.5 m	Maximum effect of increased suspended sediments and sediment deposition will occur as result of the maximum area and volume of seabed disturbed.

Potential Impact	Phase[1]					Maximum Design Scenario	Justification
	C	Op	Op repair	D_{insitu}	$D_{removal}$		
						Increase in suspended sediments as a result of disturbance at out of service and in-service cables and associated rock protection: • 28 out of service cable crossings • 21 in-service cable crossings Seabed disturbance as a result of the use of jack-up vessels at the HDD • Maximum of two jack-up vessels required (assumed to be less than the associated sediment removal area below). Habitat loss as a result of excavations at HDD exit pits, if required: • Localised excavations using either a back-hoe dredger (long arm barge mounted excavator), mass flow excavation (MFE) or a Trailing Suction Hopper Dredger (TSHD). Sediment will be removed from an area of approximately 15 m x 15 m around the (x4) exit points **Operational phase repair activities** • De-burial and re-burial of cable failure points across two 370 km bundled cables. (Infrequent, isolated repair activities.) **Decommissioning phase (removal)** Cable would be removed.	
Injury and disturbance from noise and vibration	Yes	No	Yes	No	Yes	**Construction phase** • Cable installation activities will be undertaken on a 24 hour/7-day basis. • Activities will include seabed clearance, dredging, HDD and cable burial.	Noise and vibration assessment presented as PEIR Volume 3, Appendix 4.1.

Potential Impact	Phase[1]					Maximum Design Scenario	Justification
	C	Op	Op repair	D_{insitu}	$D_{removal}$		
						Operational phase repair activities • De-burial and reburial of cables at failure points	
						Decommissioning phase (removal) • Cables would be removed.	
Electromagnetic field (EMF) effects	No	Yes	Yes	No	No	**Operational phase and Operational phase repair activities** • 4x 525 kV HVDC cables (175 mm in diameter) installed as bundled pairs. • Cable burial across entire length, with estimated up to 150 km of route requiring potential additional rock protection • Target burial depth of 1.5 m (average minimum depth of 0.8 m)	Maximum EMF values emitted from cable and extent of the EMFs will occur as a result of the maximum cable voltage, distance from the seafloor and length of the cable.
Habitat alteration and long-term habitat loss	No	Yes	Yes	Yes	No	**Operational phase and Operational phase repair activities** 597,000 m^2 of habitat alteration / long term habitat loss as a result of: Additional rock protection across cables equating to a estimated maximum rock protection footprint of 450,000 m^2 (225,000 m^2 per cable bundle): • Rock protection across a maximum of 150 km of cable. • Rock protection assumed 1.5 m wide. Rock protection over in-service cable crossings equating to a maximum rock protection footprint of 147,000 m^2: • 21 in service cable crossings • Maximum rock protection footprint of 3,500 m2 per crossing (7 m wide and 500 m long) • 2 cable bundles	Maximum effect of habitat alteration and long term habitat loss will result from the maximum area of seabed covered by rock protection.
	Yes	No	Yes	No	Yes	**Construction phase**	

Potential Impact	Phase[1]					Maximum Design Scenario	Justification
	C	Op	Op repair	Dinsitu	Dremoval		
Collision risk to basking shark from vessel activities (operational-repair)						Presence of up to 32 vessels on site at any one time (noting not all in same location): • 20 Guard vessels stationed every 10 nautical miles (nm) • 2 Rock placement vessels • 1 CLV (two for brief periods during changeovers) • 4 Trenching vessels • 2 Pre-installation survey vessels • Up to 2 jack up / multi-cat vessels **Operational phase repair activities** • Vessels to support unplanned maintenance and repair, as needed **Decommissioning phase (removal)** • Assumed to be similar in nature to that of construction	Maximum impact from collision to basking sharks will result from the maximum number of vessels that will be on site at any one time.
Changes to water quality from resuspension of sediments	Yes	No	Yes	No	Yes	**Construction phase** • As per Temporary increase in suspended sediments and sediment deposition **Operational phase repair activities** • As per Temporary increase in suspended sediments and sediment deposition **Decommissioning phase** • As per Temporary increase in suspended sediments and sediment deposition	Maximum effects of changes to water quality as a result of resuspension of suspended sediments will results from the maximum amount of disturbance and chemical composition of the sediment.
Changes to water quality as a result of accidental pollution	Yes	No	Yes	No	Yes	**Construction phase** Presence of 32 vessels on site at any one time: • 20 Guard vessels stationed every 10 nautical miles (nm) • 2 Rock placement vessels • 1 CLV (two for brief periods during changeovers) • 4 Trenching vessels	The greatest likelihood of accidental pollution will result from the maximum number of vessels on site at any one time. The Maximum Design Scenario also considers the release of bentonite from HDD.

Potential Impact	Phase[1]					Maximum Design Scenario	Justification
	C	Op	Op repair	Dinsitu	Dremoval		
						• 2 Pre-installation survey vesselsUp to 2 jack up / multi-cat vessels Release of bentonite during HDD **Operational phase repair activities** Presence of: • One survey vessel to undertake routine surveys once a year for the first 5 years of operation, then every 5 years for the remainder of the cable lifetime • Vessels to support unplanned maintenance and repair, as needed **Decommissioning phase (removal)** • Assumed to be similar in nature to that of construction	
Change in hydrodynamic regime	No	Yes	Yes	No	No	• Operational phase and Operational Phase repair activitiesAs above for 'Habitat alteration and long-term habitat loss'.	The maximum change in hydrodynamic regime will result from the maximum area and height of rock protection.
Sediment heating	No	Yes	Yes	No	No	**Operational phase and Operational Phase repair activities** • 4 525 kV HVDC cables (175 mm in diameter) with a length of 370 km.	The maximum heat change will result from the maximum cable voltage. Maximum extent of heat change will result from the maximum length of the cable bundles.
Introduction of invasive non-native species	Yes	No	Yes	No	Yes	**Construction phase** • 20 Guard vessels stationed every 10 nautical miles (nm) • 2 Rock placement vessels • 1 CLV (two for brief periods during changeovers) • 4 Trenching vessels • 2 Pre-installation survey vessels • Up to 2 jack up / multi-cat vessels	The most likely pathway for INNS is via vessel activities, therefore the maximum number of vessels will represent the maximum risk of introduction of INNS.

Potential Impact	Phase[1]					Maximum Design Scenario	Justification
	C	Op	Op repair	D_{insitu}	$D_{removal}$		
						Operational phase repair activities • 1 Survey vessel equipped with ROV, MBES, SSS and magnetometer	
						Decommissioning phase (removal) • Assumed to be similar in nature to that of construction	

[1] C=Construction phase, Op=Operational phase, Op_{repair}=Operational phase repair activities, $D_{in\text{-}situ}$=Decommissioning phase assuming cable de-energised and left *in-situ,* D_{remove}=Decommissioning phase assuming cable removed

2.7 Mitigation Measures Adopted as Part of the Proposed Development

2.7.1 As part of the project design process, a number of embedded mitigation measures have been proposed to reduce the potential for impacts on fish and shellfish (**Table 2.19**). This approach has been employed to demonstrate commitment to measures by including them in the design of the Project, and have therefore been considered in the assessment presented in **sections 2.8, 2.9** and **2.10**. These measures are largely considered standard industry practice for this type of development. Assessment of sensitivity, magnitude and therefore significance includes implementation of these measures.

2.7.2 The mitigation measures proposed as part of the Proposed Development include the following types of mitigation:

- Primary (inherent) mitigation – measures included as part of the Proposed Development design. The Institute of Environmental Management and Assessment (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 Proposed Development 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 Proposed Development and the parameters secured in the DCO and/or marine licences. For example, a reduction in footprint or height.
- 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 an environmental management plan.
- 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 the Offshore Construction Environmental Management Plan (an outline Offshore CEMP is provided as PEIR Volume 1, Appendix 3.3, which will continue to be developed and submitted as part of the DCO application).

Table 2.19: Mitigation measures adopted as part of the Proposed Development

Measure Adopted	How the Measure Will be Secured
Primary mitigation	
Cable burial	Cables will be buried (where possible) to a target depth of 1.5 m below the seabed, subject to a detailed CBRA.
Secondary mitigation	
N/A	
Tertiary mitigation	

Measure Adopted	How the Measure Will be Secured
Ballast Water Management	All ships subject to the Ballast Water Management Convention (2017) requirements will be obliged to conduct ballast water management in accordance with the contractual provisions and those within the Convention.
Offshore Construction Environmental Management Plan (CEMP)	An Offshore CEMP will detail the best practice approach to offshore activities and would implement those measures and environmental commitments identified in the EIA. The following measures will be included in the Offshore CEMP: marine pollution prevention; waste management; marine invasive species; and dropped object procedures. An Outline Offshore CEMP will form part of the DCO (with a final Offshore CEMP finalised by offshore contractor). A draft outline Offshore CEMP is provided at PEIR stage, as Volume 1, Appendix 3.3, of the PEIR.
MARPOL	To further minimise the risk of accidental spillage of hazardous materials, regulations that implement MARPOL and its various annexes and protocols will be followed.
HDD drill fluid system	The use of an HDD drill fluid system that allows for the monitoring of pressure loss and therefore allows for the rapid identification of potential break outs. Also use of self-sealing platelet grout lubricants (to minimise risk of break out).
Vessel Management Plan (VMP)	The VMP will confirm the types and numbers of vessels that would be engaged on the Proposed Development and consider vessel coordination including indicative transit route planning. Pre-requisite contractor requirement – secured via final Offshore CEMP.

2.8 Preliminary Assessment of Construction Effects

2.8.1 The impacts of the construction of the Proposed Development have been assessed. The potential preliminary impacts arising from the construction phase of the Proposed Development are listed in **Table 2.18**, along with the maximum design scenario against which each impact has been assessed.

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

Temporary habitat loss / disturbance

2.8.3 Temporary habitat loss / disturbance associated with the Proposed Development may occur during the construction phase as a result of a range of activities including the use of jack-up vessels during HDD installation activities, preparation of the seabed along the route of and ahead of the cable lay, and burial of the offshore cables.

Sensitivity of the Receptor

2.8.4 Species with wholly pelagic life cycles are expected to have very little interaction with the benthic environment and as such no impact pathway is expected for these IEFs. Therefore, the sensitivity of horse mackerel, sprat, mackerel, basking shark, porbeagle and blue shark has been assessed as **negligible**. The Offshore Cable Corridor overlaps with spawning grounds for many species which have pelagic eggs (**Table 2.14;** Volume 3, Figures 2.2-2.4). Given the lack of an impact pathway the eggs of these pelagic spawners are also not expected to be affected by habitat loss.

2.8.5 Mobile species (most fish and cephalopods) with broad habitat preferences are expected to be able to avoid the associated temporary impact, occupy nearby undisturbed suitable habitat and then quickly recolonise the area upon cessation of activities. Nursery grounds for a number of species overlap with the Offshore Cable Corridor. Juvenile fish are expected to show some level of mobility, albeit less so than their adult counterparts. Furthermore, any loss of nursery grounds would be small in the context of their wider nursery ground areas.

2.8.6 Species with stationary eggs and/or restricted habitat preferences are expected to be less adaptable and more vulnerable to the loss of spawning and nursery grounds. Lemon sole, while mobile in nature, are much more selective of their habitat type than similar flatfish species such as plaice and sole (Heinz *et al*., 2003; 2006), with Heinz *et al*., (2003) hypothesising that habitat selection may be influenced by the availability of suitable small prey items given their small mouth size. The Study Area encompasses a broad range of habitat types, and therefore despite lemon soles more restrictive habitat preferences, they are expected to be able to find suitable habitat nearby. Lemon sole are considered to have a medium vulnerability (some ability to avoid the impact and accommodate the change), high recoverability and are of regional value. This receptor is therefore assessed as **medium** sensitivity.

2.8.7 The Offshore Cable Corridor overlaps with high intensity spawning grounds and low intensity nursery grounds for sandeel. Sandeel are selective on their habitat, with a preference for medium to coarse sand with little mud and gravel content (Wright *et al*. 2000; Holland *et al*. 2005). Furthermore, sandeel lay benthic eggs which adhere to the sand and the adults spend much of the year buried into the sand, and as such can be considered as stationary receptors across at least part of their life cycle. Preferred habitat for sandeel (sand to gravelly sand) is extensive across the Study Area and wider reaches (EMODnet, 2023; Volume 3, Figure 2.7), and therefore the loss of habitat along the Offshore Cable Corridor will be small in the context of the wider area which they utilise. Considering their stationary life stages, sandeel are deemed to be of high vulnerability, high recoverability (mobile adults will quickly recolonise the area) and are of national value. They have been assessed as **medium** sensitivity.

2.8.8 Other species with benthic eggs which may spawn along the Offshore Cable Corridor include many species of skate and shark. Eggs of these species are often long lived, with common skate eggs taking approximately 17 months to hatch (Benjamins *et al*. 2021), thornback ray eggs taking 4-6 months and lesser spotted catshark eggs taking 5-11 months (Pawson and Ellis, 2005). During this time their eggs are completely stationary and therefore are vulnerable to habitat loss. Elasmobranch eggs are either deposited on soft sediments or attached to hard substrata (Smith and Griffiths, 1997), and while the full distribution of their spawning grounds is unknown it is very probable that they spawn within the Study

Area. However, loss of elasmobranch eggs is only expected to affect a small number of individual eggs, given the wider context of available potential spawning grounds within the Study Area. Therefore, these receptors are deemed to have some ability to avoid the impact as adults (medium vulnerability), medium recoverability and are of local to international importance. These IEFs are considered to be of **medium** sensitivity.

2.8.9 Diadromous fish species migrating through the Proposed Development may utilise the benthic habitats, however, are unlikely to be within the vicinity for extended times. Given their highly mobile nature they are expected to be able to avoid the impact (low vulnerability), therefore diadromous fish have been assessed as **low** sensitivity.

2.8.10 Sessile or low mobility species, such as many species of shellfish, are expected to be particularly vulnerable to habitat loss. The Marine Evidence based Sensitivity Assessment (MarESA) database was reviewed to determine the potential sensitivity of key shellfish species in the Study Area. The MarESA assessment suggests that king scallops and Nephrops have a Moderate sensitivity to substratum loss due to being intolerant to the impact. However, all species have a moderate to high recoverability rate (Mensink *et al*., 2000). There is no MarESA assessment for whelks. King scallops and whelks have an ability to avoid the impact, albeit only by moving small distances, and are expected to quickly re-colonise the area. They are of low vulnerability, high recoverability and are of regional value and therefore, have been assessed as **low** sensitivity.

2.8.11 The Study Area overlaps with spawning and nursery grounds for Nephrops, however these do not overlap with the Offshore Cable Corridor. Nephrops are mobile but are likely to seek refuge within burrows instead of moving away from and avoiding the impact. Furthermore, this species takes several years to reach sexual maturation. Nephrops are considered to be of moderate vulnerability, moderate recoverability and are of regional value. They have been assessed as **medium** sensitivity.

2.8.12 Brown crab are mobile and occupy a wide range of habitat types. European lobster and crawfish, while also mobile, occupy rocky habitat types, which may take longer to recover from habitat loss than soft sediment habitats (Newell *et al*. 1998; Desprez, 2000). However, rocky habitats are numerous across the wider reaches and therefore habitat loss is unlikely to result in the huge loss of available European lobster and crawfish habitat. Brown crab and European lobster are of regional importance and are widespread and abundant across the Study Area (Lynam and Ribeiro, 2022). Crawfish are of national importance but are not as widespread or abundant across the Study Area, which may be a result of them showing a preference for high elevation reefs (Giacalone *et al*., 2006). Habitat loss is therefore, only likely to impact a small number of individuals for crawfish.

2.8.13 The MarESA assessment assesses brown crab as having moderate sensitivity to substratum loss and crawfish as high sensitivity. There is no MarESA assessment for European lobster. Brown crab and European lobster are numerous across the Study Area and are expected to be able to have some ability to avoid the impact (albeit less so when compared to fish species) and will be able to occupy suitable habitats nearby, recolonising the affected area upon cessation of activities. They are considered as medium vulnerability, medium recoverability and are of regional value. They have been assessed as **medium** sensitivity.

2.8.14 Crawfish are not as numerous across the Study Area as European lobster and brown crab. However, they have more selective habitat preferences and are of national value. Temporary habitat loss is only likely to affect a small number of individuals (and an even smaller number of individuals which make up part of the Bideford to Foreland Point and Lundy MCZ population). Therefore, they have been considered as medium vulnerability and medium recoverability and have been assessed as **medium** sensitivity.

2.8.15 Blue mussel have been assessed by MarESA as having a high intolerance but a high recoverability to substratum loss (Tyler-Walters, 2008). Blue mussels do not occur in any great number across the Offshore Cable Corridor but do occur within the Taw-Torridge estuary and associated shellfish water protected area. Therefore, they are expected to be outside the ZoI for temporary habitat loss / disturbance and have been assessed as **negligible** sensitivity.

2.8.16 All other IEFs are highly mobile with broad habitat preferences and are expected to be able to avoid, tolerate and / or adapt to the impact (low vulnerability). They are of local to regional value and have been assessed as **low** sensitivity.

Magnitude of Impact

2.8.17 The Maximum Design Scenario presents the maximum extent of temporary habitat loss / disturbance as a result of sandwave clearance (7,400,000 m^2), boulder clearance and / or pre-lay surface ploughing (6,000,000 m^2), and seabed debris removal (740,000 m^2), and as a result of cable trenching activities (11,100,000 m^2). It should be noted however that these seabed area disturbance estimates are conservatively high, with associated precautionary assumptions associated. Furthermore, a portion of cable burial will occur within the same area previously disturbed by seabed preparation activities, and as such at least part of the Maximum design scenario (MDS) for cable burial would be repeat disturbance as opposed to disturbance of a new area.

2.8.18 Temporary habitat loss / disturbance will only affect a small number of the habitats present across the wider Study Area (<0.01%) and will be confined to within the Offshore Cable Corridor, and consequently within the Study Area and outside of designated sites. Construction works will take place during several months over approximately 3 years per cable bundle.

2.8.19 BERR (2008) reviewed a number of case studies from OWFs and concluded that sand will infill rapidly following ploughing or trenching, with coarse sediments either infilling immediately or leaving a shallow trough following ploughing or trenching. Sandy habitats are prevalent across the Offshore Cable Corridor and therefore habitats are expected to recover within the short term.

2.8.20 The Maximum design scenario (MDS) also factors in a maximum of 28 out of service cable crossings requiring removal and the presence of two jack-up vessels for HDD operations. The seabed area disturbed as a result of these activities is expected to be small when compared to the MDS for all other activities. Jack-up footprints will result in compression of seabed sediments beneath spud cans or tubular legs, however post-construction monitoring at Barrow OWF has demonstrated that depressions associated with jack-up operations quickly infill approximately one year after construction (BoWind, 2008).

2.8.21 The impact will affect the IEFs directly through removal or disturbance of individuals and indirectly due to the temporary loss of important habitats, such as foraging, nursery or spawning habitats. Habitat loss will be localised along the final cable route. The impact is therefore considered to be low in extent, frequent and medium term (will occur frequently within a given month across the construction period). The magnitude has therefore been assessed as **low**.

Significance of the Effect

2.8.22 The magnitude of the impact has been determined as **low**.

2.8.23 Pelagic IEFs and blue mussels have been determined as **negligible** sensitivity, therefore the effect will be of **negligible** significance, which is **not significant** in EIA terms.

2.8.24 Species with stationary benthic eggs and/or restricted habitat preferences have been determined as **medium** sensitivity, therefore the effect will be of **minor adverse** significance, which is **not significant** in EIA terms.

2.8.25 European lobster, brown crab and crawfish have been determined as **medium** sensitivity, therefore the effect will be of **minor adverse** significance, which is **not significant** in EIA terms.

2.8.26 All other IEFs have been determined as **low** sensitivity, therefore the effect will be of **minor adverse** significance, which is **not significant** in EIA terms.

Further Mitigation

2.8.27 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.8.28 No significant effects have been identified and there is no further monitoring proposed.

Temporary increase in suspended sediments and sediment deposition

2.8.29 Increases in SSC and associated sediment deposition will occur during the construction phase as a result of a range of activities, including sandwave clearance, boulder clearance and cable burial.

Sensitivity of receptor

2.8.30 Adult fish have a high mobility and can actively avoid areas high in suspended sediment concentration making them less vulnerable than juvenile fish and low mobility / sessile shellfish. Juvenile fish are likely to be present with nursery grounds for a number of species overlapping with the Offshore Cable Corridor and Study Area. Juvenile fish however, often naturally inhabit areas with high and/or variable levels of suspended sediment (Rijnsdorp and Stralen, 1985).

2.8.31 Diadromous fish are expected to show a high level of tolerance to increased levels of suspended sediments and deposition, given their migratory routes pass through areas with high and variable levels of suspended sediments. For example, the Severn Estuary can regularly be exposed to suspended sediment concentrations of >1000 mg/l (Bull, 1997), with concentrations varying by five fold over a 24 hour period (Rijnsdorp and Stralen, 1985). It is predicted that activities associated with the Proposed Development will produce temporary and short-lived increases in suspended sediment concentrations, with levels below those experienced in estuarine environments, such as in the nearby Severn estuary. It would therefore, be expected that any effects on diadromous species would be short lived behavioural effects (avoidance).

2.8.32 Eggs are non-mobile and therefore will not have the ability to avoid increased levels of suspended sediments or associated deposition, like their adult or juvenile counterparts. For those species that spawn within the Study Area, increased suspended sediment concentrations could reduce the buoyancy of pelagic fish eggs leading to fatalities (Westerberg *et al*., 1996). However, given their pelagic nature they would not be affected by sediment deposition. Species with benthic eggs may also be affected by increased levels of suspended sediments, with the effects varying depending on interspecific factors, sediment concentration levels and the composition of the suspended sediment (Kjelland *et al*., 2015). For example, Kiørboe *et al*. (1981) found no effect on development or hatching of herring eggs exposed to 5-500 mg/l of suspended sediments, whereas Griffin *et al*. (2009) found sub lethal and lethal effects on Pacific herring *Clupea Pallasi* eggs exposed to 250 and 500 mg/l of suspended sediment.

2.8.33 All fish IEFs are expected to be able to avoid the impact as adults and tolerate the impact during their egg and juvenile stages (given they naturally occur in areas with high levels of suspended sediments and deposition). They are considered of low vulnerability, high recoverability and local to international value and have been assessed as **Low** sensitivity.

2.8.34 Sessile/low mobility shellfish, such as whelk, blue mussels and scallops, may be vulnerable to increased suspended sediment concentrations and to sediment deposition as this can lead to clogged feeding apparatus and smothering. Whelk and scallops are slightly mobile and can travel short distances to avoid the impact, with whelk having the ability to burrow into sediments and scallops having the ability to lift themselves clear of any sediment deposition. There is no MarESA assessment for whelk, however MarESA have assessed king scallop as low sensitivity to increased suspended sediments and smothering (deposition). Therefore, low mobility shellfish IEFs are considered to be of low vulnerability (reasonable capacity to avoid or tolerate change), high recoverability and are of regional value, and have been assessed as **low** sensitivity.

2.8.35 Blue mussels occur in areas with naturally high and variable levels of suspended sediment (e.g. the Taw-Torridge estuary) and therefore are not expected to be effected by temporary increases in SSC or deposition. They have been assessed as not sensitive to increased suspended sediment by MarESA and having a low sensitivity to smothering. Therefore, blue mussels are considered to be of low vulnerability (high capacity to tolerate change), high recoverability and are of local value, and have been assessed as **negligible** sensitivity.

2.8.36 European lobster, crawfish and brown crab are mobile and are expected to be able to avoid areas high in suspended sediments and sediment deposition. However, increased suspended sediment could impact upon egg carrying individuals which require regular aeration of their eggs. The impact is only expected to affect a small number of ‘berried’ individuals and therefore European lobster, crawfish and brown crab are expected to show a medium level of tolerance and adaptability to the impact, high recoverability and are of regional to national value. They have been assessed as **low** sensitivity.

2.8.37 Nephrops occupy muddy habitats with naturally high levels of deposition. Given their burrowing behaviour they are also expected to be able to adapt to any increased levels of deposition. They have been assessed as **negligible** sensitivity.

2.8.38 Cephalopods are highly mobile and are expected to be able to avoid the impact, however their benthic eggs may be impacted by suspended sediment and deposition. They have been assessed as **low** sensitivity.

2.8.39 Basking sharks, porbeagle and blue shark are not expected to be impacted by increased levels of suspended sediments and deposition, given their highly mobile migratory nature. They have been assessed as **negligible** sensitivity.

Magnitude of impact

2.8.40 During construction a range of activities will disturb the seabed resulting in increased levels of SSC and associated increases in sediment deposition. The MDS assumes a range of seabed preparation activities including sandwave clearance, boulder clearance, seabed debris removal and pre-lay trenching. Also included within the MDS is the disturbance of sediments as a result of cable trenching (where bed conditions allow trenching/ excavation of the seabed to a target depth of 1.5 m will be undertaken) and HDD (localised 15 m x 15 m excavations at exit pits and use of jack-up vessels).

2.8.41 The distance and duration of SSC will depend upon factors such as particle size and water movement within the area (current and wave energy). For example, sand and gravels will settle rapidly and therefore any increases in SSC are small in extent. Silts on the other hand remain in suspension longer and as such any increases in SSC are greater in extent.

2.8.42 BERR (2008) reviewed a number of case studies that had modelled or monitored suspended sediment release and deposition during the construction of Offshore Wind Farms (OWF). They concluded that SSC and associated deposition resulting from cable burial operations are short term and localised, with the majority of sediment deposition falling immediately to the seabed. For example, for Norfolk OWF coarse sediments were modelled to deposit at a maximum extent of 200 m away from the disturbance, with 90% of SSC being deposited within 20 m. Modelling for Sheringham Shoal OWF, sandy gravel with low fines, found SSC to drop to less than 1 mg/l above baseline levels within a single ebb or flood tidal excursion (9 km in extent).

2.8.43 BERR (2008) also reviewed the SSC associated with various cable laying methods at Nysted OWF (Seacon, 2005 as referenced in BERR, 2008). They found SSC, 200 m away from the source, to be a maximum of 75 mg/l for trenching, 35 mg/l for backfilling and 18 mg/l for jetting.

2.8.44 The high-level sediment dispersion assessment, based on 2D depth averaged tidal currents with no inclusion of wave climate, found Fine Sand (wentworth) in depths between 10.1 m and 123.3 m to travel between approximately 0.05 and 3.8 km, with time in suspension ranging from 1 to 4 hours. For Very Fine Sand, in depths between 18.5 and 104.1 m, maximum distance travel ranged from approximately 2 km to 3.9 km, with time in suspension being 5 hours.

2.8.45 The physical processes assessments (Volume 3, Chapter 8, of the PEIR) confirm that, for the overwhelming majority of the time, local currents will not be sufficient to transport sediment plumes beyond the immediate vicinity of the disturbance activities.

2.8.46 The Taw-Torridge estuary (including shellfish water protected area) is located approximately 5 km from the Offshore Cable Corridor and therefore is outside the ZoI for increased levels of suspended sediments.

2.8.47 Temporary increases in suspended sediments and deposition are of low extent (restricted to within close proximity to the source), low duration, frequent and of low consequence. The magnitude has therefore been assessed as **low**.

Significance of effect

2.8.48 The magnitude of the impact has been determined as **low**.

2.8.49 Basking sharks, porbeagle, blue shark and blue mussels have been determined as **negligible** sensitivity, therefore the effect will be of **negligible** significance, which is **not significant** in EIA terms.

2.8.50 All other IEFs have been assessed as **low** sensitivity, therefore the effect will be of **minor adverse** significance, which is **not significant** in EIA terms.

Further Mitigation

2.8.51 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.8.52 No significant effects have been identified and there is no further monitoring proposed.

Injury and disturbance from noise and vibration

2.8.53 Underwater noise will be produced from a range of construction activities, including seabed preparations, HDD and cable burial.

Sensitivity of receptor

2.8.54 Underwater noise and vibration can cause several effects on fish and shellfish including:

- Behavioural effects (e.g. reduced detection of predators/prey, inhibited communication between conspecifics, alteration in swimming behaviour);
- Masking effects (i.e. the reduced detectability of a given sound owing to the simultaneous occurrence of another sound);
- Temporary threshold shift (TTS) in hearing (short or long-term changes in hearing sensitivity that may or may not reduce fitness);
- Recoverable tissue injury (not resulting in mortality e.g. minor internal or external hematoma); and
- Mortality or potential mortal injury (immediate or delayed death).

2.8.55 Hearing abilities of fish are related to the morphological adaptations of the acoustico-lateralis apparatus, in particular the distance of the swim bladder to the inner ear (Hastings & Popper, 2005; Mason, 2013). Species with no swim bladder have a lower hearing ability than many other fish species and rely on the detection of particle motion (the oscillatory displacement of fluid particles in a sound field) (Popper et al., 2014).

2.8.56 Fish species can broadly be characterised into four groupings based on their hearing abilities:

- Type 1 – Species with no swim bladder that rely on the detection of particle motion. They have a lower hearing ability than other groups.
- Type 2 – Species with a swim bladder that is not connected to the inner ear. They generally have a better level of hearing than Type 1 but also rely on the detection of particle motion.
- Type 3 – Species with a swim bladder that is involved in hearing (connected to the inner ear). They can detect both particle motion and sound pressure and can hear sounds over a far greater distance than other hearing groups.
- Type 4 – Fish eggs and larvae.

2.8.57 For fish, the most relevant criteria for injury are considered to be those defined by Popper *et al.* (2014). Popper *et al.* (2014) sets out criteria for effects arising from different sources of noise (**Table 2.20**). The criteria used within this assessment are associated with continuous noise; this may not be the case in reality but ensures a precautionary assessment. Where insufficient data exists to determine a quantitative value, the risk is categorised in relative terms as “high”, “moderate” or “low” at three distances from the source: “near” (i.e. in the tens of metres), “intermediate” (i.e. in the hundreds of metres) or “far” (i.e. in the thousands of metres).

Table 2.20: Mortality, potential injury, temporary threshold shift, masking and behaviour criteria for fish in relation to continuous noise (Popper et al. 2014). (N) nearfield – tens of metres, (I) intermediate – hundreds of metres, (F) far – thousands of metres.

Hearing category	Mortality and Potential Mortal Injury	Recoverable Injury	TTS	Masking	Behavioural Response
Type 1	**(N)** Low **(I)** Low **(F)** Low	**(N)** Low **(I)** Low **(F)** Low	**(N)** Moderate **(I)** Low **(F)** Low	**(N)** High **(I)** High **(F)** Moderate	**(N)** Moderate **(I)** Moderate **(F)** Low
Type 2	**(N)** Low **(I)** Low **(F)** Low	**(N)** Low **(I)** Low **(F)** Low	**(N)** Moderate **(I)** Low **(F)** Low	**(N)** High **(I)** High **(F)** Moderate	**(N)** Moderate **(I)** Moderate **(F)** Low
Type 3	**(N)** Low **(I)** Low **(F)** Low	170 dB_{rms} 1µPa for 48hrs	158 dB_{rms} 1µPa for 12hrs	**(N)** High **(I)** High **(F)** High	**(N)** High **(I)** Moderate **(F)** Low
Type 4	**(N)** Low **(I)** Low **(F)** Low	**(N)** Low **(I)** Low **(F)** Low	**(N)** Low **(I)** Low **(F)** Low	**(N)** High **(I)** Moderate **(F)** Low	**(N)** Moderate **(I)** Moderate **(F)** Low

Type 1 and 2 species

2.8.58 Those fish with no swim bladder (Type 1) or a swim bladder that is not involved in hearing (Type 2), are reported to be insensitive to sound pressure and are most likely to detect the particle motion element of sound (Popper et al., 2014).

2.8.59 Type 1 species found within the Study Area include mackerel, sand eel, flatfish, lampreys and elasmobranchs, and Type 2 include ling, blue whiting, Atlantic salmon and sea trout. The exact threshold at which effects will occur for these types is unknown and as such Popper et al. (2014) provides a qualitative category system based on risk of occurring at different distances. Mortality and recoverable injury are considered a low risk even within the near field (tens of metres) of the source. However, they are at high risk of masking effects and a moderate risk for behavioural responses within the near and intermediate field (hundred of metres).

2.8.60 All Type 1 and 2 IEFs are considered to be of low vulnerability, high recoverability and of local to international value. They have been assessed as **low** sensitivity.

Type 3 species

2.8.61 Type 3 species are those with swim bladders that are involved in hearing and as such are more sensitive to sound than Type 1 and 2 species. Type 3 species within the Study Area include cod, whiting, Atlantic herring, sprat, allis shad and twaite shad.

2.8.62 Popper *et al*. (2014) has identified that Type 3 species are subject to recoverable injury at 170 dB_{rms} 1µPa for 48 hours and temporary threshold shifts at 158 dB_{rms} 1µPa for 12 hours. However, Type 3 fish are at a low risk of mortality to continuous sound sources.

2.8.63 Cod, sprat and whiting spawning grounds span across the Study Area, with thresholds for recoverable injury and TTS spanning across a very small extent of these grounds. All these species are pelagic spawners and are not expected to spend significant time spawning within discrete locations, like for benthic spawners. Atlantic herring, allis shad and twaite shad also occur within the Study Area. As highly mobile and migratory species they are also not expected to occur within the ZoI for recoverable injury and TTS for any extended periods of time.

2.8.64 The Taw-Torridge estuary is utilised by a number of diadromous species, with twaite shad spending significant time within this estuary (Davies et al. 2020).

2.8.65 The exact threshold at which masking and behavioural effects will occur for Type 3 species is unknown and as such Popper et al. (2014) provides a qualitative category system based on risk of occurring at different distances. Type 3 species are at a high risk of masking affects across the near, intermediate, and far field (up to thousands of metres), and moderate risk to behavioural responses within the near field and intermediate field.

2.8.66 Considering the small extent of recoverable injury and TTS thresholds and the high mobility of these IEFs, recoverable injury and TTS is only expected to affect a small number of individuals. Effects on a larger scale are expected to be restricted to masking and behavioural responses. Type 3 IEFs are therefore considered to be of low vulnerability, high recoverability and local to international value. They have been assessed as **low** sensitivity.

Type 4

2.8.67 No data exists in relation to the effects of continuous noise to eggs and larvae. However, Popper et al. (2014) suggests that eggs and larvae are at a low risk of mortality and recoverable injury, even in the near field (tens of metres) of the noise source. Spawning grounds for a number of species overlap with the Study Area and Offshore Cable Corridor, however any impacts on eggs and larvae are expected to be small in extent. IEFs with spawning grounds in the area have therefore been considered as low vulnerability, high recoverability and regional value. They have been assessed as **low** sensitivity.

Shellfish

2.8.68 Shellfish are unable to detect sound pressure but are likely to be able to detect particle motion through a variety of organs such as hairs on the body that respond to mechanical stimulation, chordotonal organs associated with joints, or vibrations transmitted through the exoskeleton from the substrate (Popper & Hawkins, 2018). Any impacts on shellfish species are likely to be localised to within a small extent of the noise source and therefore will only affect a small number of individuals. All shellfish IEFs have been considered as low vulnerability, high recoverability and local to national importance. They have been assessed as **low** sensitivity.

Magnitude of impact

2.8.69 The methodology employed and results from the underwater noise modelling are presented within the following PEIR Appendix - Volume 3, Appendix 4.1: Underwater Noise Assessment.

2.8.70 The maximum sound pressure levels for the Proposed Development are expected to be low in comparison to activities such as percussive pilling, with the maximum sound pressure expected to be 192 dB re 1µPa at 1 m from water jetting (158 dBrms 1µPa at <215 m). The recoverable injury and TTS thresholds, as stated by Popper et al. (2014) for Type 3 fish, are not expected to exceed 40 m and 215 m, respectively (**Table 2.21**). Cable installation activities could take place 24 hours a day on a 7-day basis across several discrete months – over the entire 370 km length of works.

2.8.71 Most of the noise producing activities will be restricted to the circalittoral and offshore zones of the Offshore Cable Corridor. However, HDD will occur inshore at the landfall site. HDD will take place over a shorter period of time (entire HDD works will still take place over several months) and will be limited to the usual hours of work and so there will be quiet periods when drilling will not take place. HDD will generate a noise level of 129 dB re 1µPa at 39 m from source and therefore will not exceed the Popper et al. (2014) threshold for recoverable injury and TTS at 39 m from source (**Table 2.21**).

2.8.72 The Taw-Torridge estuary (including shellfish water protected area) is located approximately 5 km from the Offshore Cable Corridor and therefore is outside the ZoI for recoverable injury and TTS (sound produced by HDD at landfall is not predicted to reach these threshold values within 39 m). Furthermore, the Taw-Torridge estuary contains a number of shallow and intertidal sand banks at its entrance which will attenuate sound waves.

Table 2.21: Sound pressure at 1 m and extent of recoverable injury and TTS thresholds from various modelled noise sources for this project.

Noise source	Source Level (dB re 1µPa @ 1m)	Recoverable Injury Isopleths **(m)** *(Threshold: 170 dB_{rms} 1µPa for 48hrs)*	TTS Isopleths **(m)** *(Threshold: 158 dB_{rms} 1µPa for 12hrs)*
Seabed obstacle clearance	178 - 183	<10	<50
Mass flow excavation	162 - 167	Not reached	<5
Dredging	183 - 188	<20	<100
Cable burial – water jetting	188 - 193	<40	<215
Cable burial – mechanical cutter	183 - 188	<20	<100
HDD	129.5 at 39 m	<39	<39
Installation of Rock protection	188.4	<20	<110
Associated vessel movements – tug	172	<10	<10
Associated vessel movements – cable lay vessel	188	<20	<100

Table based on that from Volume 3, Appendix 4.1.

2.8.73 Injury and disturbance from underwater noise has been assessed as low extent (near-field and adjacent near-field), short term duration (individual installation events several months in duration), continuous to frequent throughout construction period and of low consequence. The magnitude has therefore been assessed as **low**.

Significance of effect

2.8.74 The magnitude of the impact has been determined as **low**. All IEFs have been assessed as **low** sensitivity, therefore the effect will be of **minor adverse** significance, which is **not significant** in EIA terms.

Further Mitigation

2.8.75 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.8.76 No significant effects have been identified and there is no further monitoring proposed.

Collision risk to basking shark from vessel activities

2.8.77 Increased vessel movements associated with the installation of the cables has the potential to lead to an increased risk of collision with basking shark which may be present near to the surface within the Offshore Cable Corridor.

Sensitivity of receptor

2.8.78 There are different potential outcomes of vessel collision on marine megafauna; both fatal and non-fatal injuries have been documented for cetaceans (Laist et al., 2001; Cates et al., 2017). Evidence of this has included carcasses washing up on beaches, carcasses caught on vessel bows or floating carcasses, with propeller cuts, impact injuries, fractures, and remnant ship paint (Laist et al., 2001; Douglas et al., 2008).

2.8.79 For basking shark, propeller and boat strikes may result in serious injury, particularly in summer months when animals are spending significant time at the surface feeding. Anecdotal evidence of basking sharks with suspected vessel collision related injuries have been reported (Speedie et al., 2009; Hall et al., 2013), however the extent of which collisions occur to basking sharks is not fully understood, with likely many unreported incidents (Bloomfield and Solandt, 2006; Hall et al., 2013).

2.8.80 The baseline environment suggests that the Study Area is commonly utilised by basking sharks. If a vessel were to collide with a basking shark it is expected that the animal would be injured (either fatal or non-fatal injury). On this basis basking shark are deemed to be of high vulnerability, low recoverability, and international value. The sensitivity of these IEFs to collision risk from vessel activities is **high**.

Magnitude of impact

2.8.81 The maximum design scenario is for up to 32 different vessels , noting that it is unlikely that these would all be on site at any given time, given requirement for works phasing. Vessel types include guard vessels, rock placement vessels, cable laying vessels, trenching vessels, pre-installation vessels and jack-up vessels. Whilst this will lead to an uplift in vessel activity, the movements will primarily be along the Offshore Cable Corridor and along existing shipping routes to / from port.

2.8.82 The baseline environment presented in Volume 3, Chapter 5: Shipping and Navigation, of the PEIR, suggests an average number of 90 vessels per day within 5 nm of the Offshore Cable Corridor. Vessel traffic associated with the Proposed Development will lead to an increase in vessel movements within the Study Area, albeit to a very small degree when compared to the baseline numbers. This increase in vessel movement could lead to an increase in interactions between basking sharks and vessels during construction. Vessels travelling at 7 m/s or faster are those most likely to cause death or serious injury to basking sharks and turtles (Laist *et al*., 2001). Vessels are likely to be travelling considerably slower than this, and all vessels will be expected to follow a Vessel Management Plan.

2.8.83 As such, collision risk to basking shark from increased vessel activities involved in the construction phase is deemed to be restricted to the near field and adjacent far-field areas (along Offshore Cable Corridor and existing shipping routes), medium term duration, frequent and of low consequence. Considering the small increase in vessel numbers from that of the baseline, the magnitude has been considered as **negligible**.

Significance of effect

2.8.84 The magnitude of the impact has been determined as **negligible**. Basking sharks have been determined as **high** sensitivity, therefore the effect will be of **minor adverse** significance, which is **not significant** in EIA terms.

Further Mitigation

2.8.85 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.8.86 No significant effects have been identified and there is no further monitoring proposed.

Changes to water quality as a result of accidental pollution

2.8.87 Accidental release of pollutants (such as fuel, lubricants, and anti-fouling biocides) from vessels or equipment associated with the Proposed Development has the potential to occur during the construction phase.

Sensitivity of receptor

2.8.88 The most sensitive IEFs are sessile or low mobility species which are unable to avoid the pollution event and those that may absorb contaminants via suspension feeding. For example, blue mussels are suspension feeders and may absorb contaminants via suspended particulate matter (many chemicals preferentially adsorb to organic and mineral fractions of sediments). Bivalves are able to accumulate heavy metals into their tissues to levels much higher than environmental levels and therefore show a degree of tolerance (Widdows and Donkin, 1992), however, sub-lethally the contaminants could reduce the growth rate of individuals (Tyler-Walters, 2008). Similarly, synthetic compounds can accumulate in tissues of bivalves and cause a reduction in growth rates and fecundity, and potentially mortality of individuals (Tyler-Walters, 2008).

2.8.89 Hydrocarbons and PAH contamination normally occurs as a result of oil spills and high swell and winds can cause oil pollutants to mix with the seawater and potentially negatively affect sublittoral habitats (Castège *et al*., 2014). Filter feeders are highly sensitive to oil pollution, particularly bottom dwelling organisms in areas where oil components are deposited by sedimentation. Bivalve contact with oil causes an increase in energy expenditure and a decrease in feeding rate, resulting in less energy available for growth and reproduction (Suchanek, 1993). Crustaceans are widely reported to be intolerant of synthetic chemicals (Cole *et al*., 1999). For decapod crustaceans (as with bivalves), sublethal physiological effects would be expected to occur as concentrations can build up in their gill tissues, carapace, tail mussels and ovaries (Sabatini and Hill, 2008).

2.8.90 The MarESA assessment has assessed blue mussel and king scallop as low sensitivity to synthetic compounds, heavy metals and hydrocarbons. However, the MarESA assessment has assessed Nephrops and brown crab as low sensitivity to heavy metal contamination, and brown crab as low sensitivity to hydrocarbon contamination but a medium sensitivity to synthetic compounds. MarESA has not assessed the sensitivity to chemical pressures on European lobster or crawfish, however they are expected to be similar to that for brown crab.

2.8.91 It is anticipated that, following cessation of any potential (temporary) impact, re-colonisation of affected areas would occur via adult migration and larval settlement thereby allowing a return to ecological baseline conditions. Considering crustaceans intolerance to synthetic compounds, European lobster, crawfish and brown crab have been considered as medium vulnerability, high recoverability and are of regional to national value. They have therefore been assessed as **medium** sensitivity. All other shellfish IEFs are deemed to have some degree of adaptability and tolerance, are expected to recover within the medium term and are of local to regional importance. These IEFs are assessed as **low** sensitivity.

2.8.92 Accidental pollution can impact upon the hatching success of fish eggs via delaying the hatching process, causing premature hatching and fatalities of newly hatched larvae (Jezierska *et al.,* 2008; Sorensen *et al.*, 2019). This could reduce recruitment of those species that spawn within the Proposed Development and Study Area. However, given the large area of available spawning habitat, any impacts are expected to be small. Fish species with overlapping spawning grounds are deemed to have some level of adaptability and tolerance, are expected to recover within the medium term and are of regional importance. These IEFs are assessed as **low** sensitivity.

2.8.93 Most fish are highly mobile and consequently have the ability to avoid polluted areas. These IEFs are deemed to be able to avoid the impact, are expected to recover within the short term and are of regional importance. These IEFs are assessed as **low** sensitivity.

2.8.94 Accidental pollution can impact basking, porbeagle and blue shark. These species are deemed to have a high capacity to avoid the pollution areas and as such are considered to have a low vulnerability and are expected to recover within the short term. These species are considered to be of international value. These IEFs are assessed as **low** sensitivity.

Magnitude of impact

2.8.95 Construction activities may lead to the accidental release of pollutants through spills and leaks from vessels and equipment. The Maximum Design Scenario is for up to 32 vessels on site (unlikely to be present at the same time). Vessel traffic associated with the Proposed Development will lead to an increase in vessel movements within the Study Area, albeit to a very small degree when compared to the baseline numbers. This increase could lead to an increased risk of accidental pollution through the release of synthetic compounds, for example from antifouling biocides, heavy metal, and hydrocarbon contamination as a result of seabed preparation, route clearance, cable laying, HDD and burial activities. Although many of the large vessels (e.g. installation vessels) may contain large quantities of diesel oil, any accidental spill from vessels, vehicles, machinery from construction activities would be subject to immediate dilution and rapid dispersal.

2.8.96 The embedded measures include an Offshore Construction Environmental Management Plan (CEMP), as well as compliance with MARPOL. Adherence to the embedded measures and good working practices will significantly reduce the likelihood of an accidental pollution incident occurring and the magnitude of its impact. Given the embedded measures, the likelihood of accidental release is considered to be extremely low.

2.8.97 There is also a risk to fish and shellfish IEFs from water based drilling mud, including bentonite, which is used as a lubricant during the HDD process. HDD will be undertaken to install the cable at the landfall. Drilling muds are used in a closed system to minimise loss to the environment, however, some muds (including bentonite) will be released when the HDD borehole breaks through the seabed. Bentonite is low toxicity drilling mud and therefore the risk to fish and shellfish is minimal, particularly when considering that any releases will be quickly diluted (seawater degrades the bentonite fluid, causing it to flocculate and allowing faster dispersal). The volume of muds released to the environment will be managed via good working practices (e.g. close monitoring of mud volumes and pressure as break through approaches). The risk of accidental ‘frack-out’ of drill fluids will be minimised by best practice management of the drill, including dynamic monitoring of drill pressures, use of sealed system / low volume drill fluid volumes, and the use of self-sealing platelet grouts (Bentonite) which are designed to plug minor fissures.

2.8.98 Accidental release of pollutants during the construction phase is predicted to be of near-field, short-term duration (any pollutant will be quickly dispersed), infrequent and of low consequence. Considering the small degree of increase in vessels associated with the construction phase from that of the baseline and the low likelihood of a pollution event occurring, the magnitude is considered to be **negligible**.

Significance of effect

2.8.99 The magnitude of the impact has been assessed as **negligible**.

2.8.100 The sensitivity of European lobster, brown crab and crawfish has been assessed as **medium**. Therefore, the significance of effect will be **minor adverse** significance, which is not significant in EIA terms.

2.8.101 The sensitivity of all other IEFs has been assessed as **low**. Considering the very low likelihood of a pollution event occurring the significance of effect has been determined as **negligible** significance, which is not significant in EIA terms.

Further Mitigation

2.8.102 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.8.103 No significant effects have been identified and there is no further monitoring proposed.

Changes to water quality from resuspension of sediments

2.8.104 Release of pollutants such as hydrocarbons and heavy metals may result from the disturbance and resuspension of any contaminated sediments that may be present, during construction activities.

Sensitivity of receptor

2.8.105 The sensitivity of the IEFs to changes to water quality from resuspension of sediments is the same as that outlined in **paragraphs 2.8.88 to 2.8.94** for the impact '*Changes to water quality as a result of accidental pollution'*.

Magnitude of impact

2.8.106 During construction a range of activities will disturb the seabed resulting in increased levels of SSC and associated changes to water quality. The MDS assumes a range of seabed preparation activities including sandwave clearance, boulder clearance, seabed debris removal and pre-lay trenching. Also included within the MDS is the disturbance of sediments as a result of cable burial (220 km to a target depth of 1.5m) and HDD (localised excavations and use of jack-up vessels).

2.8.107 Chemical Action Levels (cALs) as derived by Cefas and Canadian marine Sediment Quality Guidelines were used to characterise the broad contamination status of sediment samples taken during subtidal site-specific benthic surveys. Concentrations below cAL1 are of no concern, chemical levels between cAL1 and cAL2 generally would indicate further consideration would be required for disposal at sea, while dredged material with chemical levels above cAL2 are generally considered unsuitable for sea disposal (MMO 2015). This framework is used in licence decision making around disposal of dredged sediments but is useful here to contextualise the degree of contamination.

2.8.108 Analysis of sediment concentrations of heavy metals indicated that Arsenic concentrations exceeded cAL1 at eight stations sampled during surveys, but below cAL2 and the Probable Effects Level (PEL). These samples were located within Bideford Bay and off the north coast of Devon. Results from the Burial Assessment Study indicate that there are no identified sand waves in this area and/or large ripples present and as a result, no seabed preparation activities would be required. Heavy metal concentrations were found below cAL1 at all other stations. Hydrocarbon compounds tested from the collected grab samples exceeded cAL1, but were below cAL2.

2.8.109 The high-level sediment dispersion assessment to inform this PEIR found Fine Sand (wentworth) in depths between 10.1 m and 123.3 m to travel between approximately 0.05 and 3.8 km, with time in suspension ranging from 1 to 4 hours. For Very Fine Sand, in depths between 18.5 and 104.1 m, maximum distance travel ranged from approximately 2 km to 3.9 km, with time in suspension being 5 hours.

2.8.110 Changes to water quality as a result of resuspension of suspended sediments during the construction phase is predicted to be of near-field and adjacent far-field extent, short-term duration (any pollutants would be quickly dispersed), frequent and of low consequence. Considering all elements and compounds were below Action level 2, the magnitude is considered to be **negligible**.

Significance of effect

2.8.111 The magnitude of the impact has been assessed as **negligible**.

2.8.112 The sensitivity of European lobster, brown crab and crawfish has been assessed as **medium**. Therefore, the significance of effect will be **negligible** significance, which is not significant in EIA terms.

2.8.113 The sensitivity of all other IEFs has been assessed as **low**. Considering the very low likelihood of a pollution event occurring the significance of effect has been determined as **negligible** significance, which is not significant in EIA terms.

Further Mitigation

2.8.114 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.8.115 No significant effects have been identified and there is no further monitoring proposed.

Introduction of invasive non-native species

2.8.116 The introduction and spread of Invasive Non-Native Species (INNS) may occur during the construction phase of the Proposed Development through vessel movements (transfer via their hulls or in ballast water).

Sensitivity of receptor

2.8.117 The introduction of INNS has the potential to directly and in-directly impact upon the marine environment and those plants and animals that utilise it. Direct impacts may include displacement, competition, predation and genetic dilution, with indirect impacts including changes in prey items and alterations to habitats (Çinar *et al.,* 2014).

2.8.118 American lobster *Homarus americanus* predominantly occurs along the East coast of North America and Canada, however, escapes from holding facilities has led to populations establishing across the UK coast (Stebbing *et al*., 2012; Barrett *et al*., 2020). The introduction of American lobster *Homarus americanus* may impact directly upon shellfish species within the Study Area via displacement and competition with native species and via genetic dilution (hybridisation with native European lobster).

2.8.119 Other INNS, including Wakame *Undaria pinnatifida*, carpet sea squirt *Didemnum vexillum* and pacific oyster *Magallana gigas,* are widespread and have been considered within the baseline environment.

2.8.120 The sensitivity of all IEFs to the introduction of INNS, not already considered as part of the baseline, has been assessed as **negligible**.

Magnitude of impact

2.8.121 The introduction and spread of INNS may occur during the construction phase of the Proposed Development through vessel movements via their hulls or in ballast water. Furthermore, the introduction of hard substrata (e.g. rock protection) within the marine environment might present a pathway for the spread of INNS.

2.8.122 Within the UK, pathways of introduction involving vessel movements have been identified as the highest potential risk routes for the introduction of non-native species, via ballast discharge or transportation on vessel hulls (Carlton, 1992).

2.8.123 Given there will be no introduction pathway with the activities associated with the Proposed Development, the impact upon fish and shellfish receptors from the introduction of American lobster has not been considered.

2.8.124 The MDS assumes 32 vessels on site at any given time. Vessel types include guard vessels, rock placement vessels, cable laying vessels, trenching vessels, pre-installation vessels and jack-up vessels. The precise number of vessel return trips and ports of origin are yet to be determined. However, the increase in vessel numbers as a result of construction activities will be small when compared to the baseline environment presented in Volume 3, Chapter 5: Shipping and Navigation, of the PEIR, which suggests an average number of 90 vessels per day within 5 nm of the Offshore Cable Corridor.

2.8.125 The introduction of INNS, not already considered as part of the baseline, as a result of construction activities is considered to be highly unlikely, given best practice shipping guidelines that will be adhered to e.g. via the CEMP (including management of ballast waters).

2.8.126 The impact is predicted to be of far-field extent and long-term to permanent duration (newly introduced INNS may persist in the environment indefinitely). However, with the implementation of the embedded mitigation measures mentioned above, the risk of the introduction and spread of INNS is low. The magnitude has therefore been considered as **low**.

Significance of effect

2.8.127 The magnitude of the impact has been determined as **low**. All IEFs have been determined as **negligible** sensitivity, therefore the effect will be of **negligible** significance, which is **not significant** in EIA terms.

Further Mitigation

2.8.128 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.8.129 No significant effects have been identified and there is no further monitoring proposed.

2.9 Preliminary Assessment of Operational Effects

2.9.1 The impacts of the operation and maintenance phase of the Proposed Development have been assessed. The potential preliminary impacts arising from the operation and maintenance phase of the Proposed Development are listed in **Table 2.18**, along with the maximum design scenario against which each impact has been assessed.

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

Temporary habitat loss / disturbance

2.9.3 Temporary habitat loss / disturbance will occur during the operation and maintenance phase as a result of repair and reburial activities (Operational-repair). There would be no equivalent impact associated with normal operation, which is expected for the majority of the time. Long-term habitat alterations are assessed separately below: 'Impact: *Habitat alteration and long-term habitat loss*'.

Sensitivity of receptor

2.9.4 The sensitivity of the IEFs to temporary habitat loss / disturbance is the same as that described for construction in **section 2.8**.

Magnitude of impact

2.9.5 The Maximum Design Scenario considers the de-burial, repair and re-burial of segments of the cable at failure points when they are required. In the event of a cable failure the cable would be cut, recovered to the surface, repaired using a section of spare cable and redeployed for reburial using similar methods to those used for installation. Given additional cable length would be required to join the cut ends at the surface, the relayed cable would take up a greater footprint than the original cable. However, the re-laid cable would fall within the Offshore Cable Corridor. The magnitude of temporary habitat loss / disturbance from operation and maintenance is expected to be significantly less the similar activities undertaken (over a much greater area) during the construction phase.

2.9.6 The impact will affect the IEFs directly through removal or disturbance of individuals and indirectly due to the temporary loss of important habitats, such as foraging, nursery or spawning habitats. Habitat loss will be localised to along failure point of the Offshore Cable Corridor. The impact is therefore considered to be low in extent, in-frequent, short term and of low consequence. The magnitude has therefore been assessed as **negligible**.

Significance of effect

2.9.7 The magnitude of the impact has been determined as **negligible**.

2.9.8 Pelagic IEFs and blue mussels have been determined as **negligible** sensitivity, therefore the effect will be of **negligible** significance, which is **not significant** in EIA terms.

2.9.9 Species with stationary benthic eggs and/or restricted habitat preferences have been determined as **medium** sensitivity, therefore the effect will be of **negligible** significance, which is **not significant** in EIA terms.

2.9.10 European lobster, brown crab and crawfish have been determined as **medium** sensitivity, therefore the effect will be of **negligible** significance, which is **not significant** in EIA terms.

2.9.11 All other IEFs have been determined as **low** sensitivity, therefore the effect will be of **negligible** significance, which is **not significant** in EIA terms.

Further Mitigation

2.9.12 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.9.13 No significant effects have been identified and there is no further mitigation proposed.

Temporary increases in suspended sediments

2.9.14 Increases in suspended sediments and deposition will occur during the operation and maintenance phase should repair activities be required.

Sensitivity of receptor

2.9.15 The sensitivity of the IEFs to temporary increases in suspended sediment and deposition is the same as that described for construction in **section 2.8**.

Magnitude of impact

2.9.16 The Maximum Design Scenario considers the de-burial, repair and re-burial of segments of the cable at failure points when they are required. In the event of a cable failure the cable would be cut, recovered to the surface, repaired using a section of additional cable and redeployed for reburial using similar methods to those used for installation. The magnitude of increased suspended sediments and deposition from operation and maintenance is expected to be significantly less than that for construction.

2.9.17 Increased suspended sediment and associated deposition will be localised to within the Study Area. The impact is therefore considered to be low in extent, infrequent, short term and of low consequence. The magnitude has therefore been assessed as **negligible**.

Significance of effect

2.9.18 The magnitude of the impact has been determined as **negligible**.

2.9.19 Basking sharks, porbeagle, blue shark and blue mussels have been determined as **negligible** sensitivity, therefore the effect will be of **negligible** significance, which is **not significant** in EIA terms.

2.9.20 All other IEFs have been assessed as **low** sensitivity, therefore the effect will be of **negligible** significance, which is **not significant** in EIA terms.

Further Mitigation

2.9.21 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.9.22 No significant effects have been identified and there is no further monitoring proposed.

Injury and disturbance from noise and vibration

2.9.23 Underwater noise and vibration will be generated during the re-burial of cables, should repair activities be required during the Operational phase.

Sensitivity of receptor

2.9.24 The sensitivity of the IEFs to underwater noise and vibration is the same as that described for construction in **section 2.8**.

Magnitude of impact

2.9.25 The methodology used and results of the underwater noise modelling are presented as Volume 3, Appendix 4.1: Underwater Noise Assessment Technical Appendix, of the PEIR.

2.9.26 The greatest noise source is expected to occur as a result of water jetting for cable burial, with an indicative maximum noise pressure of 193 dB re 1µPa at 1m from noise source. The recoverable injury and TTS thresholds, as stated by Popper et al. (2014) for Type 3 fish, are not expected to exceed 40 m and 215 m, respectively (**Table 2.21**). Cable repair activities will occur infrequently when and where required and are expected to be localised to within the vicinity of the cable failure point.

2.9.27 Injury and disturbance from underwater noise has been assessed as low extent (near-field and adjacent near-field), short term duration (individual repair activities will be short in duration), infrequent and of low consequence. The magnitude has therefore been assessed as **negligible**.

Significance of effect

2.9.28 The magnitude of the impact has been determined as **negligible**. All IEFs have been assessed as **low** sensitivity, therefore the effect will be of **minor adverse** significance, which is **not significant** in EIA terms.

Further Mitigation

2.9.29 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.9.30 No significant effects have been identified and there is no further monitoring proposed.

Electromagnetic field (EMF) effects

2.9.31 The conduction of electricity through subsea power cables has the potential to emit a localised EMF which could potentially affect the sensory mechanisms of some species of fish and shellfish, particularly electrosensitive species including elasmobranchs. EMF comprises both the electrical (E) fields, measured in volts per metre (V/m) or microvolts per metre (µV/m), and the magnetic (B) fields, measured in microtesla (µT) or milligauss (mG) (1 µT = 10 mG). Direct E-field are typically blocked using conductive sheathing, meaning that the EMFs that are emitted into the marine environment are the B-field and the resultant induced electrical field (iE).

Sensitivity of receptor

2.9.32 Electro-magnetic sensitivities vary significantly by species according to their physiology and life-functions. Life functions supported by an electric sense may include detection of prey, predators or conspecifics to assist with feeding, predator avoidance, and social or reproductive behaviours; whilst life functions supported by a magnetic sense may include orientation, homing, and navigation to assist with long or short-range migrations or movements (Normandeau *et al*., 2011).

2.9.33 Elasmobranchs are widely known to be sensitive to electric fields due to the presence of electroreceptive pores on the surface of their skin, known as Ampullae of Lorenzini. Gill and Taylor (2001) exposed lesser spotted catsharks to an electrical current with variable resistance in seawater tanks. Individuals avoided electric fields of 1000 uV/m but were attracted to electric fields of 0.1 uv/cm. Hutchison *et al*., (2020) observed an increase in exploratory/foraging behaviour in little skate *Leucoraja erinacea* in response to maximum magnetic fields of 51.6, 55.3 and 65.3 µT (516, 553 and 653 mG respectively).

2.9.34 Other species, whilst not possessing specialised electroreceptors, are likely to be able to detect induced voltage gradients, including river lamprey, sea lamprey, European eel, cod, plaice and Atlantic salmon (Gill *et al*., 2005). Armstrong *et al*. (2015) exposed adult and post-smolt Atlantic salmon to electromagnetic fields up to 95 µT (950 mG) in experimental aquariums and observed no difference in behaviour or survival rate. Furthermore, research in Sweden on the effects of a HVDC cable on the migration patterns of a range of fish species, including salmonids, failed to find any effect (Westerberg *et al*., 2007 as referenced in Wilhelmsson *et al*., 2010), and research conducted at the Trans Bay cable, a direct current (DC) undersea cable near San Francisco, California, found that migration success and survival of chinook salmon *Oncorhynchus tshawytscha* was not impacted by the cable (Kavet *et al*., 2016). They did however find slight behavioural effects on smolts which showed attraction to the cable.

2.9.35 Studies on the effects of EMFs on European eel show similar observations, with mark and recapture experiments indicating no hinderance of crossing a 132 kV export cable by European eel (Hvidt et al., 2003) and Westerberg and Langenfelt (2008) observing behavioural responses (reduced swimming speed) of European eel to a 130 kV subsea (AC) power cable. Westerberg and Langenfelt (2008) concluded that these effects were short lived (average 40 minutes) and would not impede their larger migration.

2.9.36 Lampreys possess specialised ampullary electroreceptors that are sensitive to weak, low frequency electric fields (Bodznick and Preston, 1983; Normandeau *et al*., 2011), but information regarding what use they make of the electric sense is limited. Chung-Davidson *et al*., (2008) demonstrated that the migratory behaviour of sea lamprey was affected (i.e. adults did not move) when stimulated with electrical fields of intensities of between 2.5 and 100 mV/m, with normal behaviour observed at electrical field intensities higher and lower than this range.

2.9.37 Some benthic shellfish species may be affected to some extent by magnetic fields, for example Caribbean spiny lobster *Panulirus argus* is thought to use the earth's magnetic field to orientate (Boles and Lohmann, 2003). However, it is unknown if other decapod crustaceans, including commercially important European lobster, brown crab and Nephrops, are able to respond to magnetic fields in this way. American lobster *Homarus americanus* exposed to maximum EMFs of 65.3 μT (653 mG) in aquarium spent more time on the bottom, hypothesised by Hutchison *et al*. (2020) as being a behavioural change towards more foraging and searching. Bochert and Zettler (2004) exposed blue mussel, brown shrimp *Crangon crangon*, round crab *Rhithropanopeus harrisii* and flounder *Plathichthys flesus* to magnetic fields (B-field) of 3.7 mT for several weeks and found no differences in survival between exposed and control animals (Bochert and Zettler, 2004).

2.9.38 Love *et al*. (2016) studied the benthic community occupying two energised submarine power cables (average 73 μT / 730 mG and 91.4 μT / 914 mG) in comparison to adjacent non-energised pipes and natural habitats, off Southern California over a two-year period. They failed to find any significant difference in fish or invertebrate assemblages between energised cables, non-energised pipes and natural habitat. They concluded that EMF are unlikely to impact fish and shellfish assemblages to any great extent.

2.9.39 The effects of EMFs on fish and shellfish receptors are likely to be restricted to short term behavioural changes. All IEFs are considered low vulnerability, high recoverability and are of local to international importance. They have therefore been assessed as **low** sensitivity to EMF effects.

Magnitude of impact

2.9.40 EMF occurs naturally in the marine environment. The Earth's static magnetic field (geomagnetic field) is present in all environments, terrestrial and aquatic, and lies in the range of 25 to 65 μT (250 to 650 mG) (Hutchison *et al*., 2018; Normandeau *et al*., 2011). Movement of seawater through the Earth's magnetic field (geomagnetic field) creates localised E-fields, which are typically very small, in the order of 10s of µV m-1 (Tasker *et al*., 2010; Normandeau *et al*., 2011). Small electric fields are also directly produced by marine organisms.

2.9.41 The Maximum Design Scenario assumes the presence of four 525 kV HVDC cables, with a diameter of 175 mm, across a length of 370 km. Cables would be buried to a target depth of 1.5 metres deep. The calculated static magnetic field levels of the bundled cables is 79 µT (790 mG), with no static electric fields being emitted due to the cable shielding system (Amplitude Consultants, 2021).

2.9.42 CSA (2019) compared offshore subsea cables and found magnetic fields between seafloor and 1 m above seafloor (for buried 75 – 500 kV cables) to range between 590 and 1250 mG for Direct Current (DC) export cables. CSA (2019) also compared offshore Alternating Current (AC) subsea cables from wind farms and found magnetic field levels directly over the cables to range between 20 to 65 mG for 34.5 to 161 kV inter-array cables and 30 to 165 mG for 138 to 400 kV export cables at the seafloor. A reduction in magnetic field levels was seen 1 m above the seafloor, with 5 to 15 mG for inter-array cables and 10 to 40 mG for export cables. Induced electric field levels were 0.1 to 1.2 mV/m for inter-array and 0.2 to 2.0 mV/m for export cables, 1 m above the seafloor. Love *et al*. (2016) made a similar observation, with EMF levels being undetectable 1 m away from most of the energised submarine power cables monitored as part of their study.

2.9.43 Electromagnetic field effects are therefore considered to be small in extent (within metres of cable), long-term duration (occur across whole operational period), continuous and of low consequence. The magnitude has been assessed as **low**.

Significance of effect

2.9.44 The magnitude of the impact has been determined as **low**. All IEFs have been determined as **low** sensitivity, therefore the effect will be of **minor adverse** significance, which is **not significant** in EIA terms.

Further Mitigation

2.9.45 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.9.46 No significant effects have been identified and there is no further monitoring proposed.

Habitat alteration and long-term habitat loss

2.9.47 Habitat alteration and long-term habitat loss will occur as a result of the placement of rock protection along areas of the cable that cannot be fully buried with backfill sediments and at cable crossings. This impact considers the habitat alteration and long-term habitat loss occurring during the operational and maintenance phases.

Sensitivity of receptor

2.9.48 Habitat alteration could lead to the long-term loss of suitable habitats and spawning and nursery grounds via the introduction of hard substrata (rock protection) within the Offshore Cable Corridor. The Offshore Cable Corridor overlaps with spawning and nursery grounds for several species. Horse mackerel, sprat and mackerel have an entirely pelagic life history, including pelagic eggs. Therefore, horse mackerel, sprat and mackerel have little dependency on the benthic environment and are not expected to be affected by habitat alteration. These IEFs have been assessed as **negligible** sensitivity. All other species with overlapping spawning and/or nursery grounds have a benthic or demersal life stage, and therefore will have some interaction with the benthic environment.

2.9.49 Sandeel are selective on their habitat type, with the introduction of hard substrata not representing a substitute for their soft sediment preferences. Preferred habitat for sandeel (sand to gravelly sand) is extensive across the Study Area and wider reaches (EMODnet, 2023), and therefore the long-term loss of sand eel spawning and nursery grounds along the Offshore Cable Corridor will be small in the context of the wider area which they can utilise. Sandeel are deemed to be of medium vulnerability, medium recoverability and are of national value. They have been assessed as **medium** sensitivity.

2.9.50 Flatfish and rays, including those with spawning and nursery grounds in the area, also show a level of habitat selectivity with the introduction of hard substrata not necessarily representing a substitute (Heinz *et al*., 2003; 2006; Martin *et al*., 2012). However, a number of studies have demonstrated that flatfish species will occupy soft sediment environments adjacent to rock protection (Buyse *et al*., 2021; 2023a; 2023b) and may even benefit from the increased prey availability that they offer. The total area of habitat alteration will be small in the context of the habitat available for these species and therefore, there is unlikely to be a population-level effect within the Study Area. They have been assessed as **low** sensitivity.

2.9.51 All other fish species in the area occupy a wide range of habitat types, including hard substrata, and therefore will be able to adapt to and tolerate the change (low vulnerability). They are of local to international value and have been assessed as **negligible** sensitivity.

2.9.52 European lobster, brown crab and crawfish naturally occupy hard substrate habitat types and readily utilise artificial hard substrata (Krone *et al*., 2017; Thatcher *et al*., 2023). The total area of habitat alteration will be small in the context of the area of rocky habitat already present in the vicinity and therefore an increase in abundance as a result of the presence of rock protection is unlikely to occur. These IEFs have been assessed as **negligible** sensitivity.

2.9.53 Scallops prefer sandy and gravelly sediments. Habitat alteration will cause a loss of appropriate habitat for scallops in the long term. Sandy and gravelly sediments are widespread across the Study Area and therefore habitat alteration will only affect a small area of potential scallop habitat. They have been assessed as **low** sensitivity.

2.9.54 Nephrops are likely to occur across the Export Cable Corridor, albeit in discrete locations. Nephrops prefer muddy sediments and therefore the introduction of rock protection will not be a suitable substitute. Nephrops are considered to be of medium vulnerability, medium recoverability and are of regional value. They have been assessed as **medium** sensitivity.

2.9.55 Blue mussels depend upon a hard substratum to settle on for recruitment. Studies at Offshore Wind Farms have found that they can colonise concrete foundations within a year and can become abundant within 2 years post-construction (De Mesel et al., 2015). Therefore, blue mussels are expected to have a high level of adaptability, tolerance and recoverability to the impact. Blue mussels have been assessed as **negligible** sensitivity.

2.9.56 Other shellfish species, such as whelk and cephalopods, occupy a wide range of habitat types, including hard substrates, and therefore have been assessed as **negligible** sensitivity.

2.9.57 Basking shark, porbeagle and blue shark are pelagic and have little interaction with the benthic environment. Therefore, they have been assessed as **negligible**.

Magnitude of impact

2.9.58 The Maximum Design Scenario considers a maximum of 597,000 m2 of habitat alteration / long term habitat loss associated with rock protection (450,000 m2) and at in-service cable crossings (147,000 m2). Rock protection would consist of coarse gravel and cobbles, ranging from 1 – 5 inches in diameter.

2.9.59 It should be noted however that the seabed area for rock protection adopts conservatively high values. The laying of rock protection will be the final option for these areas, with pre-lay ploughing and mechanical cutting being used to attempt to create a full target depth trench at first. The area of seabed with associated rock protection (and rock protection above seabed level) will be minimised where possible.

2.9.60 The Offshore Cable Corridor and Study Area is predominantly sand and coarse sediment-based habitat types with small areas of rocky habitat. The introduction of hard substratum via rock protection will therefore represent some degree of change from the baseline, particularly when placed over areas of soft sediment habitat (e.g. sand). However, habitat alteration / long term habitat loss will only affect a small number of the habitats present across the wider Study Area (<0.01%).

2.9.61 The impact will affect the IEFs directly through removal of individuals and indirectly due to long term loss of important habitats, such as foraging, nursery or spawning habitats. Habitat loss will be localised to discrete locations along the Offshore Cable Corridor (e.g. at cable crossings and in areas where rock protection is utilised). The impact is therefore considered to be low in extent, continuous, long term (will occur continuously throughout 50-year operation period) and of low consequence. The magnitude has therefore been assessed as **Low**.

Significance of effect

2.9.62 The magnitude of the impact has been assessed as **low**.

2.9.63 Nephrops and sand eel have been determined as **medium** sensitivity. Therefore, the effect will be of **minor adverse** significance, which is **not significant** in EIA terms.

2.9.64 Flatfish, rays and king scallops have been determined as **low** sensitivity. Therefore, the effect will be of **minor adverse** significance, which is **not significant** in EIA terms.

2.9.65 All other fish and shellfish IEFs have been determined as **negligible**. Therefore, the effect will be of **negligible** significance, which is **not significant** in EIA terms.

Further Mitigation

2.9.66 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.9.67 No significant effects have been identified and there is no further monitoring proposed.

Collision risk to basking shark from vessel activities

2.9.68 Increased vessel movements associated with the repair and maintenance of the cables (where required) has the potential to lead to an increased risk of collision on basking shark which tend to occur near the surface.

Sensitivity of receptor

2.9.69 The sensitivity is the same as that described for the construction phase in **section 2.8**.

Magnitude of impact

2.9.70 The maximum design scenario considers the presence of one survey vessel to undertake routine surveys once a year for the first 5 years of operation, then every c. 5 years for the remainder of the cable lifetime. Furthermore, there will be a vessel requirement to support unplanned maintenance and repair, as and when required. Whilst this will lead to an uplift in vessel activity, the movements will primarily be limited to the Offshore Cable Corridor and along existing shipping routes to/from port.

2.9.71 The baseline environment presented in Volume 3, Chapter 5: Shipping and Navigation, of the PEIR, suggests an average number of 90 vessels per day within 5 nm of the Offshore Cable Corridor. Vessel traffic associated with the Proposed Development will lead to an increase in vessel movements within the Study Area, albeit to a very small degree when compared to the baseline numbers. This increase in vessel movement could lead to an increase in interactions between basking sharks and vessels during construction. Vessels travelling at 7 m/s or faster are those most likely to cause death or serious injury to basking sharks and turtles (Laist et al., 2001). Vessels are likely to be travelling considerably slower than this, and all vessels will be expected to follow a Vessel Management Plan.

2.9.72 As such, collision risk to basking shark from increased vessel activities involved in the construction phase is deemed to be restricted to the near field and adjacent far-field areas (along Offshore Cable Corridor and existing shipping routes), short term duration (individual and discrete repair activities), infrequent and of low consequence. Considering the small increase in vessel numbers from that of the baseline, the magnitude has been considered as **negligible**.

Significance of effect

2.9.73 The magnitude of the impact has been determined as **negligible**. Basking sharks have been determined as **high** sensitivity, therefore the effect will be of **minor adverse** significance, which is **not significant** in EIA terms.

Further Mitigation

2.9.74 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.9.75 No significant effects have been identified and there is no further monitoring proposed.

Changes to water quality as a result of accidental pollution

2.9.76 Accidental release of pollutants (such as fuel, lubricants, and anti-fouling biocides) from vessels or equipment associated with the Proposed Development has the potential to occur during maintenance and repair activities.

Sensitivity of receptor

2.9.77 The sensitivity is the same as that described for the construction phase in **section 2.8.**

Magnitude of impact

2.9.78 The maintenance associated with the Operation and Maintenance phase may lead to the accidental release of pollutants through spills and leaks from vessels and equipment. The maximum design scenario considers the presence of one survey vessel to undertake routine surveys once a year for the first 5 years of operation, then approximately every 5 years for the remainder of the cable lifetime. Vessels will furthermore be required to support unplanned maintenance and repair, as and when required. Whilst this will lead to an uplift in vessel activity, the movements will primarily be along the Offshore Cable Corridor and along existing shipping routes to / from port.

2.9.79 The baseline environment presented in Volume 3, Chapter 5: Shipping and Navigation, of the PEIR, suggests an average number of 90 vessels per day within 5 nm of the Offshore Cable Corridor. Vessel traffic associated with maintenance will lead to an increase in vessel movements within the Study Area, albeit to a very small degree when compared to the baseline numbers. This increase could lead to an increased risk of accidental pollution through the release of pollutant chemicals from maintenance vessels and equipment. Any accidental spill from vessels, vehicles, or machinery from operation and maintenance activities would be subject to immediate dilution and rapid dispersal.

2.9.80 Relevant embedded measures include adherence to an Offshore Construction Environmental Management Plan (CEMP), as well as compliance with MARPOL. Adherence to the embedded measures and good working practices will significantly reduce the likelihood of an accidental pollution incident occurring and the magnitude of its impact. The likelihood of accidental release is considered to be extremely low.

2.9.81 Accidental release of pollutants during the Operational (repair) phase is predicted to be of near-field and adjacent far-field extent, short-term duration (any pollutant will be quickly dispersed), infrequent and of low consequence. Considering the small degree of increase in vessels associated with the operational phase from that of the baseline and the low likelihood of a pollution event occurring, the magnitude is considered to be **negligible**.

Significance of effect

2.9.82 The magnitude of the impact has been assessed as **negligible**.

2.9.83 The sensitivity of European lobster, brown crab and crawfish has been assessed as **medium**. Therefore, the significance of effect will be **minor adverse** significance, which is not significant in EIA terms.

2.9.84 The sensitivity of all other IEFs has been assessed as **low**. Considering the very low likelihood of a pollution event occurring the significance of effect has been determined as **negligible** significance, which is not significant in EIA terms.

Further Mitigation

2.9.85 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.9.86 No significant effects have been identified and there is no further monitoring proposed.

Changes to water quality from resuspension of sediments

2.9.87 Release of pollutants such as hydrocarbons and heavy metals may result from the disturbance and resuspension of any contaminated sediments that may be present, during repair activities.

Sensitivity of receptor

2.9.88 The sensitivity is the same as that described for the construction phase in **section 2.8.**

Magnitude of impact

2.9.89 The Maximum Design Scenario considers the de-burial, repair and re-burial of segments of the cable at failure points when they are required. In the event of a cable failure the cable would be cut, recovered to the surface, repaired using a section of additional cable and redeployed for reburial using similar methods to those used for installation. The magnitude of changes to water quality from resuspension of sediments from operation and maintenance is expected to be less than that for construction (**paragraph 2.8.110**).

2.9.90 The impact is therefore considered to be low in extent, infrequent, short term and of low consequence. The magnitude has therefore been assessed as **Negligible**.

Significance of effect

2.9.91 The magnitude of the impact has been assessed as **negligible**.

2.9.92 The sensitivity of European lobster, brown crab and crawfish has been assessed as **medium**. Therefore, the significance of effect will be **minor adverse** significance, which is not significant in EIA terms.

2.9.93 The sensitivity of all other IEFs has been assessed as **low**. Considering the very low likelihood of a pollution event occurring the significance of effect has been determined as **negligible** significance, which is not significant in EIA terms.

Further Mitigation

2.9.94 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.9.95 No significant effects have been identified and there is no further monitoring proposed.

Change in hydrodynamic regime

2.9.96 The presence of placed rock protection and removal of sand waves has the potential to alter the local hydrodynamic regime (currents and waves).

2.9.97 For example, decreases in current flow rate (around rock protection) could lead to sediments becoming muddier owing to increased settlement of particulate matter. Furthermore, reductions in current flow could decrease the availability of suspended food particles, impacting species indirectly via prey sources.

Sensitivity of receptor

2.9.98 Many fish and shellfish have a larval planktonic phase, with dispersal being dictated by local hydrographic conditions. Changes to hydrographic conditions could potentially affect recruitment, reducing larval settlement and subsequently causing declines in local abundance of affected species.

2.9.99 Larval dispersal strategies are designed to account for variation and unpredictability in local currents – generally by production of extremely large numbers of larvae – thus the receptor is considered to have a high capacity to tolerate the impact. The sensitivity of all IEFs to localised changes in hydrodynamic regime is considered to be **negligible**.

Magnitude of impact

2.9.100 The MDS considers a maximum of 597,000 m^2 of rock protection may be required across the entire Proposed Development. However, the aim where possible would be to place rock within the trench, i.e. not above the existing seabed level.

2.9.101 Where necessary, rock protection would extend to a maximum of 1 m above the seabed, which will minimise potential effects on water flow and local hydrodynamics. At the isolated cable crossing locations, protection berms may extend to 1.4 m above the bed.

2.9.102 The impact could directly affect benthic receptors through (highly localised) changes to physical processes and will occur continuously throughout the lifetime of the Proposed Development. However, it is anticipated that any changes in hydrodynamic regime as a result of cable protection 'structures' would only affect a small proportion of the habitats immediately adjacent to the Offshore Cable Corridor.

2.9.103 The impact is predicted to be of local spatial extent and long-term duration. Overall, the magnitude if impact is considered to be **low**.

Significance of effect

2.9.104 The magnitude of the impact has been assessed as **low** with all IEFs being assessed as **negligible** sensitivity. The effect will therefore be of **negligible** significance, which is not significant in EIA terms.

Further Mitigation

2.9.105 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.9.106 No significant effects have been identified and no future monitoring is proposed.

Sediment heating

2.9.107 Nearby sediment heating will occur as a result of the heat produced from the cable during operation.

Sensitivity of receptor

2.9.108 Sensitivity to temperature effects is species-specific and the degree of impact may vary depending on timing, intensity, exposure and speed of temperature changes (Volkoff and Rønnestad, 2020). Increased temperatures can affect receptors directly via behavioural changes such as avoidance, changes in metabolic rates, growth rates and spawning success (Widdows, 1973; Tsoukali et al., 2016; Volkoff and Rønnestad, 2020; Riyanto et al., 2022). Moreover, temperature changes can affect receptors indirectly via changes in prey species.

2.9.109 Species with wholly pelagic life cycles are expected to have very little interaction with the benthic environment (occur away from the ZoI) and as such no impact pathway is expected for these IEFs. Therefore, the sensitivity of horse mackerel, sprat, mackerel, basking shark, porbeagle and blue shark has been assessed as **negligible**. The Offshore Cable Corridor overlaps with spawning grounds for many species which have pelagic eggs. Given the eggs of these pelagic spawners are unlikely to spend significant amounts of time within the ZoI, they are not expected to be affected by sediment heating.

2.9.110 Mobile fish and shellfish are also unlikely to spend significant time within the specific ZoI for a noticeable effect to occur, given their mobile nature. However, benthic fish eggs will be unable to avoid the impact like their adult counterparts. Increases in temperature can influence fish reproductive processes such as the development and survival rates of eggs (Tsoukali *et al.,* 2016). In general, early life stages are more sensitive to temperature changes due to more narrow thermal tolerance ranges when compared to adult counterparts. Benthic eggs are likely to show some degree of sensitivity to sediment heating through effects on hatching and egg laying. For instance, Régnier et al. (2018) observed hatching of lesser sand eels to be influenced by temperature and eggs hatching earlier at a temperature increase of 5°C. Furthermore, the size of hatched larvae was reduced at high incubation temperature. Benthic eggs laid by elasmobranchs are also likely to exhibit similar patterns. A similar finding was, for example, found in a study by Holden et al. (1971) on thornback rays where egg laying rates were observed to increase with increasing temperature.

2.9.111 In addition to egg-life stages, adult sand eels may also be impacted by sediment heating. Winsdale (1974) found adults of lesser sand eel to not significantly change activity patterns in response to a temperature increase of 5 °C. Nonetheless, it is important to note that sand eels exhibit a strong site fidelity, and their distribution may be impacted (on small spatial scales) by the temperature rise if unable to adapt (Heath *et al.,* 2012).

2.9.112 Sediment heating could also affect shellfish. For instance, studies on blue mussel have found their metabolic rate to be temperature dependent and their body condition to decrease with increasing temperature (Widdows, 1973; Bayne and Thomson, 1970). Gastropods have also been documented to have a sensitivity to temperature. For instance, Giacoletti et al. (2017) found that Florida dog winkle *Stramonita haemastoma* feeding rates increased with increasing temperature, albeit the rate of increase varied depending on the type of prey.

2.9.113 All of the sessile to low mobility IEFs naturally occur in areas with higher temperatures than that experienced in the Study Area. While increased temperatures may cause changes in metabolic rates and spawning success for these species or life-stages that occur within close proximity of the cable, any effects are expected to be mild and not to have an impact at a whole stock level. Furthermore, mobile species are not expected to spend significant time within the ZoI and have the ability to avoid the impact.

2.9.114 All IEFs have been considered to be not vulnerable to the impact (high capacity to avoid, adapt and/or tolerate the impact) and are of local to international value. The sensitivity has therefore been considered as **low** for all IEFs.

Magnitude of impact

2.9.115 The Electromagnetic Field and Thermal Study (Amplitude Consultants, 2021) presents increases to ambient sediment temperature associated with the proposed HVDC cable technology. Temperature uplift (sediment heating) predictions for the planned cable bundle(s) can be made by assuming a precautionary 15°C 'soil' ambient temperature (anticipated to be 5 - 10°C along the Offshore Cable Corridor) and a seabed thermal resistivity of 0.7 K.m/W. The target burial depth across the Offshore Cable Corridor is 1.5 m (as calculated by the provisional BAS) therefore the max temp uplift of the surface sediment directly above the cable is estimated to be 4ºC[1], which would rapidly decrease (exponential temperature decay) to a negligible temperature increase at c.2.5m distance from the cable. Given that in most locations the cable will be buried below the seabed surface, the horizontal seabed surface distance to negligible temperature uplift would therefore be less than 2.5m.

2.9.116 Any effects associated with localised sediment / seabed temperatures will therefore be limited to the immediate seabed overlying the cable bundles. The effects of sediment heating are considered to be restricted to the near field (within 2.5 m of cable), long term, continuous (will occur throughout 50 year operation phase) and of low consequence. The impact has been assessed as **low** magnitude.

Significance of effect

2.9.117 The magnitude of the impact has been determined as **low**.

2.9.118 Pelagic IEFs have been assessed as **negligible** sensitivity. Therefore, the effect will be of **negligible** significance, which is **not significant** in EIA terms.

2.9.119 All other IEFs have been assessed as **low** sensitivity. Therefore, the effect will be of **negligible** significance, which is **not significant** in EIA terms.

Further Mitigation

2.9.120 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.9.121 No significant effects have been identified and there is no further monitoring proposed.

Introduction of invasive non-native species

2.9.122 The introduction and spread of INNS may occur during the operation and maintenance phase of the Proposed Development through vessel movements (transfer via their hulls or in ballast water).

Sensitivity of receptor

2.9.123 The sensitivity of the IEFs to introduction of invasive non-native species is the same as that described for construction in **section 2.8**.

[1] Temperature/Distance to cable estimates based on modelled horizontal temperature decay relationships derived at 1.05m depth (Amplitude Consultants, 2021)

Magnitude of impact

2.9.124 Within the UK, pathways of introduction involving vessel movements have been identified as the highest potential risk routes for the introduction of non-native species, via ballast discharge or transportation on vessel hulls (Carlton, 1992; Pearce *et al*., 2012).

2.9.125 The MDS assumes one survey vessel to undertake routine surveys once a year for the first 5 years of operation, then approximately every 5 years for the remainder of the cable lifetime, as well as vessels to support unplanned maintenance and repair, as and when needed. The precise number of vessels, vessel return trips and ports of origin are yet to be determined. However, the increase in vessel numbers as a result of operational phase activities will be small when compared to the baseline environment presented in Volume 3, Chapter 5: Shipping and Navigation, which suggests an average number of 90 vessels per day within 5 nm of the Offshore Cable Corridor.

2.9.126 As set out in **Table 2.19**, to reduce the likelihood of the introduction and spread of INNS, all ships will be subject to the Ballast Water Management Convention (2017).

2.9.127 Any impact is predicted to be of far-field extent and long-term to permanent duration (newly introduced INNS may persist in the environment indefinitely). However, with the implementation of the embedded mitigation measures mentioned above and the very small degree of increase from that of the baseline, the risk of the introduction and spread of INNS is very low. The magnitude has therefore been considered as **negligible**.

Significance of effect

2.9.128 The magnitude of the impact has been determined as **negligible**. All IEFs have been determined as **negligible** sensitivity, therefore the effect will be of **negligible** significance, which is **not significant** in EIA terms.

Further Mitigation

2.9.129 No significant effects have been identified and there is no additional mitigation proposed (beyond the embedded mitigation presented in **Table 2.19**).

Future Monitoring

2.9.130 No significant effects have been identified and there is no further monitoring proposed.

2.10 Preliminary Assessment of Decommissioning Effects

2.10.1 At the end of the operational life of the cable the options for decommissioning will be evaluated and taking into consideration other Proposed Development constraints (e.g. safety and liability), the least environmentally damaging option would usually be chosen. The decommissioning phase activities will be subject to the permitting regimes (and associated Environmental Impact Assessment practices) at the time (+50 years from current day).

2.10.2 Should full removal of the cable from the seabed be required, this would have the potential to cause similar impacts to the construction phase (**section 2.8**), noting that the magnitude of effects associated with cable removal would likely to reduced relative to construction phase impacts (given reduced footprint of disturbance, for example). As a precautionary approach, the impacts identified in the appraisal undertaken in respect of the construction phase are considered to also apply to decommissioning activities.

2.10.3 If cables are de-energised and left *in-situ*, this would result in permanent impacts similar to those identified for the operational phase (with the exclusion of any impacts associated with EMF and sediment heating, and exclusion of any ongoing vessel related impacts). Overall, no effects from decommissioning activities are considered to be significant in EIA terms.

2.11 Cumulative Environmental Assessment

2.11.1 The Cumulative Effects Assessment (CEA) considers the impact associated with the Proposed Development together with other projects and plans. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise (see Volume 1, Appendix 5.3: CEA screening matrix, of the PEIR). 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.

2.11.2 The fish and shellfish CEA methodology has followed the methodology set out in Volume 1, Chapter 5: EIA methodology, of the PEIR. As part of the assessment, all projects and plans considered alongside the Proposed Development have been allocated into 'tiers' reflecting their current stage within the planning and development process (as advocated under the Planning Act, 2008).

- Tier 1
  - Under construction
  - Permitted application
  - Submitted application
  - Those currently operational that were not operational when baseline data were collected, and/or those that are operational but have an ongoing impact
- Tier 2
  - Scoping report has been submitted
- Tier 3
  - Scoping report has not been submitted
  - Identified in the relevant Development Plan
  - Identified in other plans and programmes.

2.11.3 This tiered approach is adopted to provide a clear assessment of the Proposed Development alongside other projects, plans and activities.

2.11.4 The specific projects, plans and activities scoped into the CEA, are outlined in **Table 2.22**, and presented on Figure 1.2 of Volume 1, Appendix 5.3, of the PIER.

Table 2.22: List of cumulative developments considered within the CEA

Project	Status	Distance from Proposed Development (nearest point, km)	Description	Dates of Construction (if available)	Dates of Operation (if available)	Overlap with the Proposed Development?
Tier 1						
Aqua Botanika Nearshore seaweed cultivation of native species	Pending	27.4	A Kelp Farm on ropes with buoys anchored to the seabed or to blocks in roughly 50-meter frequencies, main ropes connecting the buoys in each direction creating a grid. Growing ropes are then connected to main ropes to run parallel at 10-meter centres. Proposal is for multiple bays which equate to an area of 100 hectares.	Autumn 2024	Winter 2024 - Spring 2025	No overlap with construction, however there will be operational overlap with the Proposed Development
TwinHub Floating Offshore Wind Demonstration Project	Under construction	29.5	Two semisubmersible platforms with two turbines each in order to generate up to 32MW power from renewable floating offshore wind energy. The Site already consists of existing cables and onshore infrastructure which was originally granted consent in 2007. No further work to existing infrastructure is anticipated.	Q4 2024	Q2 2025	No overlap with construction, however there will be operational overlap with the Proposed Development
White Cross Floating Offshore Windfarm	Permitted	7.8 (with the Offshore Cable Corridor overlapping / directly adjacent to the White Cross Cable Corridor)	Proposed offshore windfarm located in the Celtic Sea with a capacity of up to 100MW. The Windfarm Site is located over 52km off the North Cornwall and North Devon coast (west-north-west of Hartland Point), in a water depth of 60m – 80m. The Windfarm Site covers 50km2. The current wind turbine design envelope for the project is a WTG capacity of 12-24 MW, 6-8 three bladed horizontal axis turbines with a rotor diameter of 220-300 m.	Mid 2024	2026	No overlap with construction, however there will be operational overlap with the Proposed Development

Project	Status	Distance from Proposed Development (nearest point, km)	Description	Dates of Construction (if available)	Dates of Operation (if available)	Overlap with the Proposed Development?
Celtic Interconnector	Permitted	Crosses offshore cable corridor	700 MW high-voltage direct current submarine power cable under construction between the southern coast of Ireland and the north-west coast of France. The UK elements of the Celtic Interconnector comprise: • A submarine cable within the UK EEZ approximately 211km in length placed on or beneath the seabed. It passes approximately 30km west of the Isles of Scilly and approximately 75km west of Land's End, but does not enter UK Territorial Waters. • Secondary rock protection using rock placement (if required), where target depth of cable lowering is not fully achieved or at cable crossings, with a linear extent of between 0km and 80km or 0 to 270 tonnes. • A fibre optic link shall be laid along the cable route for operational control, communication and telemetry purposes.	2024	2027	No overlap with construction, however there will be operational overlap with the Proposed Development
Tier 2						
None identified						
Tier 3						
The Crown Estate's Celtic Sea Floating Offshore Wind Leasing Round 5 - Project	Future planned development	20.1	PDA 2 sits within Welsh and English Governance and is one of three suitable PDAs identified within the Celtic Sea for floating offshore wind development, each of which having a potential capacity of up to 1.5 GW.	Unknown (the schedule for PDA 2 is unknown, however, pre-consent	Unknown	As the schedule for PDA 2 is currently unknown, there is the potential for overlap with both

Project	Status	Distance from Proposed Development (nearest point, km)	Description	Dates of Construction (if available)	Dates of Operation (if available)	Overlap with the Proposed Development?
Development Area 2 (PDA2)				metocean surveys are planned for early 2024 and geotechnical investigations are planned for summer 2024)		the construction and operational phases of the Proposed Development
The Crown Estate's Celtic Sea Floating Offshore Wind Leasing Round 5 - Project Development Area 3 (PDA3)	Future planned development	Overlaps with portion of the offshore cable corridor	PDA 3 sits within English Governance and is one of three suitable PDAs identified within the Celtic Sea for floating offshore wind development, each of which having a potential capacity of up to 1.5 GW.	Unknown (the schedule for PDA 3 is unknown, however, pre-consent metocean surveys are planned for early 2024 and geotechnical investigations are planned for summer 2024)	Unknown	As the schedule for PDA 3 is currently unknown, there is the potential for overlap with both the construction and operational phases of the Proposed Development

Cumulative Effects Assessment

2.11.5 A description of the significance of cumulative effects upon fish and shellfish receptors arising from construction and operation is given below.

Construction

Tier 1 Projects

2.11.6 There is potential for cumulative impacts as a result of construction, operation and decommissioning activities associated with the other projects overlapping with that of the construction phase for the Proposed Development. However, the projects identified under Tier 1, which include offshore wind farms and a subsea cable, will all be operational at the time that the Proposed Development enters construction (i.e. there will be no overlap of construction of the Proposed Development with the construction of other projects).

2.11.7 Operation and maintenance activities associated with these Tier 1 projects is expected to be similar in nature to that of the Proposed Development. Cumulative impacts between the construction phase of the Proposed Development and the operational phase of the Tier 1 projects may include temporary habitat loss / disturbance, temporary increases in suspended sediments, injury and disturbance from noise, collision risk and changes to water quality. All of these impacts are expected to be very infrequent, short term in duration and low in extent with regards to operation and maintenance activities. While there may be some overlap with these activities with that of the construction of the Proposed Development, it is expected for the majority of the time these impacts would be temporally and / or physically separated. Therefore, the risk of impact on fish and shellfish receptors is not higher than that described in **section 2.8**. Any impacts are considered not significant in EIA terms.

Operation and Maintenance

Tier 1 Projects

2.11.8 Cumulative impacts may arise as a result of the operation and maintenance phase of the Proposed Development overlapping with that of the other Tier 1 projects.

2.11.9 Operation and maintenance activities associated with these Tier 1 projects is expected to be similar in nature to that of the Proposed Development. Cumulative impacts between the operation and maintenance phase of the Proposed Development and the operational phase of the Tier 1 projects may include those impacts associated with repair activities (temporary habitat loss / disturbance, temporary increases in suspended sediments, injury and disturbance from noise, collision risk and changes to water quality). All of these impacts are expected to occur very infrequently, be short term in duration and low in extent. While there may be some overlap between repair activities associated with the Proposed Development and that of the other Tier 1 projects, it is expected for the majority of the time these impacts would be temporally separated.

2.11.10 Cumulative impacts may also arise from non-repair activity related impacts, which include EMF effects, long term habitat loss, changes in hydrodynamic regime and sediment heating. While all of these impacts are continuous and long term they are small in extent and no layered or additive effects are predicted.

2.11.11 Therefore, the risk of impact on fish and shellfish receptors is not higher than that described in **section 2.9**. Any impacts are considered not significant in EIA terms.

Decommissioning

Tier 1 Projects

2.11.12 At the current stage of development, there is limited information on the various project's decommissioning programmes. However, it is anticipated that in general the decommissioning impacts would be similar in nature to those of construction but with a lower magnitude of effect. In addition, it is not confirmed at this time, if the Proposed Development will be decommissioned and cables removed, or decommissioned and cables left *in-situ*.

2.11.13 Any impacts are considered not significant in EIA terms.

2.12 Transboundary Effects

2.12.1 Transboundary effects are defined as those effects upon the receiving environment of other European Economic Area (EEA) states, whether occurring from the Proposed Development alone, or cumulatively with other projects in the wider area. The offshore elements of the Proposed Development (the Offshore Cable Corridor) extends to the edge of the UK EEZ, however the UK project forms just one section of the overall Morocco-UK cable route. The Applicant will seek separate consents for the works within other jurisdictions.

2.12.2 A screening of transboundary impacts has been carried out and any potential for significant transboundary effects with regard to fish and shellfish from the Proposed Development upon the interests of other states has been assessed as part of this PEIR. The potential transboundary impacts initially identified for consideration (within Volume 1,Appendix 5.2 of this PEIR) are summarised below, which include:

- Temporary increases in suspended sediments and associated deposition.
- Injury and disturbance from noise and vibration.

2.12.3 The distance of the Proposed Development from the jurisdictional boundary of the nearest other states are as follows: France (0 km); Ireland (54 km); Guernsey (269 km); Jersey (299 km); and Spain (320 km).

2.12.4 There is potential for transboundary impacts on fish and shellfish due to the mobile and often migratory nature of many of these species. However, any transboundary impacts that do occur as a result of the Proposed Development are predicted to be short-term and intermittent, with the recovery of fish and shellfish to baseline levels following the completion of the work. Therefore, it is predicted to result in transboundary effects of **minor** or **negligible adverse** significance.

2.13 Inter-related Effects

2.13.1 Inter-relationships are the impacts and associated effects of different aspects of the Proposed Development on the same receptor. These are as follows:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the Proposed Development (construction, operation and maintenance), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three phases (e.g., construction noise effects from piling and operational substation noise).
- Receptor led effects: Assessment of the scope for all effects (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 fish and shellfish, such as temporary habitat loss / disturbance and increased levels of suspended sediments and deposition, 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.

2.13.2 A description of the likely interactive effects arising from the Proposed Development on fish and shellfish receptors are provided in Volume 4, Chapter 5: Inter-related effects of the PEIR.

2.14 Summary of Impacts, Mitigation Measures and Monitoring

2.14.1 Information on fish and shellfish within the study area was collected through desktop review and site specific benthic survey.

2.14.2 **Table 2.23** presents a summary of the impacts assessed to be associated with the Proposed Development and residual effects in respect to fish and shellfish.

2.14.3 The appraisal of the potential impacts on fish and shellfish receptors identified impacts not exceeding minor significance and therefore additional mitigation, beyond the embedded mitigation proposed in **Table 2.19** is not considered necessary.

2.14.4 Overall, it is concluded that there will be no significant effects arising from the Proposed Development during the construction, operation and maintenance or decommissioning phases.

2.14.5 A cumulative assessment has been undertaken which has found that the risk of impact on fish and shellfish receptors is not higher than that assessed for the Proposed Development alone. It is concluded that there will be no significant cumulative effects from the Proposed Development alongside other projects / plans.

2.14.6 Potential transboundary and inter-related impacts have been assessed and no significant effects have been identified.

Table 2.23: Summary of potential environmental effects

Impact	Sensitivity of receptors	Short / medium / long term	Magnitude of impact	Significance of effect	Significant / Not significant	Notes
Construction phase						
Temporary habitat loss / disturbance	Negligible to Medium	Short term	Low	Negligible to Minor adverse	Not significant	
Temporary increase in suspended sediments and sediment deposition	Negligible to Low	Short term	Low	Negligible to Minor adverse	Not significant	
Injury and disturbance from noise and vibration	Low	Short term	Low	Minor adverse	Not significant	
Collision risk to basking shark from vessel activities	High	Short term	Negligible	Minor adverse	Not significant	
Changes to water quality as a result of accidental pollution	Low to Medium	Short term	Negligible	Negligible to Minor adverse	Not significant	
Changes to water quality from resuspension of sediments	Low to Medium	Short term	Negligible	Negligible	Not significant	
Introduction of invasive non-native species	Negligible	Long-term to permanent	Low	Negligible	Not significant	
Operational phase (repair)						
Temporary habitat loss / disturbance	Negligible to Medium	Short term	Negligible	Negligible	Not significant	
Temporary increases in suspended sediments	Negligible to Low	Short term	Negligible	Negligible	Not significant	
Injury and disturbance from noise and vibration	Low	Short term	Negligible	Minor adverse	Not significant	
Habitat alteration and long-term habitat loss	Negligible to Medium	Long-term to permanent	Low	Negligible to Minor adverse	Not significant	
Collision risk to basking shark from vessel activities	High	Short term	Negligible	Minor adverse	Not significant	

Impact	Sensitivity of receptors	Short / medium / long term	Magnitude of impact	Significance of effect	Significant / Not significant	Notes
Changes to water quality as a result of accidental pollution	Low to Medium	Short term	Negligible	Negligible to minor adverse	Not significant	
Changes to water quality from resuspension of sediments	Low to Medium	Short term	Negligible	Negligible to minor adverse	Not significant	
Change in hydrodynamic regime	Negligible	Long-term / Permanent	Low	Negligible	Not significant	
Introduction of invasive non-native species	Negligible	Long-term to permanent	Negligible	Negligible	Not significant	
Operational phase (normal)						
Change in hydrodynamic regime	Negligible	Long-term / Permanent	Low	Negligible	Not significant	
Sediment heating	Negligible	Permanent	Low	Negligible	Not significant	
Electromagnetic field (EMF) effects	Low	Permanent	Low	Minor adverse	Not significant	
Decommissioning phase						
Should full removal of the cable from the seabed be required, this would have the potential to cause similar impacts to the construction phase (recognising that this is a precautionary approach and that in reality, impact magnitudes would likely be reduced relative to construction phase on account of e.g. reduced disturbance footprints). If cables are left in-situ, this would result in permanent impacts similar to that identified for the operational phase (normal) with exclusion of any sediment heating or EMF effects. Significance of all decommissioning effects deemed Not Significant.						

2.15 Next Steps

2.15.1 A desk-based review is deemed sufficient to enable characterisation of the baseline environment and to allow a robust assessment of the potential impacts on fish and shellfish receptors. No further site-specific surveys are deemed necessary for incorporation into the ES.

2.15.2 Statutory and non-statutory consultations and ongoing engagement with relevant stakeholders will inform the fish and shellfish assessment presented within the ES.

2.16 References

Aarestrup, K., Jepsen, N. and Thorstad, E. B. (2017) Brown trout on the move–migration ecology and methodology. Brown Trout: Biology, Ecology and Management, 401-444.

Armstrong, J.D., Hunter, D-C, Fryer, R.J., Rycroft, P. and Orwood, J.E. (2015) Behavioural Responses of Atlantic Salmon to Mains Frequency Magnetic Fields. Scottish Marine and Freshwater Science Vol 6 No 9. Edinburgh: Scottish Government, 17pp.

Bache-Jeffreys, M., de Moraes, B.L.C., Ball, R.E., Menezes, G., Pálsson, J., Pampoulie, C., Stevens, J.R. and Griffiths, A.M. (2021) Resolving the spatial distributions of Dipturus intermedius and *Dipturus batis*—the two taxa formerly known as the 'common skate'. Environmental Biology of Fishes, 104, 923-936.

Baglinière, J. L., Sabatié, M. R., Rochard, E., Alexandrino, P. A. U. L. O. and Aprahamian, M. W. (2003) The allis shad *Alosa alosa*: Biology, ecology, range, and status of populations. In American Fisheries Society Symposium (Vol. 35, pp. 85-102).

Barnes, M.K.S. (2008) *Merluccius merluccius* European Hake. In Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Plymouth: Marine Biological Association of the United Kingdom.

Barnes, M.K.S. (2008) *Trachurus trachurus* Horse mackerel (or scad). In Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Plymouth: Marine Biological Association of the United Kingdom. Available from: https://www.marlin.ac.uk/species/detail/97

Barrett, C.J., Cook, A., Stone, D., Evans, C., Murphy, D., Johnson, P., Thain, M., Wyn, G., Grey, M., Edwards, H. and Quigley, D. (2020) A review of American lobster (*Homarus americanus*) records around the British Isles: 2012 to 2018. Hydrobiologia, 847, pp.3247-3255.

Bendall, V. J., Ellis, J. R., Hetherington, S. J., McCully, S. R., Righton, D., and Silva, J. F. (2013) Preliminary observations on the biology and movements of porbeagle *Lamna nasus* around the British Isles. Collect. Vol. Sci. Pap. ICCAT, 69(4), 1702-1722.

Benjamins, S., Cole, G., Naylor, A., Thorburn, J. A. and Dodd, J. (2021) First confirmed co-waltersmplete incubation of a flapper skate (*Dipturus intermedius*) egg in captivity. Journal of Fish Biology, 99(3), 1150-1154.

BERR. (2008) Review of cabling techniques and environmental effects applicable to the offshore wind farm industry. Technical report. January 2008

Bloomfield, A. and Solandt, J.L. (2006) The Marine Conservation Society Basking Shark Watch 20-year report (1987-2006). Ross on Wye, UK: Marine Conservation Society.

Bloor, I. S., Wearmouth, V. J., Cotterell, S. P., McHugh, M. J., Humphries, N. E., Jackson, E. L., E.L. Attrill. M.J. and Sims, D.W. (2013) Movements and behaviour of European common cuttlefish *Sepia officinalis* in English Channel inshore waters: first results from acoustic telemetry. Journal of experimental marine biology and ecology, *448*, 19-27.

Bochert, R., & Zettler, M. L. (2004). Long-term exposure of several marine benthic animals to static magnetic fields. Bioelectromagnetics: Journal of the Bioelectromagnetics Society, The Society for Physical Regulation in Biology and Medicine, The European Bioelectromagnetics Association, 25(7), 498-502.

Bodznick, D., & Preston, D. G. (1983). Physiological characterization of electroreceptors in the lampreys Ichthyomyzon unicuspis and Petromyzon marinus. Journal of comparative physiology, 152, 209-217

Boles, L. C., & Lohmann, K. J. (2003). True navigation and magnetic maps in spiny lobsters. Nature, 421(6918), 60-63.

BOWind (2008), 'Barrow Offshore Wind Farm Post Construction Monitoring Report'. First annual report, 15 January 2008, 60.

Bull, L.J. (1997) Relative velocities of discharge and sediment waves for the River Severn, UK. Hydrological sciences journal, 42(5), 649-660.

Buyse, J., Annelies, D.B. and Hostens, K. (2021) Small-scale distribution patterns of flatfish on artificial hard substrates in a Belgian offshore wind farm. Memoirs, 69

Buyse, J., Hostens, K., Degraer, S., De Troch, M., Wittoeck, J. and De Backer, A. (2023a) Increased food availability at offshore wind farms affects trophic ecology of plaice Pleuronectes platessa. Science of The Total Environment, 862, 160730.

Buyse, J., Reubens, J., Hostens, K., Degraer, S., Goossens, J. and De Backer, A. (2023b) European plaice movements show evidence of high residency, site fidelity, and feeding around hard substrates within an offshore wind farm. ICES Journal of Marine Science, fsad179.

Campana, S. E., Dorey, A., Fowler, M., Joyce, W., Wang, Z., Wright, D. and Yashayaev, I. (2011) Migration pathways, behavioural thermoregulation and overwintering grounds of blue sharks in the Northwest Atlantic. PloS one, 6(2), e16854.

Campbell, N., Allan, L., Weetman, A. and Dobby, H. (2009) Investigating the link between *Nephrops norvegicus* burrow density and sediment composition in Scottish waters. ICES Journal of Marine Science, 66(9), 2052-2059.

Carlton, J. T. (1992). Introduced marine and estuarine mollusks of North America: an end-of-the-20th-century perspective. Journal of shellfish research, 11(2), 489-505

Castège, I., Milon, E. and Pautrizel, F. (2014) Response of benthic macrofauna to an oil pollution: Lessons from the "Prestige" oil spill on the rocky shore of Guéthary (south of the

Bay of Biscay, France). Deep Sea Research Part II: Topical Studies in Oceanography, 106, 192-197

Catchpole, T.L., Ribeiro-Santos, A., Mangi, S.C., Hedley, C. and Gray, T.S. (2017) The challenges of the landing obligation in EU fisheries. Marine Policy, 82, 76-86.

Cates, K., D.P. DeMaster, R.L. Brownell Jr, G. Silber, S. Gende, R. Leaper, F. Ritter and S. Panigada (2017) IWC Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations: 2017-2020.

CEFAS Report. (2016) Suspended Sediment Climatologies around the UK. Report for the UK Department for Business, Energy & Industrial Strategy offshore energy Strategic Environmental Assessment programme.

Chartered Institute of Ecology and Environmental Management (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine (version 1.2 – Updated April 2022.

Chung-Davidson., Y., Bryan, M.B., Teeter, J., Bedore, C.N. and Li, W. (2008) Neuroendocrine and Behavioural Responses to Weak Electric Fields in Adult Sea Lampreys (Petromyzon marinus). Hormones and Behaviour, 54(1), 34-40.

Çinar, M.E., Arianoutsou, M., Zenetos, A. and Golani, D. (2014) Impacts of invasive alien marine species on ecosystem services and biodiversity: a pan-European review. Aquatic Invasions, 9(4), pp.391-423.

Clare, D., Downie, A., Hawes, J. and Langton, B. (2020) East of Haig Fras Marine Conservation Zone (MCZ) Monitoring Report. JNCC/Cefas Partnership Report No. 29. JNCC, Peterborough, ISSN 2051-6711, Crown Copyright.

Close, Williams and Pettigrew. (2019) Ichthyoplankton Analysis Data from the Western Coastal Shelf 2016. Cefas, UK.

Cohen, D. M., Inada, T., Iwamoto, T. and Scialabba, N. (1990) Gadiform fishes of the world. FAO fisheries synopsis, 10(125),442

Cole, S., Codling, I.D., Parr, W. and Zabel, T. (1999) Guidelines for managing water quality impacts within UK European Marine sites. Natura 2000 report prepared for the UK Marine SACs Project. 441 pp.,

Coull, K.A., Johnstone, R. and Rogers, S.I. (1998) Fisheries Sensitivity Maps in British Waters. UKOOA Ltd: Aberdeen.

CSA Ocean Sciences Inc. and Exponent. (2019) Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Sterling, VA. OCS Study BOEM 2019-049. 59 pp.

CSTP. (2016) (Milner, N., McGinnity, P. & Roche, W. Eds) Celtic Sea Trout Project – Technical Report to Ireland Wales Territorial Co-operation Programme 2007-2013 (INTERREG 4A). [Online] Dublin, Inland Fisheries Ireland. Available: http://celticseatrout.com/downloads/technical-report/

Davies, P., Britton, R. J., Nunn, A. D., Dodd, J. R., Crundwell, C., Velterop, R. ... and Bolland, J. D. (2020) Novel insights into the marine phase and river fidelity of anadromous twaite shad Alosa fallax in the UK and Ireland. Aquatic Conservation: Marine and Freshwater Ecosystems, 30(7), 1291-1298.

de Boer, M.N., Jones, D., Jones, H. and Knee, R. (2018) Spatial and temporal baseline information on marine megafauna-data facilitated by a wildlife tour operator. Open Journal of Marine Science, 8(01), 76.

De Mesel, I., Kerckhof, F., Norro, A., Rumes, B. and Degraer, S. (2015) Succession and seasonal dynamics of the epifauna community on offshore wind farm foundations and their role as stepping stones for non-indigenous species. Hydrobiologia, 756, 37-50.

Department for the Environment, Food and Rural Affairs (DEFRA). (2016) Marine Conservation Zones: Bideford to Foreland Point. Access at https://www.gov.uk/government/publications/marine-conservation-zones-bideford-to-foreland-point

Department for the Environment, Food and Rural Affairs (DEFRA). (2019) UKCP18 Science Overview report. Met Office Hadley Centre, Exeter, UK. Available at https://www.daera-ni.gov.uk/articles/uk-climate-change-projections

Department for the Environment, Food and Rural Affairs (DEFRA). Geographic information about the natural environment from across government. Available at https://magic.defra.gov.uk/

Desprez, M. (2000) Physical and biological impact of marine aggregate extraction along the French coast of the eastern English Channel: short and long-term post-dredging restoration. ICES Journal of Marine Science 57 (5), 1428-1438.

Doherty, P.D., Baxter, J.M., Gell, F.R., Godley, B.J., Graham, R.T., Hall, G., Hall, J., Hawkes, L.A., Henderson, S.M., Johnson, L. and Speedie, C. (2017) Long-term satellite tracking reveals variable seasonal migration strategies of basking sharks in the north-east Atlantic. Scientific reports, 7, p.42837.

Douglas, A. B., Calambokidis, J., Raverty, S., Jeffries, S. J., Lambourn, D. M., and Norman, S. A. (2008). Incidence of ship strikes of large Whales in Washington state. J. Mar. Biol. Assoc. 88, 1121–1132.

Ellis, J. Farrell., E. Jung., A. McCully., S. Sims, D. and Soldo, A. (2015) *Lamna nasus* (Europe assessment). The IUCN Red List of Threatened Species 2015: e.T11200A48916453. Accessed on 31 January 2024.

Ellis, J.R., Milligan, S.P., Readdy, L, Taylor, N. and Brown, M.J. (2012) Spawning and nursery grounds of selected fish species in UK waters. Scientific Series Technical Report. Cefas Lowestoft, 147: 56 pp

Environment Agency (EA) (2024a) Transitional & coastal water fish surveys. National Fish Populations Database.

Environment Agency (EA) (2024b) Freshwater Fish Surveys. National Fish Populations Database.

European Marine Observation and Data Network (EMODnet) (2024). Seabed Habitats. Available at: https://emodnet.ec.europa.eu/en/seabed-habitats

European Environmental Agency. (2023) How climate change impacts marine life. Available at: https://www.eea.europa.eu/publications/how-climate-change-impacts. Accessed on: 22/02/2024.

Francis, M. P., Natanson, L. J. and Campana, S. E. (2008) The biology and ecology of the porbeagle shark, Lamna nasus. Sharks of the Open Ocean: Biology, Fisheries and Conservation, 105-113.

Froese, R. and D. Pauly. Editors (2023). FishBase. World Wide Web electronic publication. www.fishbase.org, (10/2023)

Garbett, A., Phillips, N. D., Houghton, J. D., Prodöhl, P., Thorburn, J., Loca, S. L., ... and Collins, P. C. (2021) The critically endangered flapper skate (*Dipturus intermedius*): Recommendations from the first flapper skate working group meeting. Marine Policy, 124, 104367.

Gargan, P. G., Poole, W. R. and Forde, G. (2006) A review of the status of Irish sea trout stocks. Sea trout: Biology, conservation and management, 25-44.

Giacalone, V. M., D'anna, G., Pipitone, C. and Badalamenti, F. (2006) Movements and residence time of spiny lobsters, *Palinurus elephas* released in a marine protected area: an investigation by ultrasonic telemetry. Journal of the Marine Biological Association of the United Kingdom, 86(5), 1101-1106.

Gill, A. B. and Taylor, H. (2001) The potential effects of electromagnetic fields generated by cabling between offshore wind turbines upon elasmobranch fishes (Vol. 33, No. 10). Bangor (UK: Countryside Council for Wales.

Gill, A. B., Gloyne-Phillips, I., Neal, K. J. and Kimber, J. A. (2005) The Potential Effects of Electromagnetic Fields Generated by Sub-Sea Power Cables Associated with Offshore Wind Farm Developments on Electrically and Magnetically Sensitive Marine Organisms – A Review. COWRIE 1.5 Electromagnetic Fields Review.

Griffin, F.J., Smith, E.H., Vines, C.A. and Cherr, G.N. (2009) Impacts of suspended sediments on fertilization, embryonic development, and early larval life stages of the Pacific herring, *Clupea pallasi*. The Biological Bulletin, 216(2), 175-187.

Kavet, R.; Wyman, M.; Klimley, A. and Vergara, X. (2016) Assessment of Potential Impact of Electromagnetic Fields from Undersea Cable on Migratory Fish Behavior. Report by Electric Power Research Institute (EPRI). Report for Bureau of Ocean Energy Management (BOEM). Report for US Department of Energy (DOE).

Hall, J., Stone, E., Gell, F.G. and Hanley, L. (2013) Basking Sharks. In Hanley et al., (eds.), Manx Marine Environmental Assessment. Isle of Man Marine Plan. Isle of Man Government, pp. 38

Hastings, M. C., & Popper, A. N. (2005). Effects of sound on fish (No. CA05-0537). California Department of Transportation.

Hauser, L., Turan, C. & Carvalho, G. Haplotype frequency distribution and discriminatory power of two mtDNA fragments in a marine pelagic teleost (Atlantic herring, Clupea harengus). Heredity 87, 621–630 (2001).

Heath, M.R., Neat, F.C., Pinnegar, J.K., Reid, D.G., Sims, D.W. and Wright, P.J. (2012) Review of climate change impacts on marine fish and shellfish around the UK and Ireland. Aquatic Conservation: Marine and Freshwater Ecosystems, 22(3), 337-367.

Hinz, H., Kaiser, M. J., Bergmann, M., Rogers, S. I. and Armstrong, M. J. (2003) Ecological relevance of temporal stability in regional fish catches. Journal of Fish Biology, 63(5), 1219-1234.

Hinz, H., Bergmann, M., Shucksmith, R., Kaiser, M.J. and Rogers, S.I. (2006) Habitat association of plaice, sole, and lemon sole in the English Channel. ICES Journal of Marine Science, 63(5), pp.912-927.ICES. (2022) Celtic Seas Ecoregion – fisheries Overview. In Report of the ICES Advisory Committee, 2022. ICES Advice 2022, section 7.2. https://doi.org/10.17895/ices.advice.21641312

Hillman, R. (2003) The distribution, biology and ecology of shad in South-West England. Environment Agency.

Holden, M. J., Rout, D. W. and Humphreys, C. N. (1971) The rate of egg laying by three species of ray. ICES Journal of Marine Science, 33(3), 335-339.

Holland, G. J., Greenstreet, S. P., Gibb, I. M., Fraser, H. M. and Robertson, M. R. (2005) Identifying sandeel *Ammodytes marinus* sediment habitat preferences in the marine environment. Marine Ecology Progress Series, 303, 269-282.

Hutchison, Z. L., Gill, A. B., Sigray, P., He, H. and King, J. W. (2020) Anthropogenic electromagnetic fields (EMF) influence the behaviour of bottom-dwelling marine species. Scientific reports, 10(1), 4219.

Hulme, P.E. (2009) Trade, transport and trouble: managing invasive species pathways in an era of globalization. Journal of applied ecology, 46(1), 10-18.

Hvidt, C. B., Bech, M. and Klaustrup, M. (2003) Monitoring programme-status report 2003. Fish at the cable trace. Nysted offshore wind farm at Rødsand. Bioconsult.

ICES. (2022) Celtic Seas Ecoregion – fisheries Overview. In Report of the ICES Advisory Committee, 2022. ICES Advice 2022, section 7.2.

ICES. (2023) Working group on mackerel and horse mackerel egg surveys (WGMEGS). ICES Scientific Reports.

IUCN. (2023). The IUCN Red List of Threatened Species. Version 2023-1. https://www.iucnredlist.org.

Jackson, A.C., 2021. Bayesian occupancy modelling of benthic Crustacea and the recovery of the European spiny lobster, Palinurus elephas. Journal of the Marine Biological Association of the United Kingdom, 101(7), pp.1033-1046.

Jezierska, B., Ługowska, K. and Witeska, M. (2009) The effects of heavy metals on embryonic development of fish (a review). Fish physiology and biochemistry, 35, pp.625-640.

Kavet, R.; Wyman, M.; Klimley, A. and Vergara, X. (2016) Assessment of Potential Impact of Electromagnetic Fields from Undersea Cable on Migratory Fish Behavior. Report by Electric Power Research Institute (EPRI). Report for Bureau of Ocean Energy Management (BOEM). Report for US Department of Energy (DOE).

Kiørboe, T., Frantsen, E., Jensen, C. and Sørensen, G. (1981) Effects of suspended sediment on development and hatching of herring (*Clupea harengus*) eggs. Estuarine, Coastal and Shelf Science, 13(1), 107-111.

Kjelland, M.E., Woodley, C.M., Swannack, T.M. and Smith, D.L. (2015) A review of the potential effects of suspended sediment on fishes: potential dredging-related physiological, behavioral, and transgenerational implications. Environment Systems and Decisions, 35, 334-350.

Krone, R., Dederer, G., Kanstinger, P., Krämer, P., Schneider, C. and Schmalenbach, I. (2017) Mobile demersal megafauna at common offshore wind turbine foundations in the German Bight (North Sea) two years after deployment-increased production rate of Cancer pagurus. Marine environmental research, 123, 53-61.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. & Podesta, M. (2001) Collisions between ships and whales. Marine Mammal Science. 17, 35 – 75

Latto P. L., Reach I.S., Alexander D., Armstrong S., Backstrom J., Beagley E., Murphy K., Piper R. and Seiderer L.J., 2013. Screening Spatial Interactions between Marine Aggregate Application Areas and Sandeel Habitat. A Method Statement produced for BMAPA.

Leslie, B. and Shelmerdine, R. L. (2012) Management measures for self propagated future recovery of crawfish, *Palinurus elephas*, in Welsh waters.

Love, M. S., Nishimoto, M. M., Clark, S. and Bull, A. S. (2016) Renewable Energy in situ Power Cable Observation. U.S. Department of the Interior, Bureau of Ocean Energy Management, Pacific OCS Region, Camarillo, CA. OCS Study, 8, 2016-008.

Lowe, R. H. (1952) The Influence of Light and Other Factors on the Seaward Migration of the Silver Eel (*Anguilla anguilla* L.). Journal of Animal Ecology, 21(2), 275–309.

Lynam, C.P. and Ribeiro, J. (2022) A data product derived from Northeast Atlantic groundfish data from scientific trawl surveys 1983-2020. Cefas, UK. V1. doi:https://doi.org/10.14466/CefasDataHub.126

Maitland, P.S. and Hatton-Ellis, T.W. (2003) Ecology of the Allis and Twaite Shad. Conserving Natura 2000 Rivers Ecology Series No. 3. English Nature, Peterborough.

Mann, R. H. K. and Welton, S. J. (1995) Eel stock assessment in the UK. https://nora.nerc.ac.uk/id/eprint/509628/1/N509628CR.pdf

Marine Management Organisation (2023). UK Sea Fisheries Statistics 2022. Marine Management Organisation, London. Available at: https://www.gov.uk/government/collections/uk-sea-fisheries-annual-statistics

MarLIN. 2024. Norway lobster (*Nephrops norvegicus*). Available at: https://www.marlin.ac.uk/species/detail/1672. Accessed on: 26/02/2024.

Marshall, C.E. and Wilson, E. (2008) *Pecten maximus* Great scallop. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Plymouth: Marine Biological Association of the United Kingdom.

Martin, C.S., Vaz, S., Ellis, J.R., Lauria, V., Coppin, F. and Carpentier, A. (2012) Modelled distributions of ten demersal elasmobranchs of the eastern English Channel in relation to the environment. Journal of Experimental Marine Biology and Ecology, 418, 91-103.

Mason T. (2013). Modeling of subsea noise during the proposed piling operations at the Dudgeon Wind Farm. Subacoustech Report E438R0106.

McCormick, H., Murray, J., Colclough, S., Gessner, J., Greenslade, J., Reynolds, L., Hedges, S., Philipsen, P., Debney, A. (Eds). (2023) UK Sturgeon Conservation Strategy and Action Plan. Zoological Society of London, UK. 39 pp.

Nakano, H. and Stevens, J. D. (2008) The biology and ecology of the blue shark, *Prionace glauca*. Sharks of the open ocean: Biology, fisheries and conservation, 140-151.

Neal, K.J. and Pizzolla, P.F. (2006) *Dipturus batis* Common Skate. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom.

Newell, R.C. Seiderer, L.J. Hitchcock, D.R. (1998) The impact of dredging works in coastal waters: A review of the sensitivity to disturbance and subsequent recovery of biological resources on the seabed. Oceanography and Marine Biology, 36 (1), 127-178.

Norling, P., & Kautsky, N. (2007) Structural and functional effects of Mytilus edulis on diversity of associated species and ecosystem functioning. Marine Ecology Progress Series, 351, 163-175.

Normandeau, Exponent., Tricas, T. and Gill, A.B. (2011) Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09.

OSPAR. (2010) Background Document for Atlantic salmon *Salmo salar* (OSPAR Commision report, p. 25 pp. + annex).

Pade, N. G., Queiroz, N., Humphries, N. E., Witt, M. J., Jones, C. S., Noble, L. R. and Sims, D. W. (2009) First results from satellite-linked archival tagging of porbeagle shark, Lamna nasus: area fidelity, wider-scale movements and plasticity in diel depth changes. Journal of Experimental Marine Biology and Ecology, 370(1-2), 64-74.

Parkhouse, L., Henly, L. and Stewart, J. (2021) Taw-Torridge Estuary Subtidal Mussel Assessment 2021. Available: https://www.devonandsevernifca.gov.uk/wp-content/uploads/2023/09/Taw-TorridgeSubtidalMusselAssessment2021v1.0.pdf

Pawson, M. G. and Ellis, J. R. (2005) Stock identity of elasmobranchs in the Northeast Atlantic in relation to assessment and management. Journal of Northwest Atlantic Fishery Science, 35, 173-193

Popper A. N., Hawkins A. D., Fay R. R., Mann D. A., Bartol S., Carlson T. J., Coombs S. Ellison W. T. · Gentry R. L., Halvorsen M. B., Løkkeborg S., Rogers P. H., Southall B., Zeddies D. G.& Tavolga W. N. (2014) Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report Prepared by ANSI-Accredited Standards Committee S3/Sc1 a (Springerbriefs in Oceanography).

Popper, A. N., & Hawkins, A. D. (2018) The importance of particle motion to fishes and invertebrates. The Journal of the Acoustical Society of America, 143(1), 470-488.

Post, M. H., Blom, E., Chen, C., Bolle, L. J. and Baptist, M. J. (2017) Habitat selection of juvenile sole (*Solea solea* L.): Consequences for shoreface nourishment. Journal of sea research, 122, 19-24.

Potter, I. C., Bird, D. J., Claridge, P. N., Clarke, K. R., Hyndes, G. A. and Newton, L. C. (2001) Fish fauna of the Severn Estuary. Are there long-term changes in abundance and species composition and are the recruitment patterns of the main marine species correlated? Journal of Experimental Marine Biology and Ecology, 258(1), 15-37.

Queiroz, N., Humphries, N. E., Noble, L. R., Santos, A. M., & Sims, D. W. (2010) Short-term movements and diving behaviour of satellite-tracked blue sharks *Prionace glauca* in the northeastern Atlantic Ocean. Marine Ecology Progress Series, 406, 265-279.

Quigley, D.T., Flannery, K., Herdson, D., Lord, R. and Holmes, J.M.C. (2010) Slipper lobster (Scyllarus arctus (L.) (Crustacea: Decapoda) from Irish, UK and Channel Island waters. The Irish Naturalists' Journal, 31(1), pp.33-39.

Régnier, T., Gibb, F. M., & Wright, P. J. (2018). Temperature effects on egg development and larval condition in the lesser sandeel, *Ammodytes marinus*. Journal of Sea Research, 134, 34-41.

Renaud, C.B. (2011) Lampreys of the world. An annotated and illustrated catalogue of lamprey species known to date. FAO Species Catalogue for Fishery Purposes. No. 5. Rome, FAO. 109 pp.

Rigby, C.L. Barreto, R., Carlson, J. Fernando, D., Fordham, S. Francis, M.P. Herman, K. Jabado, R.W. Liu, K.M. Marshall, A. Pacoureau, N. Romanov, E. Sherley, R.B. and Winker, H. (2019) *Lamna nasus*. The IUCN Red List of Threatened Species 2019: e.T11200A500969.

Rijnsdorp, A.D., Van Stralen, M. and Van Der Veer, H.W. (1985) Selective tidal transport of North Sea plaice larvae Pleuronectes platessa in coastal nursery areas. Transactions of the American Fisheries Society, 114(4), 461-470.

Rindorf, A., Wanless, S. and Harris, M. P. (2000) Effects of changes in sandeel availability on the reproductive output of seabirds. Marine Ecology Progress Series, 202, 241-252.

Riyanto, M., Mawardi, W., and Khoerunnisa, F. I. (2022). Temperature effect on heart rate performance of eel (*Anguila bicolor*). In IOP Conference Series: Earth and Environmental Science, 1033(1), 012029. IOP Publishing.

Sabatini, M. and Hill, J.M. (2008) *Nephrops norvegicus* Norway lobster. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 26-09-2019]. Available from: https://www.marlin.ac.uk/species/detail/1672.

Seacon (2005). Sediment spillage during array cable installation at Nysted Offshore Wind Farm, January 2005, Report 0402-1-1-L001 rev.1.

Sims, D., Fowler, S.L., Ferretti, F. and Stevens, J.D. (2015) Prionace glauca (Europe assessment). The IUCN Red List of Threatened Species 2015: e.T39381A48924261.

Sims, D.W., Genner, M.J., Southward, A.J. and Hawkins, S.J. (2001) Timing of squid migration reflects North Atlantic climate variability. Proceedings of the Royal Society of London. Series B: Biological Sciences, 268(1485), 2607-2611.

Sims, D. W., Southall, E. J., Richardson, A. J., Reid, P. C., and Metcalfe, J. D. (2003) Seasonal movements and behaviour of basking sharks from archival tagging: no evidence of winter hibernation. Marine Ecology Progress Series, 248, 187-196.

Smith, C., & Griffiths, C. (1997) Shark and skate egg-cases cast up on two South African beaches and their rates of hatching success, or causes of death. *African Zoology*, *32*(4).

Southall, E.J., Sims, D.W., Metcalfe, J.D., Doyle, J.I., Fanshawe, S., Lacey, C., Shrimpton, J., Solandt, J.L. and Speedie, C.D. (2005) Spatial distribution patterns of basking sharks on the European shelf: preliminary comparison of satellite-tag geolocation, survey and public sightings data. Marine Biological Association of the United Kingdom. Journal of the Marine Biological Association of the United Kingdom, 85(5), 1083.

Speedie, C.D., Johnson, L. A. and Witt, M.J. (2009) Report title. Basking Shark Hotspots on the West Coast of Scotland: Key sites, threats and implications for conservation of the species. Commissioned Report No.339.

Stebbing, P., Johnson, P., Delahunty, A., Clark, P.F., McCollin, T., Hale, C. and Clark, S. (2012) Reports of American lobsters, Homarus americanus (H. Milne Edwards, 1837), in British waters. BioInvasions Records, 1(1), pp.17-23.

Stevens, J. D. (1976) First results of shark tagging in the North-east Atlantic, 1972–1975. Journal of the Marine Biological Association of the United Kingdom 56, 929–937.

Stevens, J. D. (1990) Further results from a tagging study of pelagic sharks in the North-east Atlantic. Journal of the Marine Biological Association of the United Kingdom 70, 707–720.

Stounberg, J. L., Timmerman, K., Dahl, K., Pinna, M., & Svendsen, J. C. (2024) Comparing biogenic blue mussel (*Mytilus edulis*) reef definitions in Northern Europe: Implications for management and conservation. Environmental Science & Policy, 151, 103622.

Suchanek, T.H. (1993) Oil impacts on marine invertebrate populations and communities. American Zoologist, 33, 510-523.

Sumaila, U.R. and Tai, T.C. (2020) End overfishing and increase the resilience of the ocean to climate change. Frontiers in Marine Science, 7, 523.

Tasker, D. G., Whitley, V. H., Mace, J. L., Pemberton, S. J., Sandoval, T. D., & Lee, R. J. (2010, April). Electromagnetic effects on explosive reaction and plasma. In Fourteenth International Detonation Symposium (pp. 1209-1218)

Thatcher, H., Stamp, T., Wilcockson, D. and Moore, P.J. (2023) Residency and habitat use of European lobster (*Homarus gammarus*) within an offshore wind farm. ICES Journal of Marine Science, fsad067.

Thorburn, J., Neat, F., Bailey, D.M., Noble, L.R. and Jones, C.S. (2015) Winter residency and site association in the Critically Endangered North East Atlantic spurdog Squalus acanthias. Marine Ecology Progress Series, 526, pp.113-124.

Thorstad, E. B., Whoriskey, F., Rikardsen, A. H., & Aarestrup, K. (2011) Aquatic nomads: the life and migrations of the Atlantic salmon. Atlantic salmon ecology, 1(6), 1-32.

Thorstad, E. B., Todd, C. D., Uglem, I., Bjørn, P. A., Gargan, P. G., Vollset, K. W., ... & Finstad, B. (2016) Marine life of the sea trout. Marine Biology, 163, 1-19.

Torridge District Council (2018). North Devon and Torridge Local Plan 2011 – 2031. Available at: https://consult.torridge.gov.uk/kse/event/33615/section/ID-5051368-1#ID-5051368-1 (accessed March 2024).

Tsoukali, S., Visser, A. W. and MacKenzie, B. R. (2016) Functional responses of North Atlantic fish eggs to increasing temperature. Marine Ecology Progress Series, 555, 151-165.

Tyler-Walters H., *et al.* 2024. Marine Life Information Network: Biology and Sensitivity Key Information Review Database [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: www.marlin.ac.uk

Uriarte, A., Alvarez, P., Iversen, S. A., Molloy, J., Villamor, B., Martins, M. M. and Myklevoll, S. (2001) Spatial pattern of migration and recruitment of North East Atlantic Mackerel.

van den Brink, A., Godschalk, M., Smaal, A., Lindeboom, H. and McLay, C. (2013) Some like it hot: the effect of temperature on brood development in the invasive crab *Hemigrapsus takanoi* (Decapoda: Brachyura: Varunidae). Journal of the Marine Biological Association of the United Kingdom, 93(1), 189-196.

Vince, M.R. (1991) Stock identity in spurdog (*Squalus acanthia*s L.) around the British Isles. Fisheries research, 12(4), pp.341-354.

Volkoff, H. and Rønnestad, I. (2020) Effects of temperature on feeding and digestive processes in fish. Temperature, 7(4), 307-320.

Westerberg, H. and Langenfelt, I. (2008) Sub-Sea Power Cables and the Migration Behaviour of the European eel. Fisheries Management and Ecology, 15, 369-375.

Westerberg, H., Rännbäek, P. and Frimansson, H. (1996) Effects of suspended sediments on cod egg and larvae and on the behaviour of adult herring and cod. ICES CM E, 19961, 26.

Widdows, J. (1973) The effects of temperature on the metabolism and activity of *Mytilus edulis*. Netherlands Journal of Sea Research, 7, 387-398.

Widdows, J. and Donkin, P. (1992) Mussels and environmental contaminants: bioaccumulation and physiological aspects. In The mussel Mytilus: ecology, physiology, genetics and culture, (ed. E.M. Gosling), 383-424. Amsterdam: Elsevier Science Publ. [Developments in Aquaculture and Fisheries Science, no. 25].

Wilson, L. J. and Hammond, P. S. (2019) The diet of harbour and grey seals around Britain: Examining the role of prey as a potential cause of harbour seal declines. Aquatic Conservation: Marine and Freshwater Ecosystems, 29, 71-85.

Winslade, P. (1974) Behavioural studies on the lesser sandeel *Ammodytes marinus* (Raitt) III. The effect of temperature on activity and the environmental control of the annual cycle of activity. Journal of fish biology, 6(5), 587-599.

Wright, P., Pinnegar, J.K., and Fox, C. (2020) Impacts of climate change on fish, relevant to the coastal and marine environment around the UK. (2020 ed.) MCCIP. https://doi.org/10.14465/2020.arc16.fsh

Wright, R.M. Piper, A.T. Aarestrup, K. *et al*. (2022) First direct evidence of adult European eels migrating to their breeding place in the Sargasso Sea. Scientific Reports, 12(1), 15362.