Connah's Quay Low Carbon Power

Preliminary Environmental Information Report
Volume II, Chapter 12: Marine Ecology

Uniper

The Planning Act 2008
The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017
PINS Reference: EN010166
September 2024

Delivering a better world

Prepared for:
Uniper UK Limited

Prepared by:
AECOM Limited

Table of Contents

Tables

12. Marine Ecology

12.1 Introduction

Overview

12.1.1 This Preliminary Environmental Information Report (PEIR) chapter presents a preliminary assessment of the likely significant environmental effects of Connah's Quay Combined Cycle Gas Turbine (CCGT) with Carbon Capture Plant (CCP) (hereafter referred to as the Proposed Development) with respect to Marine Ecology during the construction, operation (including maintenance), and decommissioning phases of the Proposed Development.

12.1.2 This chapter assesses the potential effects of the Proposed Development on marine ecology, which comprises benthic[1] ecology, coastal and migratory fish, and marine mammals. This has been informed by an overview of the environmental baseline conditions, along with the anticipated key issues likely to be associated with the Water Connection Corridor within the River Dee.

12.1.3 Works carried out in the Water Connection Corridor, below mean high-water springs (MHWS), will be assessed in this chapter. These works are hereafter referred to as 'in-river works'. Any works above MHWS will be assessed in **Chapter 11: Terrestrial and Aquatic Ecology** for other relevant ecological receptors. Note, eel screens are currently fitted on the existing cooling water intake within the Water Connection Corridor. These existing eel screens will either be replaced (if existing cooling water infrastructure is refurbished only), or if new cooling water infrastructure is installed, the new infrastructure will need to meet current legislative requirements including The Eels (England and Wales) Regulations 2009 ('Eels Regulations') (**Chapter 4: The Proposed Development**). The potential impact of undertaking the works to install the new eel screens within the marine environment will be assessed in this chapter.

12.1.4 This chapter should be read in conjunction with **Chapter 4: The Proposed Development, Chapter 5: Construction Management and Programme, Chapter 11: Terrestrial and Aquatic Ecology** and **Chapter 16: Physical Processes** of this PEIR Volume II.

12.1.5 Within this chapter, marine biodiversity has been defined as those estuarine and marine ecological receptors within the tidal reach of the river and found in the area below MHWS, with the exception of birds (e.g. waders, seabirds and waterbirds) and freshwater species (e.g. brook lamprey *Lampetra planeri*, bullhead *Cottus gobio and* Petalwort *Petalophyllum ralfsii*), which are considered in **Chapter 11: Terrestrial and Aquatic Ecology**.

12.1.6 This chapter is supported by the following figures in PEIR Volume III:

- **Figure 12-1: Marine Ecology Study Area**;
- **Figure 12-2: Designated Sites with Marine Ecological Features**;

[1] Anything associated with or occurring on the bottom of a body of water.

- **Figure 12-3: Overview of Intertidal Benthic Habitats within the Study Area**;
- **Figure 12-4: Close-up of Intertidal Benthic Habitats**; and
- **Figure 12-5: Water Framework Directive Sensitive Habitats**.

12.1.7 This chapter is supported by the following appendices in PEIR Volume IV:

- **Appendix 1-B: Scoping Opinion;**
- **Appendix 2-B: Scoping Opinion Responses**;
- **Appendix 7-A: Legislative, Policy and Guidance Framework for Technical Topics**;
- **Appendix 12-A: Marine Ecology Assessment Methodology**;
- **Appendix 12-B: Underwater Sound Effects on Fish**;
- **Appendix 12-C: Relevant Designated Sites**; and
- **Appendix 12-D: Marine Ecology Plates**.

Legislation, Policy and Guidance

12.1.8 Legislation, planning policy, and guidance relating to Marine Ecology and pertinent to the Proposed Development are listed in **Table 12-1**. Further detail regarding these can be found in **Appendix 7-A: Legislative, Policy and Guidance Framework for Technical Topics** (**PEIR Volume IV**).

Table 12-1: Legislation, Planning Policy, and Guidance relating to Marine Ecology

Type	Legislation, Policy and Guidance
Legislation	• Infrastructure Planning (Environmental Impact Assessment (EIA)) Regulations 2017 (Ref 12-1); • Marine and Coastal Access Act 2009 (MCAA) (Ref 12-2); • The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2009 (Ref 12-3); • Marine Strategy Regulations 2010 (Ref 12-4); • The Ramsar Convention (Ref 12-5); • Conservation of European Wildlife and Natural habitats Convention (Bern Convention) 1979 (Ref 12-6); • Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention') (Ref 12-7); • The Wildlife and Countryside Act 1981 (as amended) (WCA) (Ref 12-8); • The Water Environment (Water Framework Directive (WFD)) (England and Wales) Regulations 2017 (Ref 12-9); • The Environment Act 2021 (Ref 12-10); • Environment (Wales) Act 2016 (Ref 12-11); • Salmon and Freshwater Fisheries Act 1975 (as amended) (SAFFA) (Ref 12-12); • The Eels (England and Wales) Regulations 2009 (Ref 12-13); • Conservation of Seals Act 1970 (Ref 12-14); • The Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas 1992 (ASCOBANS) (Ref 12-15); • Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Ref 12-16); and

Type	Legislation, Policy and Guidance
	• Invasive Alien Species (Enforcement and Permitting) Order 2019 (Ref 12-17).
National Planning Policy	• The Overarching National Policy Statement (NPS) for Energy (EN-1) (Ref 12-18); • The NPS for Natural Gas Electricity Generating Infrastructure (EN-2) (Ref 12-19); • The NPS for Natural Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (Ref 12-20); • The NPS for Electricity Networks Infrastructure (EN-5) (Ref 12-21); • Planning Policy Wales (PPW) (Ref 12-22) • Future Wales: The National Plan 2040 (Ref 12-23); • UK Marine Policy Statement (Ref 12-24); and • Welsh National Marine Plan (Ref 12-25).
Local Planning Policy	• Flintshire County Council (FCC) Local Development Plan (LDP) (2015-2030) (Ref 12-26); • HRA to Inform the Assessment of the FCC LDP (Ref 12-27); and • Flintshire County Council Biodiversity Plan 'Supporting Nature in Flintshire 2020-2023'.
National Guidance	• Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines of Ecological Impact Assessment (EcIA) (Ref 12-29); • Canadian sediment quality guidelines (Ref 12-30); • OSPAR background concentrations and background assessment concentrations (BACs) and effect range low (ERL) and effect range median (ERM) concentrations for contaminants (Ref 12-31); • Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise (Ref 12-32); • Screening for Intakes: measures to protect eel and elvers (Ref 12-33); • The Planning Inspectorate (PINS) Advice Note 10: Habitats Regulations Assessment relevant to nationally significant infrastructure projects (Ref 12-34); and • PINS Advice Note 17: Cumulative Effects Assessment relevant to nationally significant infrastructure projects (Ref 12-35).

12.2 Consultation and Scope of Assessment

Consultation

12.2.1 A request for an EIA Scoping Opinion was sought from the Secretary of State (SoS) through the Planning Inspectorate (PINS) in February 2024 as part of the EIA Scoping Process. The EIA Scoping Opinion was adopted on 20 March 2024 (**Appendix 1-B: Scoping Opinion (PEIR Volume IV)**).

12.2.2 Key issues raised in the Scoping Opinion are summarised and responded to in **Appendix 2-B: Matters Raised in the Scoping Opinion** (**PEIR Volume IV**). All issues are being considered during the EIA process, at PEIR stage where possible. Where assessments require additional data sources or modelling outputs not available at the time of writing some key issues will be addressed at the ES stage.

12.2.3 The Applicant met with NRW on 01 July 2024 to agree the requirements for additional marine ecology surveys. This meeting involved discussions regarding benthic surveys, migratory fish surveys and cetacean surveys. It

was agreed with NRW that it was not necessary to undertake migratory fish surveys or cetacean surveys. NRW also requested conducting updated subtidal benthic invertebrate surveys within the Water Connection Corridor in line with NRW best practice *benthic habitat assessment guidance 2022*.

Scope of the Assessment

12.2.4 Following the scoping process that has been undertaken, the scope of the assessment considered in this chapter of the PEIR is as follows:

Construction phase

- permanent and temporary direct loss and physical disturbance to benthic habitats and species from works (including construction phase dredging works and berthing of vessels, such as a jack-up barge (JUB)), at low tide, carried out below MHWS within the Water Connection Corridor section of the Proposed Development;
- physical disturbance to benthic habitats and species from increased suspended sediment concentration (SSC) (i.e. increased turbidity and deposition) within the Zone of Influence (ZoI) (see **Table 12-2** for ZoI definition);
- indirect effects to marine ecology from changes in marine water quality (excluding increased SSC) within the ZoI;
- underwater sound and vibration disturbance to marine ecology, particularly migratory fish, within the ZoI;
- indirect effects to marine ecology from hydromorphological changes (e.g., changes to water flow or sediment movement) within the ZoI;
- introduction and spread of invasive non-native species (INNS) from any in-river works; and
- collisions between any project vessels and marine mammals.

Operational phase

- direct loss and physical disturbance to benthic habitats and species from works (e.g. compressed air blasting to clear eel screen debris build-up) carried out below MHWS within the Water Connection Corridor section of the Proposed Development;
- indirect effects to marine ecology from any changes to existing thermal and chemical effects from treated water discharge (subject to control under the existing permitted limits required for discharges);
- indirect effects to marine ecology from hydromorphological changes (e.g., changes to water flow or sediment movement including ongoing scour) within the ZoI;
- physical disturbance and potential mortality to marine ecology from entrainment and impingement within the cooling water abstraction and discharge infrastructure within the Water Connection Corridor;
- temporary increase in suspended sediment concentrations (SSC) and sediment deposition from the use of compressed air blasting and (if required) a jet washing system leading to increased turbidity, smothering

effects and possible contaminant mobilisation on subtidal habitats and species;

- effects to intertidal habitats and species (including fish) from the deposition of airborne pollutants (e.g., from emissions from the power plant stacks during operation); and

Decommissioning phase

- potential impacts and associated effects are assumed to be similar in nature to the construction phase.

Exclusions from the assessment

12.2.5 The following aspects have not been considered within the scope of the assessment in this chapter of the PEIR:

Construction and Physical disturbance to marine ecology from changes in the airborne soundscape and visual disturbance during the construction and operation phase within the ZoI.

12.2.6 River and land-based construction and operational activities associated with the Proposed Development will create airborne sound and changes in visual cues which has the potential to disturb seals that have surfaced or have hauled out. However, the nearest haul out site for seals is Hilbre Island in the mouth of the Dee Estuary over 15 km downstream of the Proposed Development Site. Due to the intervening distance, there will be no available pathway and therefore no likely significant effect to seals and/or other marine mammals from changes in the airborne soundscape and visual disturbance. This matter has therefore been scoped out of the assessment. Potential disturbance to birds (e.g. waders, seabirds and waterbirds) from changes in the airborne soundscape and visual disturbance during the construction and operation phase has been considered in **Chapter 11: Terrestrial and Aquatic Ecology.**

Physical disturbance to marine ecology from changes in the underwater sound, and visual disturbance during the operation phase

12.2.7 The operational phase of the Proposed Development will not result in changes to underwater sound, or visual disturbance which will impact marine habitats or species. The inspectorate agrees and therefore this matter has been scoped out of the assessment.

MCZs

12.2.8 The nearest Marine Conservation Zone (MCZ) is the Fylde MCZ, which is located over 50 km away (at its closest point). This site is designated for benthic habitats (sand and mud) and due to the intervening distance and absence of potential impact pathways an assessment is not considered necessary. The inspectorate agrees and therefore this matter has been scoped out of the assessment.

12.3 Assessment Methodology

12.3.1 This chapter applies the methodology as defined in **Chapter 2: Assessment Methodology and Consultation** and **Appendix 12-A: Marine Ecology Assessment Methodology** (**PEIR Volume IV**).

Impact Assessment

12.3.2 The assessment has determined the worst-case scenario for impact pathways to marine ecological receptors, in line with the 'Rochdale Envelope' approach (described below) and has focused on those receptors considered to be 'important'. The importance criteria for marine ecological features are based on sensitivity and value of receptors as shown in **Appendix 12-A: Marine Ecology Assessment Methodology (PEIR Volume IV)**.

12.3.3 The importance of an ecological feature has been defined with reference to a specific geographical context and the scale of protection, ensuring consistency with CIEEM (2019; Ref 12-29) guidance. However, marine features are highly connected, with few boundaries, and therefore the levels of geographical importance must reflect this. The levels presented below are based on the level to which the marine ecological receptor may qualify as a legislative or policy designating feature. Therefore, the approach adopts the level of legislative designation as a proxy for the geographical importance of a marine species receptor:

- international (designated National Site Network sites (designated sites) in accordance with the Habitats Regulations – Special Areas of Conservation (SACs), Special Protected Areas (SPAs), as well as Ramsar Sites);
- national (United Kingdom (UK) protected areas – Sites of Special Scientific Interest (SSSI) and Marine Protected Areas (MPAs)); and
- regional or local (ecological features that do not meet criteria for valuation at an international or national level, but that have sufficient value to merit retention or mitigation e.g., for the purpose of ensuring no net loss of biodiversity).

12.3.4 The sensitivity and value of marine ecology receptors are evaluated based on their vulnerability, recoverability and importance. The definitions and criteria of these further explained in **Appendix 12-A: Marine Ecology Assessment Methodology (PEIR Volume IV)**.

12.3.5 The potential magnitude of change on marine ecological features arising from activities occurring as part of the Proposed Development is evaluated in consideration of their beneficial or adverse nature, the extent, duration, timing and frequency of the change and the reversibility of the impact.

12.3.6 Temporary, permanent, direct and indirect impacts have been considered during the construction, operation and decommissioning phases of the Proposed Development, and any mitigation measures necessary have been identified. To comply with National and European policy, consideration is given to the need to maintain and enhance biodiversity. The magnitude criteria are listed in **Appendix 12-A: Marine Ecology Assessment Methodology (PEIR Volume IV)**.

12.3.7 Once, potential magnitude of change has been determined for marine ecological features, the significance of an effect can be determined. The significance of effect considers the impact type and magnitude of impact having regard for the sensitivity of the marine ecological receptor. Further details on significance criteria are discussed in **Appendix 12-A: Marine Ecology Assessment Methodology (PEIR Volume IV)**.

Rochdale Envelope

12.3.8 The setting of design parameters using the 'Rochdale Envelope' approach is described in **Chapter 2: Assessment Methodology and Consultation.** Table 4-1 of **Chapter 4: The Proposed Development** sets out the maximum parameters currently envisaged for the principal components of the Proposed Development. These parameters, together with assumptions regarding the future plans for the existing Connah's Quay Power Station set out in **Chapter 2: Assessment Methodology and Consultation,** have been used to inform the representative worst-case scenario that has been assessed in this chapter, in order to provide a robust assessment of the impacts and likely significance of environmental effects of the Proposed Development at its current stage of design.

12.3.9 In particular, focused use of the Rochdale Envelope (further details on this is set out in **Chapter 5: Construction Management and Programme**) has been adopted for the following aspects:

- Vessel(s);
- Total extent of in-river works;
- Thermal load;
- Underwater sound;
- Water quality;
- Air quality.

12.3.10 Regarding the use of vessels, Connah's Quay North, the Port of Mostyn and/or the Ellesmere Port (via the Manchester Shipping Canal) will be used for deliveries via vessels. The worst-case number of vessels within the estuary, and movement of the vessels through the estuary, will be confirmed as the design develops.

12.3.11 For the total extent of in-river works, the worst-case scenario of an estimated installation of 850 m of interlocking sheet piling for a cofferdam within the Water Connection Corridor, to aid the construction of new cooling water infrastructure, has been assessed. If the existing cooling water infrastructure is refurbished instead, a slightly smaller length, 750 m, of interlocking sheet piling within the Water Connection Corridor would be required. The worst-case scenario also includes the use of a JUB during piling. The cofferdam and the JUB are expected to obstruct less than 50% of the river at low tide. However, this will be confirmed in the ES.

12.3.12 Regarding thermal load, thermal discharge modelling will not be undertaken. Therefore, the worst-case scenario is based on maintaining permitted cooling water discharge temperature limits for new cooling water infrastructure, if required.

12.3.13 For the assessment of underwater sound, we assume the worst-case will involve the installation of 850 m of interlocking sheet piling within the Water Connection Corridor for the construction of new/replacement cooling water infrastructure. It is assumed that a suitable method of piling will be used where practicable, such as vibratory piling, to reduce potential noise, however this has not been confirmed. Therefore, as a worst-case scenario, the use of

impact piling for the installation of 850 m of interlocking sheet pilling has been assessed.

12.3.14 For the assessment of water quality impacts during construction and operation, the worst-case has been described in **Chapter 13: Water Environment and Flood Risk**. The assessment of construction and operational phase impacts to marine ecology is therefore also based upon the worst-case.

12.3.15 For the assessment of air quality impacts during operation, the worst-case has been described in **Chapter 8: Air Quality**.

Assessment Assumptions and Limitations

Assessment Assumptions

12.3.16 The following assumptions have been made with regard to construction of the Proposed Development:

- the Proposed Development is considering two main options for cooling water abstraction and discharge. These options are Option 1 - utilise the existing cooling water abstraction and discharge infrastructure or Option 2 - additional / new abstraction and discharge infrastructure will be provided with the Existing Connah's Quay Power Station cooling water infrastructure remaining *in-situ*. It is assumed that the Water Connection Corridor covers the works area required for which ever option is chosen;
- if new cooling water infrastructure is required, it is assumed that permitted cooling water discharge temperature limits will be maintained;
- based on available data, it is assumed that the sediments present in the Study Area are not contaminated. However, determination of this will be subject to the result of sediment sampling, which is subject to ongoing discussions with NRW and the output will be reflected in the ES as appropriate);
- there is the potential for deliveries via vessel to be made to either the Port of Mostyn, Port of Ellesmere, and / or to Connah's Quay North. No works will be occurring at Port of Mostyn, Port of Ellesmere, or Connah's Quay North;
- construction phase dredging may be required, however full details are not currently known. Therefore, this will be assessed in the ES as appropriate;
- it is assumed that a JUB will be used for construction of the cofferdam, although further details on this is curare not currently available. Assumptions will be made clear in the ES with an assessment of related effects provided where necessary. In this PEIR chapter, potential impacts have been provided within the assessments in Section 12.6;
- sediment suspension and dispersion modelling will be included within the scope of the hydrodynamic modelling, however this will not be available at the PEIR stage and is subject to ongoing discussions with NRW and the output will be reflected in the ES as appropriate;
- equipment vendors and fabrication yard locations, from which material will be transported by vessel, have not been identified yet but will likely be a mix of overseas locations and from within the UK. The use of a vessel

from overseas has the potential to introduce, transport or spread INNS via the hull of the vessel;

- within the final, detailed Construction Environmental Management Plan (CEMP) prepared by the Engineering, Procurement and Construction (EPC) Contractor(s) there will be a Water Management Plan (WMP) or an equivalent section of the final, detailed CEMP that sets out the principles that shall be adhered to in order to manage the risk of water pollution; and
- an Outline INNS Management Plan and Biosecurity Risk Assessment will be produced for the Proposed Development at the ES stage.

12.3.17 The following assumptions have been made for the operational phase of the Proposed Development:

- all effluent will be treated in line with permitted requirements before discharge into water courses;
- there will be no 3D thermal discharge modelling for the discharge of cooling water, as permitted cooling water discharge temperature limits will be maintained for the new or refurbished cooling water infrastructure;
- as outlined in **Chapter 2: Assessment Methodology and Consultation**, it is recognised that the existing Connah's Quay Power Station will not operate at its full installed capacity (4 CCGT units) concurrently with the Proposed Development. Therefore, in the event of phased construction, the Train 1 of the Proposed Development and up to 2 existing Connah's Quay Power Station units could require cooling water at the same time; or following single phase construction (or in the event of phased construction, following commercial operation of Train 2), only the Proposed Development would have demand for abstracted cooling water. The Applicant proposes to maintain the permitted abstraction and discharge parameters as far as reasonably practicable, i.e. abstraction would continue to be limited to periods around high water in line with the current abstraction licence and proposes to engage with Natural Resources Wales on this matter to agree the approach;
- it is assumed that no maintenance dredging will be required for the operational phase. Instead, in the operational phase it is assumed that the intake and outfall infrastructure will be kept clear through the use of a compressed air blasting system, and if required a jet washing system which would be incorporated into the design. The air blast and jet washing activities would only take place on a falling tide to return the silt removed to the estuary sediment budget. Should these options not be sufficient to maintain clean flow through the screen, the use of retrievable screens for mechanical cleaning may be required. As a result, no allowance has been made in this PEIR for the consideration of maintenance dredging, or disposal of dredged material arising as a result of the operation of the cooling water infrastructure; and
- it is assumed that as air blasting and jet washing will only occur on a falling tide, this will not happen within the water column and therefore there will be no pathway for the generation of underwater sound. Therefore, this has been scoped out of further assessment.

12.3.18 The following assumptions have been made for the decommissioning phase of the Proposed Development:

- all assumptions considered to be the same as the construction phase.

12.3.19 Given the above assumptions, this assessment presents a reasonable 'worst-case' approach.

Limitations

12.3.20 A reasonable set of worst-case assumptions have been identified and assessed, using the Rochdale Envelope principle.

12.3.21 Intertidal surveys were carried out 01 and 02 July 2024 and following recent engagement with NRW on the 01 July 2024 (see Section 12.2) additional benthic invertebrate surveys were requested, which are subject to ongoing discussions with NRW and the output will be reflected in the ES as appropriate. Limitations are discussed below.

Construction

12.3.22 Hydrodynamic modelling and 2D sediment suspension modelling have not yet been completed and therefore cannot be used in the PEIR to inform marine ecological impact assessments.

Operation

12.3.23 Air quality modelling has not been completed in time to be included for this assessment and hydrodynamic modelling has not yet been completed, and therefore these also cannot be used to inform operational effects. Therefore, these assessments will also be assessed in further detail at the ES stage.

Decommissioning

12.3.24 Decommissioning will be largely based on Best Available Techniques (BAT) at the time (currently expected to be 30 years from the start of the operation phase) and so the assessment will be largely high-level until BAT are further understood.

12.4 Baseline Conditions and Study Area

Study Area

12.4.1 The study area was defined to include Marine Ecology receptors likely to be at risk from possible direct and indirect impacts that might arise from the Proposed Development, termed the ZoI. The largest potential ZoI is considered to be 10 km from the Proposed Development (for designated sites, with the exception of marine mammals), as shown on **Figure 12-1: Marine Ecology Study Area** (**PEIR Volume III**) and in **Table 12-2**. The mean tidal ellipse (nearshore at the entrance to the Dee Estuary) is approximately 6.2 km, with a maximum tidal excursion of 10 km (see **Chapter 16: Physical Processes** for further information). Therefore, the Rochdale Envelope has been applied so that the baseline characterisation data is sufficient to underpin a reasonable worst-case assessment of impact pathways.

Table 12-2: Study Areas for each Marine Ecological Receptor

Marine Ecological Receptor	ZoI distance	Rational
Designated sites	10 km	The study area for the search for relevant designated sites for marine ecology includes a 10 km radius from the Site within the marine environment (except for marine mammals, as stated below). This spatial extent was chosen on the basis that it is considered to be a worst-case scenario, taking into consideration the mean tidal ellipse and maximum tidal excursion. This distance encompasses the relevant functional habitats and range of movement of most species, particularly migratory fish (see below), present within the predicted ZoIs of the Proposed Development.
Benthic ecology	Tidally influenced limits of the River Dee and Dee Estuary	The study area for benthic ecology covers the tidally influenced limits of the River Dee and Dee Estuary. This includes White Sands, Flint Sands, Bagillt Bank, Holywell Bank, Salisbury Bank, Mostyn Bank and West Hoyle sandbank and extends upstream to around Chester Weir. Upstream of this point, the river's flow is predominantly controlled by freshwater inputs rather than tidal action. **Figure 12-1: Marine Ecology Study Area (PEIR Volume III)**.
Coastal and migratory fish	Tidally influenced limits of the River Dee and Dee Estuary, a regional approach for migratory fish and relevant ICES statistical rectaneelgle	The study area for fish and shellfish is defined as the area comprising the tidally influenced limits of the River Dee and Dee Estuary. This includes White Sands, Flint Sands, Bagillt Bank, Holywell Bank, Salisbury Bank, Mostyn Bank and West Hoyle sandbank and extends upstream to around Chester Weir. Upstream of this point, the river's flow is predominantly controlled by freshwater inputs rather than tidal action. Guidance produced by ABPmer (Ref 12-36) also recommends that a regional approach should be adopted for migratory fish to ensure any fish which may pass through the Study Area and therefore any other sites which may have interaction with the Project, but are beyond the initial screening distance, are also considered. In addition, the wider coastal area which falls within the International Council for the Exploration of the Sea (ICES) statistical rectangle 35E6, which includes the Dee Estuary, has also been considered.
Marine mammals	Celtic Sea with a particular focus on the Dee Estuary	The study area for marine mammals includes the Celtic Sea, which extends beyond the largest predicted ZoI of 10 km for other receptors, recognising the highly mobile and transient nature of marine mammals. It is considered unlikely that most cetacean species will occur in the River Dee itself, due to their preference for open, offshore, deeper waterbodies (e.g. Ref 12-37; Ref 12-38), although consideration has been given to the nearby coastal area. However, for the purposes of assessing the effects of underwater sound resulting from impact piling on marine mammals, harbour porpoise has been used as a worst-case scenario due to its particular sensitivity to noise. The disturbance range (or effective deterrent

Marine Ecological Receptor	ZoI distance	Rational
		range) for harbour porpoise in response to impact piling is considered to be 26 km (Ref 12-39). Therefore, this has been applied to the ZoI where applicable.

Existing Baseline

Designated sites

12.4.2 There are five nature conservation designations (SAC's/SSSI's/Ramsar's) with relevant marine / estuarine receptors within the study area. These designated sites are listed in detail in **Appendix 12-C: Relevant Designated Sites for Marine Ecology Receptors (PEIR Volume IV)** and shown in **Figure 12-2: Designated Sites with Marine Ecological Features (PEIR Volume III)**. The designated sites considered in this chapter, and their distance from the Water Connection Corridor (hydrologically), are:

- The Dee Estuary (Aber Dyfrdwy) SAC / RAMSAR / SSSI (within the Water Connection Corridor) designated for a number of marine Annex I habitats and Annex II lamprey species;
- River Dee and Bala Lake SAC (adjacent to Water Connection Corridor) designated for Annex II Atlantic salmon *Salmo salmar*;
- River Dee (Afon Dyfrdwy) SSSI (approximately 1 km upstream) designated for Annex II Atlantic salmon and brown trout *Salmo trutta*;
- North Anglesey Marine / Gogledd Môn Forol SAC/ MPA (80 km) designated for Annex II Harbour porpoise *Phocoena phocoena*; and
- Lleyn Peninsula and the Sarnau (Pen Llŷn â'r Sarnau) SAC is primarily designated for a number of marine Annex I habitats but is also designated for bottlenose dolphin *Tursiops truncatus* and grey seal *Halichoerus grypus* (160 km).

Benthic Ecology

Estuarine Habitats

12.4.3 The Water Connection Corridor section of the Proposed Development is situated within the River Dee and estuary. The Dee Estuary comprises Annex I habitats which are qualifying features of the Dee SAC / SSSI and River Dee and Bala Lake SAC, listed in **Appendix 12-C: Relevant Designated Sites for Marine Ecology Receptors (PEIR Volume IV)**. Below MHWS, the Water Connection Corridor is dominated by intertidal mudflats with very small areas of saltmarsh, subtidal mixed sediment and intertidal rock (**Figure 12-3: Overview of Intertidal Benthic Habitats within the Study Area** and **Figure 12-4: Close-up of Intertidal Benthic Habitats (PEIR Volume III)**). However, the majority of the saltmarsh habitat present within the Water Connection Corridor is located above MHWS and is therefore assessed in **Chapter 11: Terrestrial and Aquatic Ecology**. These habitats, which also extended beyond the Indicative Site Boundary into the wider Dee Estuary area, are described in further detail below.

12.4.4 The Dee Estuary SAC Marine Habitat Features Maps (Ref 12-40) identify the following Annex I SAC habitats within the Water Connection Corridor:

- **Annex I 1140** Mudflats and sandflats not covered by seawater at low tide:
  - Mud communities; and
  - Muddy sand communities including cockle beds.
- **Annex I 1330** Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*):
  - Low to mid marsh communities; and
  - Mid to upper marsh communities.
- **Annex I 1310** *Salicornia* and other annuals colonizing mud and sand:
  - Possible pioneer low marsh communities; and
  - Pioneer low marsh communities.
- Other estuarine communities:
  - Subtidal sediment communities

12.4.5 On the basis of intertidal surveys undertaken by Countryside Council Wales (CCW) between 2002 and 2005 (available to view on Multi Agency Geographic Information for the Countryside (MAGIC)) (Ref 12-41) the specific estuarine habitats within the Water Connection Corridor were dominated by the following European Nature Information System (EUNIS) biotopes (**Figure 12-4: Close-up of Intertidal Benthic Habitats (PEIR Volume III)**):

- **A2.3** – Intertidal mud;
- **A2.313** *Hediste diversicolor, Macoma balthica* and *Scrobicularia plana* in littoral sandy mud (included in Annex I 1140);
- **A2.2** - Intertidal sand and muddy sand; and
- **A2.241** - *Macoma balthica* and *Arenicola marina* in muddy sand shores (included in Annex I 1140).

12.4.6 There were also smaller areas of **A2.4** - Intertidal mixed sediments - **A2.43** - Species-poor mixed sediment shores (included in Annex I 1140) and **A1** - Intertidal rock - **A1.451** - Enteromorpha spp. on freshwater-influenced and/or unstable upper eulittoral rock (**Figure 12-4: Close-up of Intertidal Benthic Habitats (PEIR Volume III)).**

12.4.7 The small area of subtidal habitat within the Water Connection Corridor is dominated by mud and sandy mud habitat (Ref 12-41). Benthic invertebrate surveys carried out in the River Dee and Dee Estuary show this tidally influenced estuarine habitat to be dominated by species typically present in muddy sand shores (e.g. ragworm *Hediste diversicolor*) (Ref 12-42).

12.4.8 Beyond the Water Connection Corridor, extensive areas of intertidal mudflats and saltmarshes are located downstream of the Dee Estuary. These SAC habitats, located outside of the Indicative Site Boundary, mainly comprise Annex I 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) with some areas of Annex I 1140 Mudflats and sandflats not covered by seawater at low tide and Annex I 1310 *Salicornia* and other annuals colonizing mud and sand. This matches the EUNIS classification of habitats located downstream which were recorded during CCW intertidal surveys (2002 – 2005; available

on MAGIC (Ref 12-41)) to comprise mainly **A2.3** – Intertidal mud and **A2.2** - Intertidal sand and muddy sand.

Benthic Invertebrates

12.4.9 Habitat present in the Dee Estuary where the footprint of the Water Connection Corridor is located (**Figure 12-1: Marine Ecology Study Area (PEIR Volume III)**), consists of fine muddy sand, dominated by ragworm *Hediste diversicolor* and the Baltic tellin bivalve mollusc *Macoma balthica*. Other benthic invertebrates present within the Dee Estuary include the bivalves *Cerastoderma edule*, *Macoma balthica* and *Mya arenaria* and the lugworm *Arenicola marina*, which are typically present in muddy sand shores. Common heart urchin *Echinocardium cordatum*, peppery furrow shell *Scrobicularia plana*, Ensis sp. and polychaete worms such as *Eteone longa* are also typically present in lower shore or shallow sublittoral muddy fine sand. Slightly higher up the shore the sediments are more often dominated by amphipods *Bathyporeia pilosa* and *Corophium arenarium*.

12.4.10 Marine benthic invertebrate surveys were most recently carried out by the Environment Agency (Ref 12-42[2]) in the Dee Estuary in 2015. The surveys included 10 sample sites. The closest sampling site is station #11 which is located approximately 7.5 km downstream of the Site. The surveys collected information regarding the presence and abundance of benthic invertebrate species. The survey findings at these locations were analysed to evaluate benthic composition within the Dee Estuary. The overall benthic composition across all 10 locations comprised 31% molluscs, 25% nematodes, 23% annelids (polychaetes and oligochaetes), 19% crustaceans, and 1% Nemertea, with an overall relatively good species diversity and abundance. Across the sampling sites, the most commonly occurring taxa were Nematoda, *Peringia ulvae*, *Corophium volutator* and *Pygospio elegans.* There were no protected or rare invertebrate species identified in the Environment Agency surveys. The benthic species composition is typical of estuarine muds, likely similar within the Water Connection Corridor though it may have a higher component of more brackish benthic species given the Water Connection Corridor is located a little further upstream.

12.4.11 The invertebrates in the sediments provide an abundant food source for fish and are of particular importance for waterbirds, with over 120,000 birds visiting the estuary during the winter months (Ref 12-43). However, the lower estuary is considered to be the area most likely to support significant numbers of waterbirds (Ref 12-44). Further information on birds is included in **Chapter 11: Terrestrial and Aquatic Ecology**.

Invasive Non-Native Species

12.4.12 One marine INNS, the Chinese mitten crab *Eriocheir sinensis* was identified during the desk study within the Study Area. This species is understood to be spreading throughout the mid and lower catchment of the River Dee (Ref 12-45). No records have been found to indicate the presence of this species within the Water Connection Corridor. Furthermore, preliminary results from the intertidal walkover survey did not identify this species or any habitat suitability for this species within the Water Connection Corridor.

[2] The Environment Agency's database includes information regarding the presence, and number, of benthic invertebrate species at specific marine monitoring points.

12.4.13 This species primarily lives in freshwater; however, it migrates downstream to brackish, estuarine and marine environments to reproduce (Ref 12-46). Mating takes place in brackish conditions in the upper and middle estuary typically from mid-November after which females spawn and retain the eggs until the embryos develop. The highest abundance of larval stages are likely to be found in the Dee Estuary between May and July (Ref 12-46). Suitable estuary water temperature (>12°C) is crucial for larval survival and development (Ref 12-46). Water temperature in the Dee Estuary between October and May is likely to exclude the presence of mitten crab larvae due to low survival rates below 12°C.

12.4.14 Following metamorphosis, juvenile mitten crabs settle out of the water column throughout the estuary and migrate upstream to brackish and freshwater regions. Due to the high peak salinity juveniles are thought to migrate upstream through the River Dee but may not be present in the vicinity of the Site after the summer migration period[3] (Ref 12-47).

12.4.15 Downstream migration of reproductive adults from freshwater habitats occurs during the same period annually across all populations. The migration occurs from August to October and usually peaks during September. The timing of records from the fish trap are consistent with this period. Mating is thought to occur, as in other populations, in the upper estuary from mid-November onwards (Ref 12-47). Reports from a fisherman at Connah's Quay of catches of adult mitten crabs of both sexes and adult size starting in mid-November appear to indicate the arrival of mating adults to the Dee Estuary (Ref 12-46).

12.4.16 The total abundance of mittens crabs in the River Dee has been recorded at the Chester Weir fish trap from 2007 to 2014 (Ref 12-46). Total counts fluctuated between five and 21 individuals between 2008 and 2012. In 2013, the number of increased to 82 individuals and remained at a comparable 76 individuals in 2014. This suggests that Chinese mitten crab abundance is increasing in the River Dee. More recent data on numbers of this species in the river could not be found however, this will be re-assessed at the ES stage.

Coastal and Migratory Fish

12.4.17 The Dee Estuary and River Dee is an important breeding, sheltering and nursery area for many coastal fish species. It also supports a number of migratory species[4] including Atlantic salmon, brown trout, river lamprey *Lampetra fluviatilis*, sea lamprey *Petromyzon marinus*, European eel *Anguilla Anguilla*, twaite shad *Alosa fallax* and smelt *Osmerus eperlanus*. These species are all listed as Species of Principal Importance (SOPI) under the Natural Environment and Rural Communities Act 2006 (NERC).

12.4.18 The River Dee is of particular interest for Atlantic salmon as it is one of the North Wales' index rivers[5] for this species (Ref 12-48; Ref 12-49) and is a designated feature of River Dee and Bala Lake SAC and River Dee (Aber Dyfrdwy) SSSI. The Mynach, Meloch and Ceiriog tributaries are the most important Atlantic salmon spawning tributaries in the Dee catchment. However, the closest of these tributaries to the Dee Estuary is the Afon

[3] Greater numbers of juvenile mitten crabs were observed during July shoreline surveys than the later autumn surveys (Ref 12-13).
[4] Migratory fish species are diadromous fish which migrate between bodies of freshwater and seawater during different life phases.
[5] Index rivers are characterized by their intensive and long-term monitoring programs.

Ceiriog, located upstream approximately 31 km away from the Water Connection Corridor.

12.4.19 The Dee Estuary also supports non-migratory fish populations of brook lamprey Lampetra *planeri,* which in the context of this assessment is considered a freshwater species and is assessed in **Chapter 11: Terrestrial and Aquatic Ecology**.

Spawning and Nursery Grounds

12.4.20 Broadscale fish sensitivity maps (Ref 12-50, Ref 12-51) indicate that there are spawning areas and nursery ground for a number of fish species within the Study Area.

12.4.21 These spawning and nursery grounds are considered to be present mostly in the surrounding coastal areas, although the larvae of some species may occur in the estuary. For example, plaice larvae enter estuarine nursery areas during the flood tide where they stay whilst metamorphosing into adults, at which point they start to prefer sandy sediments and move to coastal areas outside the estuary (Ref 12-52).

12.4.22 The outer Dee Estuary is also recognised as a European bass *Dicentrarchus labrax* nursery area and is a designated European bass nursery area under the Sea Fisheries (Bass Regulation) Order 1990 (Ref 12-45). However, species such as plaice and European bass have pelagic larvae. Due to the nature of the Proposed Development, pelagic spawning and nursery grounds are not considered at risk of disturbance and / or loss. Therefore, pelagic spawners have not been considered further, with the exception of salmon and brown trout, which are important migratory species, known to spawn in the upper reaches of the River Dee. Salmon and brown trout and are discussed further in paragraphs 12.4.24 to 12.4.28.

12.4.23 Benthic spawners are at higher risk of impact due to their association with the benthos. The nursery grounds for herring located in Dee Estuary (Ref 12-50) are of high intensity (Ref 12-51). Spawning and nursery grounds for sandeel are also located within the Dee Estuary (Ref 12-50, Ref 12-51). While total counts of these species present within the River Dee or Dee Estuary is unknown[6] they are both generally understood to be present in the Dee Estuary (Ref 12-45). However, the habitats within the Water Connection Corridor comprise mainly mud and muddy sand which is not the preferred habitat for these species.

Atlantic salmon

12.4.24 Atlantic salmon are protected as an Annex II species of the European Union Directive (92/43/EEC) on the Conservation of Natural Habitats and of Wild Fauna and Flora (known as the Habitats Directive) and are a qualifying feature of River Dee and Bala Lake SAC and the River Dee SSSI (See **Appendix 12-C: Relevant Designated Sites (PEIR Volume IV)** and **Figure 12-2: Designated Sites with Marine Ecological Features (PEIR Volume III)**). They are also listed as a UK Priority Species, are included on the OSPAR list of threatened or declining species, and are listed as SOPI for the purpose of conservation of biodiversity under the NERC. The River Dee is also classified

[6] No Environment Agency fish sampling stations were located within the River Dee and therefore no information on fish counts (TraC data) were available.

as an 'index river' for Atlantic salmon and is therefore, of special interest for this species with the Mynach, Meloch and Ceiriog tributaries being the most important Atlantic salmon spawning tributaries in the Dee catchment (Ref 12-52).

12.4.25 The long-term Atlantic salmon monitoring programme, the 'Dee Stock Assessment Programme' (DSAP), has been carried out by NRW between 1991 and 2023 (Ref 12-49). The DSAP found that there has been an overall decreasing trend over the last 20 years in the overall abundance of Atlantic salmon returning to Chester weir (located >13 km upstream of the Site). Over the last 30 years, the lowest run was recorded in 2019 with a run size of 1,551 returning individuals and in the second lowest run was recorded in 2022, with a run size of 2,956 returning individuals. The main trap catch period (i.e. count numbers) for Atlantic salmon migrating upstream in the Chester Weir during 2022 was between May and August with the peak trap count being between June and August (Plate 12-1 in **Appendix 12-D: Marine Ecology Plates (PEIR Volume IV)**, Ref 12-49). The salmon stock on the River Dee was assessed as being 'at risk' both in 2021 and projected to 2026 (Ref 12-49).

12.4.26 The key migratory period for Atlantic salmon includes much of the spring, summer and autumn months with smolts migrating downstream in spring to early summer (Ref 12-54; Ref 12-55). After spending one to five years at sea, adults return to upstream spawning habitats, which in the River Dee is late summer (Ref 12-49).

Brown trout

12.4.27 Brown trout (sea trout) are UK Priority Species and protected as a SOPI the under the NERC. This species is also a qualifying feature of River Dee SSSI (See **Appendix 12-C: Relevant Designated Sites (PEIR Volume IV)**). The River Dee is also an important river for migrating brown trout. The most recent DSAP run estimates recorded 13,991 individuals within the River Dee in 2019, which is slightly above the long-term average run estimates at 11,900 individuals between 1991 and 2019 (Ref 12-42). The brown trout stock is also classified as 'probably at risk' both in 2021 and projected to 2026 (Ref 12-49).

12.4.28 The general migration period for brown trout is similar to Atlantic salmon between spring and autumn months with smolts migrating downstream in spring and early summer and adults returning to upstream habitats peaking in June to August, as in the River Dee (Plate 12-1) (**Appendix 12-D: Marine Ecology Plates (PEIR Volume IV)**), Ref 12-49; Ref 12-54; Ref 12-55).

European eel

12.4.29 The European eel is a UK Priority Species, on the OSPAR list of threatened or declining species, and a SOPI under the NERC. Although this species is not a qualifying feature of any relevant designated site, it is known to be present in the River Dee.

12.4.30 While there are no specific count data for European eels[7] or specific information on their migration period within the River Dee, they generally migrate upstream into freshwater during spring but may continue to do so until early Autumn (Ref 12-55; Ref 12-56). Once within freshwater habitats,

[7] No Environment Agency fish sampling stations were located within the River Dee and therefore no information on fish count data (i.e. TraC data) were available.

European eels remain for five to 15 years, transforming into yellow eels and then finally to silver eels when they begin their downstream migration through rivers and estuaries towards spawning grounds in the marine environment, predominately between August and December (Ref 12-57; Ref 12-58). Spawning occurs mainly in spring (Ref 12-59). Some European eels do not migrate into freshwater but instead inhabit estuaries before returning to spawning grounds.

Sea lamprey and river lamprey

12.4.31 Sea lamprey and river lamprey are protected as an Annex II species of the Habitats Directive and are a qualifying feature of The Dee Estuary SAC and River Dee and Bala Lake SAC (See **Appendix 12-C: Relevant Designated Sites (PEIR Volume IV)**). They are also listed as a SOPI under the NERC. Sea lamprey is further listed as a UK Priority Species and is on the OSPAR list of threatened or declining species.

12.4.32 Sea lamprey and river lamprey are both anadromous migratory species, spawning in freshwater. Adults return to freshwater once they have spent several years in the marine environment (Ref 12-60). Both species spawn in spring and early summer (Ref 12-60).

12.4.33 The UK distribution of river lamprey and sea lamprey, (presented in Plate 12-2 (outlined by the red circles), **Appendix 12-D: Marine Ecology Plates (PEIR Volume IV)**), suggests that both species have been recorded in the River Dee (Ref 12-61 and Ref 12-62). However river lamprey appear to be more widely recorded throughout Wales and the River Dee. Records of river lamprey caught at the fish trap at Chester weir indicate that mature adults undertake their upstream migration at two different periods of the year, either early spring (March-April) or late summer/autumn (August-November). While recent numbers of river lamprey at Chester Weir are not avalible, 421 individuals have been recorded at eight sites in 2014 within the River Dee and Bala Lake SAC (Ref 12-63).

12.4.34 Records of sea lamprey caught at the fish trap at Chester Weir indicate that mature adults migrate upstream almost exclusively during the months of May and June (Ref 12-63). Although, not designed to trap lamprey, the fish trap at Chester Weir recorded 32 individuals of sea lamprey in 2013 (between May and July), zero individuals in 2014 and 8 in 2015 (in July).

Marine Mammals

12.4.35 The Water Connection Corridor is located within the ICES Celtic Sea ecoregion (Ref 12-64), which in part forms the boundaries for the Inter-Agency Marine Mammal Working Group (IAMMWG) marine mammal Management Units (MUs) for the Celtic Sea. Within this region, 13 cetacean species occur. The five most commonly occurring species are harbour porpoise, bottlenose dolphin, common dolphin, *Delphinus delphis*, Risso's dolphin *Grampus griseus* and minke whale *Baleanoptera acutorostrata*.

12.4.36 Marine mammals are highly mobile and transient organisms, which means that local impacts can result in implications to wider populations. As such, the study area reflects MUs defined by IAMMWG for the most common cetaceans (**Table 12-3**). These MUs have been established to reflect biological population structure, movement, habitat use, and relevant management boundaries (Ref 12-65).

Table 12-3: IAMMWG Management Units for common cetacean species in the UK

Species	MU Name	MU Extent
Harbour porpoise	Celtic and Irish Seas	Entire territorial waters (TW) of southwest coast of England, Wales, and Ireland, including the western English Channel.
Bottlenose dolphin	Irish Sea	Irish Sea between St George's Channel and the North Channel
Common dolphin	Celtic and Greater North Seas	All TW around Great Britain and beyond
Risso's dolphin	Celtic and Greater North Seas	All TW around Great Britain and beyond
Minke whale	Celtic and Greater North Seas	All TW around Great Britain and beyond

12.4.37 A summary of conservation protection afforded to the five most common species is presented in **Table 12-4.**

Table 12-4: Protection status of common cetaceans present in the Study Area

Species	Wildlife and Countryside Act 1981	EC Habitats Directive (Annex)	Bonn Convention (Appendix)	Bern Convention (Appendix)	ASCOBANS
Harbour porpoise	✓	II, IV	II	II	ü
Bottlenose dolphin	✓	II, IV	II	II	✓
Common dolphin	✓	-	I, II	II	✓
Risso's dolphin	-	-	II	II	✓
Minke whale	✓	IV	-	II	-

12.4.38 An additional five species occur regularly in the ecoregion but are less common: white-beaked dolphin *Lagenorhynchus albirostris*, Atlantic white-sided dolphin *Lagenorhynchus acutus*, fin whale *Balaenoptera physalus* long-finned pilot whale *Globicephala melas*, and killer whale *Orcinus orca*.

12.4.39 In the Northeast Atlantic, cetacean abundance has been monitored via the SCANS project. This has been a ship and aerial-based effort to quantify cetacean abundance and distribution throughout the UK and Northeast Atlantic. The most recent effort (SCANS IV) occurred in 2022, the data from

which are presented here (Ref 12-66). Abundance estimates are divided into blocks (Plate 12-3 in **Appendix 12-D: Marine Ecology Plates (PEIR Volume VI)**), with the relevant block containing the Water Connection Corridor being CS-E. Consideration has also given to the adjacent block CS-D, which also encompasses the Irish Sea.

12.4.40 The most recent abundance estimates for the relevant SCANS blocks are provided in **Table 12-5**.

Table 12-5: Abundance and density estimates for SCANS Blocks CS-E and CS-D

Species	SCANS Block CS-E		SCANS Block CS-D	
	Estimated Abundance	Estimated Density (ind. km^{-2})	Estimated Abundance	Estimated Density (ind. km^{-2})
Harbour porpoise	6,325	0.515	9,773	0.280
Bottlenose dolphin	127	0.010	8,199	0.235
Common dolphin	0	0	949	0.027
Risso's dolphin	0	0	75	0.002
Minke whale	108	0.009	477	0.014

Harbour Porpoise

12.4.41 Harbour porpoise are widespread and abundant throughout UK waters including the Irish and Celtic Seas. They most commonly occur in continental shelf waters less than 100 m deep and are frequently observed in coastal bays and estuaries. Along the west coast of the UK, modelling of harbour porpoise density indicates that high densities occur year-round in the eastern Irish Sea in the coastal waters east of the Isle of Man (Ref 12-67).

12.4.42 The Water Connection Corridor occurs within IAMMWG Celtic and Irish Sea MU for harbour porpoise. The most recent estimated abundance for this MU is 62,517 individuals.

12.4.43 Within the MU, there are several sites designated for the protection of harbour porpoise: North Anglesey Marine/Gogledd Môn Forol SAC (80 km from the Water Connection Corridor), North Channel SAC (181 km from the Water Connection Corridor), West Wales Marine/Gorllewin Cymru Forol SAC (188 km from the Water Connection Corridor), and the Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC (361 km from the Water Connection Corridor). The North Anglesey Marine/ Gogledd Môn Forol SAC has been designated for its persistently high density of harbour porpoise (Ref 12-68). In summer, it is in the top 10% of densities for harbour porpoise in UK waters (Ref 12-68). It is estimated that the designated site hosts approximately 1,084 individuals for at least part of the year, comprising 4% of the Celtic and Irish Sea MU population (Ref 12-68).

12.4.44 However, harbour porpoise are only considered occasional visitors to the Dee Estuary and are most often observed around and offshore from the estuary mouth at high tide rather than further up the river (Ref 12-69). Thus, presence within the Water Connection Corridor is expected to be minimal.

12.4.45 Harbour porpoise were considered to be 'in decline' in the Celtic Seas (including the Irish Sea) by the OSPAR commission (2008), however, the range and future prospect of the harbour porpoise in the UK is considered to be of 'favourable' conservation status (Ref 12-70). Globally, this species is considered 'least concern,' despite previously being considered vulnerable (Ref 12-71).

Bottlenose Dolphin

12.4.46 Bottlenose dolphin have a near global distribution and are common throughout UK waters. In the Irish Sea a resident population is believed to occur, particularly along the north coast of Wales (Ref 12-72). The Water Connection Corridor occurs within the IAMMWG Irish Sea MU for bottlenose dolphin. The most recent abundance estimate for this MU is 293 individuals.

12.4.47 There are two recognised ecotypes of bottlenose dolphins – a coastal ecotype which primarily occurs within 30 km of the coastline and exhibits habitat fidelity, and a wide-ranging offshore ecotype (Ref 12-73). The coastal ecotype is more common in the UK, with an estimated 700 individuals distributed across four regions: the greater North Sea, coastal southwest England, western Scotland, and coastal Wales (Ref 12-74).

12.4.48 Within the MU, sites designated for the protection of bottlenose dolphin are the Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC (174 km) and the Cardigan Bay/ Bae Ceredigion SAC (265 km). However, there is very little indication that bottlenose dolphin are regular visitors to the River Dee and Estuary, with presence considered to be limited to small numbers of individuals very occasionally.

Common Dolphin

12.4.49 The common dolphin is abundant in the northern Atlantic, occurring in the UK primarily offshore west Scotland, western English Channel, and in the Irish and Celtic Seas (Ref 12-75). It is most common in the western approaches to the Channel and the deeper waters of the Irish Sea. Some seasonal movements are apparent, with an influx of species along the continental shelf between July and October. Modelling of common dolphin density indicates that common dolphin marginally increase their range in summer months, with increased densities occurring in the Irish Sea during at this time (Ref 12-67).

12.4.50 The Water Connection Corridor occurs within the IAMMWG Celtic and Greater North Sea MU for common dolphin. The most recent abundance estimates for this MU is 102,656 individuals. However, there is very little indication that common dolphin are regular visitors to the River Dee and Estuary, with presence limited to small numbers of individuals very occasionally.

Risso's Dolphin

12.4.51 Risso's dolphin occur globally between 60°N and 60°S, although it prefers waters warmer than 10-12°C (Ref 12-76). In the northeast Atlantic, their main range is along the west coast of Ireland. In summer months, their range extends to the west coast of the UK (including the Irish Sea), up to the

Shetland Isles of Scotland (Ref 12-67). Major populations are considered to occur around the Hebrides, and regularly occurs in small numbers near Shetland, Orkney, and in the Irish Sea (Ref 12-76).

12.4.52 The Water Connection Corridor occurs within the IAMMWG Celtic and Greater North Sea MU for Risso's dolphin. The most recent abundance estimates for this MU is 12,262 individuals. However, Risso's dolphin are not considered to be regular visitors to the Dee Estuary and are considered unlikely to be present within the vicinity of the Water Connection Corridor.

Minke Whale

12.4.53 The minke whale has a global distribution in tropical, temperate, and polar seas. They seasonally migrate from polar feeding grounds to temperate and tropical breeding grounds, although some may remain in temperate regions year-round. In the UK, this species is widely distributed across the northeastern Atlantic, and occurs regularly in the northern and central North Sea. In the Irish Sea, it occurs in small numbers but is primarily in the deeper central region.

12.4.54 The Water Connection Corridor occurs within the IAMMWG Celtic and Greater North Sea MU for Minke whale. The most recent abundance estimates for this MU is 20,118 individuals. However, due to a preference for deeper waters, this species is unlikely to be found in the River Dee and Estuary.

Other Cetaceans

12.4.55 In addition to the most common species described above, an additional five species are known to occur within the study area:

- White-beaked dolphin;
- Atlantic white-sided dolphin;
- Fin whale;
- Long-finned pilot whale; and
- Killer whale.

12.4.56 These five species are common in deeper waters ranging from 50 to 2,000 m and primarily occur in continental shelf waters (Ref 12-77; Ref 12-78; Ref 12-79; Ref 12-80; Ref 12-81). White-beaked dolphin are present in the northern Irish Sea year-round in depths of 50 to 100 m (Ref 12-77) and fin whales, long-finned pilot whale and killer whales are also occasionally observed. However, due to the preference for deeper water environments, the presence of these species in the River Dee and Estuary is highly unlikely and therefore they are not considered further.

Pinnipeds

12.4.57 Two seal species occur in the northeast Atlantic, the harbour seal *Phoca vitulina* and grey seal *Halichoerus grypus*, with the UK known to support important populations of both species. For harbour seal, approximately 32% of the European population is found in the UK, with a current population estimate in UK waters of 43,750 individuals (Ref 12-82). For grey seal, 36% of the world's population breeds in the UK, with the most recent population estimate of 157,300 individuals (Ref 12-83). However, approximately 86% of this population resides in Scottish waters.

12.4.58 Seal MUs have been defined by the Special Committee on Seals (SCOS; Plate 12-4 in **Appendix 12-D: Marine Ecology Plates (PEIR Volume IV)**) based on expert knowledge and opinion of seal ecology in the UK, using a pragmatic approach to management without inferring discrete populations (Ref 12-83). The Water Connection Corridor lies along the border between the Wales and Northwest England MU. The most recent abundance estimates for harbour and grey seal within these MUs are provided in **Table 12-6**.

12.4.59 Both harbour and grey seal use haul out sites for breeding, resting, and moulting. They are occasionally seen in the River Dee, with the closest haul-out site for both species on the West Hoyle sandbank (Hilbre Island, located 15 km downstream). This haul-out is considered to be the most important haul-out site in Wales, with over 800 grey seals recorded here (Ref 12-84). Grey seals are the only pinniped species to breed in Wales, however the West Hoyle haul-out site is used throughout the year, with peak numbers during the summer months, and no recent records of pup births (Ref 12-84). Harbour seals are also recorded hauled-out on the West Hoyle sandbank, however exact haul-out numbers of this species are not known.

12.4.60 The nearest designated site for pinnipeds is the Pen Llyn a'r Sarnau SAC which is designated for grey seals and is located over 160 km south-west of the Site. Additional designated sites within the relevant MUs are Cardigan Bay/Bae Ceredigion SAC and Pembrokeshire Marine/ Sir Benfro Forol SAC for grey seal.

12.4.61 Due to the presence of the haul-out site on West Hoyle sandbank, there is potential for both harbour and grey seals to be present upriver within the vicinity of the Water Connection Corridor. However, this is expected to be limited to occasional presence of a small number of individuals as the haul-out site is some distance from the Proposed Development.

Table 12-6: Abundance estimates for harbour and grey seal within the study area

Species	Southwest England MU Abundance	Wales MU Abundance
Harbour seal	0	10
Grey seal	500	900

Summary of Existing Baseline

12.4.62 Based on the information provided in Section 12.4, the following sensitive marine ecology receptors and their closest location to the Proposed Development are listed in **Table 12-7.**

Table 12-7: Sensitive Receptors within the Existing Baseline

Sensitive Receptor	Closest location to the Proposed Development
Mudflats and sandflats not covered by seawater at low tide	Within the Water Connection Corridor
Saltmarsh	Small area present within Water Connection Corridor

Benthic communities of molluscs, nematodes, crustaceans and nemerteans	Within and adjacent to the Water Connection Corridor
Atlantic salmon	Passing through periodically, adjacent to the Water Connection Corridor
Sea and river lamprey	Passing through periodically, adjacent to the Water Connection Corridor
European eel	Within River Dee and Estuary
Twaite shad	Within River Dee and Estuary
Smelt	Within River Dee and Estuary
Herring	Dee Estuary
Sandeel	Dee Estuary
European bass	Dee Estuary
Harbour porpoise	Irish Sea
Bottlenose dolphin	Irish Sea
Common dolphin	Irish Sea
Risso's dolphin	Irish Sea
Minke whale	Irish Sea
Harbour seal	River Dee (occasionally), West Hoyle sandbank
Grey seal	River Dee (occasionally), West Hoyle sandbank

Future Baseline

12.4.63 The future baseline scenarios are set out in **Chapter 2: Assessment Methodology and Consultation.**

12.4.64 This section considers any changes to the baseline conditions described above that might occur over the lifespan of the Proposed Development, regardless of its presence (i.e. in the event it is not installed).

12.4.65 There is uncertainty surrounding the impacts of climate change on benthic ecology around the UK, and whether long-term changes in ecosystems are related to changes in the climate and nutrients or internal factors such as predation (Ref 12-85). This is particularly considered the case with muddy sediment substrates present within the Water Connection Corridor and River Dee. These environments are subject to naturally high variability often observed in benthic communities, influenced by stochastic events such as larval settlement and the patchy distribution of many species. While muddy sediments are less dynamic compared to mobile sandbanks, they still experience significant ecological fluctuations. The variability in these habitats complicates the assessment of long-term changes, as it can be challenging to disentangle the effects of climate change from natural cycles and internal ecological processes.

12.4.66 There have also been substantial changes in fish communities in the north-east Atlantic, thought to be influenced by human exploitation. As well as coming under severe pressure from anthropogenic factors, particularly fishing, fish communities are likely to be affected by future climate change through a rise in sea temperatures (Ref 12-85). Climate change may influence fish

distribution and abundance by affecting growth rates, recruitment rates, behaviour, survival and responses to changes at other trophic levels (Ref 12-86).

12.4.67 Changes to fish populations can also cause knock-on effects for marine mammals due to reduced prey availability. For example, the distribution of bottlenose dolphin around the coast of Wales appears to have changed recently, for example with the number of individuals classified as resident in the Cardigan Bay SAC having declined raising concerns about the possible reasons (Ref 12-87). At present, there is no evidence to infer any negative effect to the population and bottlenose dolphins, currently classified as 'favourable' in both the Cardigan Bay SAC and the Lleyn Peninsula and the Sarnau SAC (Ref 12-87).

12.4.68 An increase in ocean acidification is also being observed in line with rising atmospheric carbon dioxide (CO_2) conditions and other greenhouse gases. This can reduce the levels of important minerals such as aragonite (Ref 12-88 and Ref 12-89) on which many shell-forming organisms rely. However, an estimated 70% of cold-coral locations are expected to be in waters under-saturated by aragonite, but over saturated by CO_2, by the end of the century. Without sufficient minerals, many shell-forming organisms such as molluscs will struggle to grow and maintain their structures, leading to weaker and more fragile shells. In comparison, macroalgae and seagrass species are expected to thrive and grow in increased CO_2 conditions (Ref 12-89).

12.4.69 These changes are expected to continue to occur regardless of the Proposed Development.

12.5 Development Design and Embedded Mitigation

12.5.1 The Proposed Development has been designed, as far as possible, to avoid or minimise impacts and effects on Marine Ecology through the process of design development, and by embedding measures into the design of the Proposed Development.

12.5.2 The following embedded mitigation measures have been incorporated into the Proposed Development design, with proposals and locations to be submitted with the Development Consent Order (DCO) Application:

- implementation of a Framework Construction Environmental Management Plan (CEMP) and Outline Site Waste Management Plan (SWMP), with measures including;
  - control and minimize the risk of pollution to surface waters by managing construction site run-off; and
  - measures to control storage, handling and disposal of polluting substances.
- a Pollution Prevention Plan, including an emergency spill plan;
- installation of measures to control the movement of construction site run-off;
- the placement of eel screens across abstraction and discharge infrastructure, in line with The Eels (England and Wales) Regulations 2009

(Ref 12-13). Committed eel screen mesh sizes and water intake velocities will be agreed with NRW (the regulator) and employed to protect eels; and

- a Decommissioning Environmental Management Plan (DEMP).

12.5.3 The following construction best practice measures are relevant to this assessment and are to be adopted by the Proposed Development:

- JNCC statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise;
- International Regulations for Preventing Collisions at Sea (IMO, 1972);
- International Convention for the Prevention of Pollution from Ships (MARPOL Convention 73/78);
- International Maritime Organisation (IMO) Guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species (Biofouling Guidelines); and
- International Convention for the Control and Management of Ships' Ballast Water and Sediments with the aim of preventing the spread of marine INNS.

12.6 Preliminary Assessment of Likely Impacts and Effects

12.6.1 Taking into account the embedded mitigation measures, as defined in Section 12.5 above, the potential impacts and effects of the Proposed Development have been assessed using the methodology defined in Section 12.3 of this chapter, **Appendix 12-A: Marine Ecology Assessment Methodology (PEIR Volume IV)** and **Chapter 2: Assessment Methodology and Consultation**.

Table 12-8: Potential Impacts Considered Further in the Assessment and Marine Ecological Receptors Most Likely to be Affected by the Proposed Development

Potential Impacts	Designated Sites	Benthic Ecology	Coastal and Migratory Fish	Marine Mammals
Construction				
Permanent and temporary direct loss and physical disturbance to benthic habitats and species from works (including construction phase dredging works and berthing of vessels, such as a jack-up barge (JUB), at low tide) below MHWS within the Water Connection Corridor	✓	✓		
Physical disturbance to marine ecology from temporary increase in SSC and subsequent sediment deposition leading to increased turbidity, smothering effects and	✓	✓	✓	✓

Potential Impacts	Designated Sites	Benthic Ecology	Coastal and Migratory Fish	Marine Mammals
possible contaminant mobilisation.				
Effects to marine ecology from changes in marine water quality due to accidental spills within the ZoI	✓	✓	✓	✓
Underwater sound and vibration disturbance to marine ecology, particularly migratory fish, within the ZoI			✓	✓
Indirect effects to marine ecology from hydromorphological changes (e.g. changes to water flow or sediment movement) within the ZoI		✓		
Introduction and spread of INNS from any in-river works	✓	✓		
Collisions between any project vessels and marine mammals, particularly seals				✓
Operation				
Direct loss and physical disturbance to benthic habitats and species from works carried out below MHWS within the Water Connection Corridor section of the Site	✓	✓		
Indirect effects to marine ecology from any changes to existing thermal and chemical effects from treated water discharge (subject to control under existing permitted limits required for discharges)		✓	✓	
Indirect effects to benthic ecology from hydromorphological changes (e.g. changes to water flow or sediment movement) within the ZoI, including ongoing scour		✓		
Physical disturbance and potential mortality to benthic and fish and shellfish ecology from entrainment and impingement within the cooling water abstraction and discharge infrastructure within the Water Connection Corridor		✓	✓	

Potential Impacts	Designated Sites	Benthic Ecology	Coastal and Migratory Fish	Marine Mammals
Temporary increase in suspended sediment concentrations (SSC) sediment deposition from the use of compressed air blasting and (if required) a jet washing system leading to increased turbidity, smothering effects and possible contaminant mobilisation		✓	✓	✓
Effects to intertidal habitats and species (including fish) from the deposition of airborne pollutants (e.g. from emissions from the power plant stacks during operation)		✓	✓	
Decommissioning				
Potential impacts and associated effects are assumed to be similar in nature to the construction phase.	✓	✓	✓	✓

Construction Phase

12.6.2 Impacts on Marine Ecology receptors during construction of the Proposed Development are considered below, from paragraphs 12.6.3 to 12.6.45.

Permanent and temporary direct loss and physical disturbance to benthic habitats and species from works carried out below MHWS within the Water Connection Corridor

12.6.3 There is the potential for the construction of the cofferdam (including the use of a JUB), the replacement of outfall and intake infrastructure, potential construction phase dredging, and berthing of vessels at low tide at Connah's Quay North, the Port of Mostyn and/or the Ellesmere Port via the Manchester Shipping Canal, to result in direct loss and physical disturbance to benthic habitats and species. Such loss and disturbance are expected to be temporary, i.e. habitat may be replaced over a period of time through natural processes and species may return. Alternatively, should the new intake infrastructure be located beyond the existing infrastructure then benthic habitat loss could be permanent. The exact location of the works, within the Water Connection Corridor, is not currently known. However, the intertidal and subtidal habitat below MHWS generally consist of sand, mud and mixed sediments (see **Figure 12-4: Close-up of Intertidal Benthic Habitats (PEIR Volume III)**).

12.6.4 The exact location and total number of piles required for the cofferdam is not known and therefore an accurate area of habitat to be lost cannot be given at this time. However, it is estimated that sheet piles will be used for the cofferdam, similar to an AZ-36 700N (700 x 499 mm). The cofferdam is expected to require 850 m of interlocking sheet piles for the construction of

new / replacement cooling water infrastructure, and up to 750 m of interlocking sheet piles for refurbishment of the existing cooling water infrastructure. There is also the potential for a JUB to be used to install and remove the cofferdam. With the cofferdam and JUB in place, it is expected that less than 50% of the river at low tide will be obstructed.

12.6.5 Dredging may also occur during the construction phase. This is also likely to result in either permanent or temporary habitat loss, including the displacement of, injury and / or mortality to benthic species, particularly those which are less mobile. Additionally, it is expected that vessels such as a JUB will be required to berth at low tide, which may also result in temporary disturbance to benthic species due to the potential contact with the river and estuary bed.

12.6.6 Sensitivity of benthic receptors to loss and disturbance of habitat varies between habitats and species depending on their resilience to disturbance and the scale of the disturbance. The Water Connection Corridor is located within the Dee Estuary SAC, for which Annex I subtidal benthic habitats including mudflats and sandflats are primary qualifying features (See **Appendix 12-C: Relevant Designated Sites (PEIR Volume IV)**). Piling and dredging are expected to affect these habitats.

12.6.7 However, this impact pathway will be assessed in further detail in the ES, once further information on the location and number of piles, berthing of vessels and construction phase dredging, is available.

Physical disturbance to marine ecology from temporary increase in SSC and subsequent sediment deposition leading to increased turbidity, smothering effects and possible contaminant mobilisation

12.6.8 Construction activities associated with the Proposed Development, including the installation and removal of a cofferdam and associated piling, the use of a JUB, the potential replacement of outfall and intake infrastructure, and construction phase dredging have the potential to disturb surrounding sediment. This can result in sediment becoming suspended in the water column, which can travel away from the source of disturbance and be deposited on the seabed elsewhere. The creation and subsequent deposition of a plume of suspended can result in several impacts to both benthic ecology receptors and fish and shellfish.

12.6.9 The distance to which the sediment plume can travel and its size is dependent on the grain size of particulate matter disturbed. Coarse materials (i.e., sand and gravel) are expected to settle to the seabed quickly, within seconds to tens of seconds, and only travel to within a few meters from the source of disturbance (depending on current speeds and the sea state). In comparison, mud and clays remain suspended for longer periods of time and can travel much further from the source of disturbance.

12.6.10 The sediment within the Water Connection Corridor, where most disturbance is expected to occur, predominantly consists of soft, muddy and mixed sediments, with small areas of intertidal rock. The exact distance over which such sediment plumes are expected to travel will be determined for the ES, using a 2D sediment suspension model (see **Chapter 16: Physical Processes**). This modelling, in combination with hydrodynamic modelling, will

allow a ZoI to be calculated and enable a more detailed assessment of the effect of increased SSC on all marine receptors in the ES.

12.6.11 Increased SSC could also result in increased levels of sediment-bound contaminants. Available waterbody classifications for the three waterbodies within the Dee Estuary catchment (Balderton Drain, Finchetts Gutter and Garden City Drain) show that all received a 'failed' chemical status in 2019 due to levels of mercury and polybrominated diphenyl ethers (PBDE) (Ref 12-90). However, given the elevated levels of such contaminants across the waterbody (Ref 12-90), the Proposed Development is only expected to cause localised increases during disturbance of sediment which are not expected to exceed baseline conditions resulting from natural sediment disturbance. Chemical analysis of sediment samples and associated modelling is subject to ongoing discussions with NRW and the output will be reflected in the ES as appropriate.

12.6.12 The full extent of construction phase dredging to be undertaken is currently unknown. Therefore, this will be assessed in detail in the ES as appropriate.

Intertidal and subtidal benthic ecology

12.6.13 Increased SSC can result in several potential effects to both intertidal and subtidal benthic receptors, including reduced rates of photosynthesis via a reduction in light availability in turbid conditions, reduced feeding efficiency of filter feeders if clogging of filtering systems occurs and the smothering of invertebrate species.

12.6.14 However, the benthic composition in the study area consists of very little vegetation and species which are largely infaunal and live within the sediment, resulting in a high tolerance and low sensitivity to increased SSC (e.g. Ref 12-91). Therefore, any increase in SSC is expected to result in minor disturbance to the benthic community. Furthermore, in the event that disturbance does occur, any increases in SSC are expected to be short-term and localised.

12.6.15 Furthermore, estuaries are turbid environments with regular disturbance due to fast-moving currents. Therefore, the impact of increased SSC on benthic ecology, which is of low sensitivity, has been assessed as having a magnitude of very low which results in a negligible effect, which is considered to be **not significant**. However, this will be assessed further following completion of sediment transport modelling.

Fish and shellfish

12.6.16 Impacts to fish and shellfish resulting from increased SSC include decreased visibility which can result in decreased feeding success, clogging of feeding and respiratory apparatus, egg and larvae mortality, toxic conditions resulting from the suspension of sediment-bound contaminants and potential barriers to fish migration and movement.

12.6.17 Sensitivity to increased SSC differs between fish species and between life stages. Demersal fish, eggs and larvae from demersal spawners (e.g., herring and sandeel) can be more vulnerable to smothering and are considered to have a moderate sensitivity due to negative implications on spawning success and recruitment (Ref 12-92). Spawning grounds for sandeel are located within the Dee Estuary. However, sandeel are a burrowing species and spend the

majority of the year under the sediment surface (Ref 12-93) and therefore are considered to have a high tolerance to smothering by sediment plumes.

12.6.18 Any increases in SSC are expected to be short-term and localised. Furthermore, estuaries and tidal rivers are generally turbid environments with regular disturbance due to fast-moving currents. Therefore, the impact of increased SSC on fish and shellfish, which are of low sensitivity, has been assessed as having a magnitude of low which results in a negligible effect, which is considered to be **not significant**. However, the assessment will be reviewed at the ES stage once sediment dispersion modelling has been completed.

Effects to marine ecology from changes in marine water quality due to accidental spills within study area

12.6.19 There is potential for the accidental release of fuels and pollutants from vessels. Such discharges have the potential to alter water quality in terms of physical, biological, and chemical parameters in the River Dee and Estuary. Spills or contaminated water can propagate along the initial receiving watercourse, and ultimately discharge into waters on the North Wales coastline.

12.6.20 There is the potential for impacts on marine water quality during land-based construction activities for the Proposed Development site, for example run-off or accidental discharges, potentially impacting on sensitive habitats (**Figure 12-5: Water Framework Directive Sensitive Habitats (PEIR Volume III)**).

12.6.21 Several embedded mitigation measures will be implemented during construction to minimise impacts and effects on the water environment, including management of construction site run-off and emergency spillage plans (see Section 12.5 and **Chapter 13: Water Environment and Flood Risk**). It is also anticipated that several design and good practice mitigation measures will be outlined in a CEMP and SWMP.

12.6.22 Additionally, to avoid accidental spills from vessels, all Proposed Development vessels will be required to adhere to guidelines outlined in Section 12.5. In any case, any spillages are expected to be small and will likely undergo rapid dispersion and evaporation when subjected to wave action, wind and currents.

12.6.23 With these mitigation measures in place, the impact of effects from changes in marine water quality on marine ecological receptors, which are of low to high sensitivity, has been assessed as having a magnitude of low which results in a negligible effect, which is considered to be **not significant**.

Underwater sound and vibration disturbance to marine ecology, particularly migratory fish, within the ZoI

12.6.24 A full assessment on the effects of underwater sound (UWS) and vibration disturbance to fish has been completed and is presented in **Appendix 12-B: Underwater Sound Effects on Fish (PEIR Volume IV)**. At this stage, with mitigation measures proposed including a soft-start for any impact piling as per JNCC guidelines (Ref 12-31), any effects to fish from underwater sound production during the construction of the Proposed Development are expected to be minor adverse or negligible. However, this will be assessed further at the ES stage once all Proposed Development parameters are confirmed.

12.6.25 There is also the potential for UWS effects on marine mammals when present in the estuary. UWS production can have several impacts on marine mammals, including auditory injury or damage, to the inner ear, or sensory hair cells (Ref 12-94), which can be categorised by two different effects:

- Permanent Threshold Shift (PTS) is a permanent elevation in hearing threshold (injury) which can occur due to several causes but is most often the result of intense and / or repeated noise exposures; and
- Temporary Threshold Shift (TTS) is a recoverable elevation in hearing threshold. This most commonly results from long-term exposure to sounds which are not high enough to result in PTS but could still result in temporary injury.

12.6.26 Behavioural responses can also occur and are highly variable and context-specific, ranging from increased alertness, altering vocal behaviour, interruption to feeding or social interaction, alteration of movement or diving behaviour, temporary or permanent habitat abandonment. Masking can also occur when anthropogenic underwater sound may partially or entirely reduce the audibility of signals of interest such as those used for communication and prey detection.

12.6.27 For UWS disturbance effects on marine mammals (based on the harbour porpoise, the most sensitive species) from impact piling, the ZoI is 26 km, as detailed in **Table 12-2.**

12.6.28 Any cetaceans in the shallow waters of Liverpool Bay around the mouth of the estuary could be affected by UWS though the risk of any disturbance is considered minimal due to the unlikely presence of such species within the estuary.

12.6.29 The activity expected to produce the highest intensity of UWS is impact piling of sheet piles during construction of the cofferdam and potential replacement of abstraction and discharge infrastructure. Impact sheet piling is considered to produce a sound pressure level (SPL_{peak}) of 205 dB and a cumulative sound exposure level (SEL_{cum}) of 198 dB (for a sound duration of 15 minutes) (Ref 12-95; Ref 12-96). This sound source level exceeds the thresholds for PTS for harbour porpoise (most sensitive to underwater sound and therefore used as a worst-case scenario), based on the most up-to-date sound exposure criteria for auditory injury in marine mammals (Ref 12-96; Ref 12-97). However, exceedance of the PTS threshold in harbour porpoise for sheet piling is only expected to result in injury when an individual is within a maximum of approximately 1,400 m from a piling sound source starting at full power. The predictions are based on a stationary receiver and a stationary source assumption, and do not take into account any movement of the source or receiver, the frequency spectrum of the sound source or the hearing sensitivity weightings of the receptor species. As such it is considered that the SEL_{cum} predictions are representative of a worst-case scenario.

12.6.30 In line with standard JNCC guidance for impact piling in marine waters (Ref 12-31), there will be an observation period to ensure no cetacean presence as piling commences, and a soft-start will be used at the beginning of any impact piling activity to deter individuals from the area. Additionally, piling is expected to be intermittent and restricted to core working hours, only lasting for a short period of time. Furthermore, the presence of cetaceans including

harbour porpoise in the estuary, and therefore in the vicinity of the Water Connection Corridor, is considered to be low and limited to occasional presence. Therefore, the risk of injury to cetaceans is highly unlikely.

12.6.31 There is also the potential for impacts to seals in the River Dee and Estuary, particularly seals foraging to and from the West Hoyle sandbank. The cumulative sound exposure level (SEL_{cum}) of 198 dB (for a sound duration of 15 minutes) expected to be produced by impact sheet piling (Ref 12-95) also exceeds the PTS threshold for seals when they are underwater (Ref 12-96; Ref 12-97). However, this is only expected to result in injury when a seal is less than 10 m from the sound source. Due to the mobile nature of seals, and the implementation of standard JNCC guidance for impact piling in marine waters, including the use of soft-start (Ref 12-31), it is expected that the risk of a seal remaining within 10 m of the impact piling activity for a duration of 15 minutes is highly unlikely.

12.6.32 Some behavioural disturbance may be observed in marine mammals such as fleeing the affected area. However, marine mammals are unlikely to be present in the estuary. Furthermore, piling activities are expected to be short-term and intermittent in nature., Therefore, any disturbance is expected to be minor.

12.6.33 As a result, the impact of UWS effects on marine mammals, which are of high sensitivity, has been assessed as having a magnitude of very low which results in a minor adverse effect, which is considered to be **not significant**.

Indirect effects to marine ecology from hydromorphological changes (e.g. changes to water flow or sediment movement) within the study area

12.6.34 Whilst the cofferdam and associated piles for outfall and intake infrastructure are in place during the construction phase, there is the potential for interference with the local hydrodynamic regime which could, for example, increase flow rates and the rate of sediment scour processes. It is not currently known how long the cofferdam will be in place. However, **Chapter 16: Physical Processes** has concluded that the impact of scour to the estuary bed is expected to be minor with sediment expected to return to equilibrium conditions once the cofferdam is removed. Therefore, any indirect effects to marine ecology are expected to be temporary and short-term. However, the extent of hydromorphological changes and scour will be further evaluated in the ES (see **Chapter 16: Physical Processes**).

12.6.35 It is anticipated that any hydromorphological changes will be small and only expected to occur within a few metres of the cofferdam. Therefore, mud and sands designated under the River Dee SAC, which support communities of bivalve molluscs, polychaetes and echinoderms which are typically buried in the sediment, are most likely to be affected. These benthic communities are expected to have some habituation to hydromorphological disturbance and scour and the sediment is expected to return to equilibrium conditions via natural current-driven sediment transport processes once the cofferdam is removed.

12.6.36 At this stage, the impact of indirect effects from hydromorphological changes on marine ecological receptors, which are of low sensitivity, has been assessed as having a magnitude of low which results in a negligible effect,

which is considered to be **not significant**. However, this will be re-assessed in the ES once further information is known regarding the size of the cofferdam and the time period for which it will be in place.

Introduction and spread of INNS from any in-river works

12.6.37 The introduction of construction materials into the marine environment, for example for the placement of the cofferdam, and the use of marine vessels as part of the Proposed Development could result in the potential for the introduction, transportation and spread of INNS, either from biofouling or from the discharge of ballast water and bilge water, from transportation of materials, or due to the placement of hard structures within a marine environment otherwise characterised by soft sediment (see Benthic Ecology section).

12.6.38 During a desk study of the local benthic environment, one marine INNS was identified, the Chinese mitten crab, which is understood to spreading through the catchment of the River Dee (Ref 12-46). The Chinese mitten crab has a preference for freshwater and estuarine soft sediment habitats. It is possible that disturbance of the estuarine soft sediment during construction could result in movement of the Chinese mitten crab and facilitate range expansion. However, the preliminary results from the intertidal walkover survey did not record the presence of Chinese mitten crab within the Water Connection Corridor.

12.6.39 Regardless of whether Chinese mitten crab are present in the Study Area or not, several good practice mitigation measures will be implemented throughout all phases of the Proposed Development, listed in Section 12.5.

12.6.40 With these measures in place, and the limited use of vessels, the impact of the introduction and spread of INNS on marine ecology, which is of low sensitivity, has been assessed as having a magnitude of very low which results in a minor adverse effect, which is considered to be **not significant**. However, this will be further confirmed following the subtidal invertebrate surveys and assessed later at the ES stage.

Collisions between project vessels and marine mammals, particularly seals

12.6.41 The construction phase of the Proposed Development is likely to require the deployment of several vessels for delivery of materials using the Port of Mostyn, Connah's Quay North and / or the Ellesmere Port via the Manchester Shipping Canal, and for construction support. The total number of vessels to be used for the Proposed Development will be defined as the design progresses.

12.6.42 Marine mammals, particularly cetaceans, are considered to be fast swimming, agile species, with rapid reflexes and good sensory capabilities (Ref 12-99). However, individuals can become distracted during important activities such as foraging and social interactions, and therefore may not perceive the threat of an approaching vessel (Ref 12-100).

12.6.43 Cetaceans and seals are reasonably resilient to minor strikes and collisions (Ref 12-100). However, a direct strike from a sharp object such as rotating propeller blades has potential to cause lethal injury (Ref 12-101).

12.6.44 The vessels used for the Proposed Development are likely to be traveling at slow speeds (estimated to be less than 10 knots) due to the shallow water depth in the river, and therefore are unlikely to pose a significant risk of collision to marine mammals. Most serious injuries are considered to occur at speeds >14 knots (Ref 12-102). Furthermore, the presence of marine mammals in the river is considered to be only occasional, with cetaceans preferring open water and the closest seal haul-out site being located 15 km downstream (see Section 12.4). Additionally, the Irish Sea outside of the estuary is characterised by a high volume of vessel traffic (Ref 12-103) and therefore marine mammals in the region are expected to have some habituation.

12.6.45 Therefore, although collisions with vessels could result in injury or mortality, the impact of collision risk on marine mammals, which are of high sensitivity, has been assessed as having a magnitude of very low which results in a minor adverse effect, which is considered to be **not significant**.

Operation Phase

12.6.46 Impacts on Marine Ecology receptors during operation of the Proposed Development are presented from paragraphs 12.6.48 to 12.6.67.

12.6.47 The earliest year of operation for the Proposed Development is anticipated to be 2030, under a phased construction approach beginning in 2026 for a period of five years. If construction was to be undertaken in a single phased approach, the earliest year of operation is anticipated to be 2035. If a single phased construction approach was undertaken at the latest possible time, five years after DCO Consent, operation would be anticipated to occur in late 2036.

Direct loss and physical disturbance to benthic habitats and species from works (e.g. air blasting and sediment clearing) carried out below MHWS within the Water Connection Corridor section of the Site

12.6.48 In the operational phase of the Proposed Development it is assumed that any intakes and outfalls will be kept clear either through the use of a compressed air blasting system, and if required a jet washing system which would be incorporated into the design. The air blast and jet washing activities would only take place on a falling tide to return the silt removed to the estuary sediment budget. Should these options not be sufficient to maintain clean flow through the screen, the use of retrievable screens for mechanical cleaning may be required.

12.6.49 The operational activities (air blast and jet washing) may cause small, localised, and temporary disturbances to benthic habitats and species within the footprint of the Water Connection Corridor, which spans intertidal and subtidal soft, sandy, and muddy habitats. However, these activities will be intermittent and short in duration, effectively returning sediment back into the estuary, thereby minimising any changes to natural transport processes and the overall sediment budget of the Dee Estuary. Therefore, at this stage, the impact of operational habitat disturbance on benthic habitats and species, which are of low sensitivity, has been assessed as having a magnitude of low which results in a minor adverse effect, which is considered to be **not significant**. A more detailed assessment will be provided within the ES once the indicative design is confirmed.

Indirect effects to marine ecology from any changes to existing thermal and chemical effects from treated water discharge (subject to control under existing permitted limits required for discharges)

12.6.50 The discharge of treated effluent, at a higher temperature than ambient, can influence a variety of marine organisms including plankton, benthic species as well as fish, shellfish and INNS. Long term effects can include changes in biological processes (e.g. growth, spawning, etc.), mortality, displacement and changes in species' community composition and distribution. Thermal discharge could also increase surrounding water temperatures, leading to a prolonged season suitable for larval development. Marine mammals can be indirectly affected by shifts in the distribution of food resources if, for example, prey species are attracted or deterred by the warmer waters around the outfall. The elevated temperatures which may be found at the release point from the outfall – which could, with water movements, form a 'thermal plume' - may also act as barrier to fish migration.

12.6.51 Thermal discharge will be considered by **Chapter 16: Physical Processes** and **Chapter 13: Water Environment and Flood Risk** at the ES stage. The results of this will be assessed within the WFD assessment and the impacts of this on marine ecology receptors will be assessed later at the ES stage.

Indirect effects to benthic ecology from hydromorphological changes (e.g. changes to water flow or sediment movement) within the ZoI, including ongoing scour

12.6.52 Due to the potential placement of new intake and outfall infrastructure, and air blasting and jet washing during the operation phase of the Proposed Development, there is the potential for hydromorphological changes to the river and estuary bed, including increased scour around new structures. Air blasting of sediment could also result in changes to sediment movement which could affect water flow through the Water Connection Corridor.

12.6.53 The extent of infrastructure and operational activities to be in place in the operation phase is not currently known. Therefore, this impact pathway will be further assessed at ES stage.

Physical disturbance and potential mortality to benthic and fish and shellfish ecology from entrainment and impingement within the cooling water abstraction and discharge infrastructure within the Water Connection Corridor

12.6.54 During operation of the Proposed Development, there is the potential for entrainment and impingement of marine receptors, particularly fish, within the abstraction and discharge infrastructure, such as fish eggs, fish larvae, juvenile fish, small mature fish and invertebrate zooplankton. Impingement occurs when fish and crustaceans pass through the initial intake screens and get removed from the water on fine-mesh screens before entering the power station. Entrainment is when smaller organisms such as fish eggs, larvae zooplankton and phytoplankton pass through the power station cooling system before they are discharged back into the estuary (Ref 12-104).

12.6.55 As part of The Eels (England and Wales) Regulations 2009 (Ref 12-9), if the abstraction and discharge infrastructure is replaced, the eel screens will also be replaced in line with current requirements. The mesh size used on the eel screen should be determined based on fish likely to be present and therefore

at risk of impingement. This will therefore be determined as part of the final design. Previous projects have used a mesh diameter of 2 mm (e.g. Ref 12-105). The mesh size on the current eel screen is 3 mm and the proposed mesh size for both the eel scree refurbishment and the eel screen replacement option is 2 mm. This size has been determined to be small enough to prevent movement through the mesh by larger fish, allowing them to swim away and reducing the risk of impingement. However, the eel screens are not likely to reduce the potential for entrainment of larvae and juveniles. Several tributaries of the River Dee are important for Atlantic salmon spawning, with nursery grounds also present in the estuary for herring and European bass. Therefore, these species are all considered at risk of entrainment.

12.6.56 However, further assessment will be undertaken in the ES once hydrodynamic modelling has been undertaken and the effect of physical processes on particle transport within the estuary, are better understood.

12.6.57 A recent assessment of entrainment effects conducted by Cefas for the Sizewell C Project (Ref 12-104) concluded effects to marine fish and benthic species to be negligible, partly due to the total number of fish likely to be entrained compared to total populations. Furthermore, the mesh size will be minimised from 3 mm to 2 mm, resulting in an overall improvement compared to the existing mesh size. Therefore, the impact of entrainment and impingement on marine ecology, which are of low to high sensitivity, has been assessed as having a magnitude of low which results in a moderate beneficial effect[8], which is currently considered to be **not significant**. However, this will be assessed in more detail in the ES.

Temporary increase in suspended sediment concentrations (SSC) sediment deposition from air blasting and screen cleaning leading to increased turbidity, smothering effects and possible contaminant mobilisation on subtidal habitats and species

12.6.58 In the operational phase of the Proposed Development it is assumed that any intakes and outfalls will be kept clear either through the use of a compressed air blasting system, and if required a jet washing system which would be incorporated into the design. The air blast and jet washing activities would only take place on a falling tide to return the silt removed to the estuary sediment budget. Should these options not be sufficient to maintain clean flow through the screen, the use of retrievable screens for mechanical cleaning may be required.

12.6.59 This will be in place to return silt to the estuary sediment budget and has the potential for small, localised, temporary increases in SSC and subsequent contaminant mobilisation, resulting in a sediment plume and effects on benthic and fish and shellfish receptors. The sediment within the Water Connection Corridor, where most disturbance is expected to occur, predominantly consists of soft, muddy and mixed sediments, with small areas of intertidal rock. The exact distance over which such sediment plumes are expected to travel will be calculated in the ES using a 2D sediment suspension model (see **Chapter 16: Physical Processes**).

[8] This assessment has used a non-matrix approach, and therefore a 'moderate' effect may not always be significant. Please see Appendix 12A: Marine Ecology Assessment Methodology for more information.

12.6.60 Due to the failed chemical status of the three waterbodies in the Dee Estuary catchment (Ref 12-90), there is potential for localised increases in contaminant mobilisation during disturbance of the sediment during construction. However, this is not expected to exceed baseline levels resulting from natural sediment disturbance as the sediment contamination is widespread within the waterbody.

12.6.61 This impact pathway will be further assessed at the ES stage following completion of the 2D sediment modelling (which is subject to ongoing discussions with NRW and the output will be reflected in the ES as appropriate).

Effects to intertidal habitats and species (including fish) from the deposition of airborne pollutants (e.g. from emissions from the power plant stacks during operation)

12.6.62 Deposition of air pollutants released from point source emissions can be deposited into the marine environment either by wet or dry deposition processes. Deposition of air pollutants, particularly nitrogen compounds can cause direct disturbance to marine habitats and species through acidification and eutrophication (Ref 12-106), as well as affect fish species which may depend on these habitats for specific functions (e.g. spawning grounds).

12.6.63 Airborne pollutants are expected to be emitted from the Proposed Development during operation with the potential for nitrogen oxides (NO_X), nitrogen dioxide (NO_2) and carbon monoxide (CO) deposition to occur in the marine environment. Dispersion modelling will be undertaken in the ES to evaluate changes in air quality during operation of the Proposed Development, including NO_X, NO_2 and CO, and to calculate a ZoI (see **Chapter 8: Air Quality**).

12.6.64 The hydrodynamic conditions in the study area, including the open nature of the nearby coastline and strong tidal currents in the estuary mean that this area is subject to frequent tidal washing. Therefore, any deposits that do occur will be rapidly dispersed, particularly within intertidal habitats, and therefore the potential for adverse effects to these habitats is considered to be low.

12.6.65 However, specific modelling is required to reach an accurate conclusion, and this will be reassessed at the ES stage. However, on the basis of current evidence, the impact of the deposition of airborne pollutants on intertidal habitats and species, which are of low to high sensitivity, has been assessed as having a magnitude of low which results in a minor adverse effect, which is considered to be **not significant.**

Decommissioning Phase

12.6.66 Impacts on Marine Ecology receptors during decommissioning of the Proposed Development are likely to include:

- potential impacts and associated effects are assumed to be similar in nature to construction.

12.6.67 It is assumed that the environmental effects associated with decommissioning of the Proposed Development would be no worse than those during construction and operation phases. Therefore, no significant adverse effects

are expected. However, this will be further assessed at the ES stage once all Proposed Development parameters are known.

12.7 Additional Mitigation and Enhancement Measures

12.7.1 There are currently no additional mitigation measures proposed as there have been no significant adverse effects identified at this stage. However, assessments and residual effects will be reviewed at the ES stage once all modelling and ecological surveys have been completed.

12.8 Summary of Potential Significant Residual Effects

12.8.1 **Table 12-9**: to **Table 12-11**: summarise the potential residual significant effects of the Proposed Development on Marine Ecology and receptors following implementation of mitigation.

12.8.2 An assessment of cumulative effects with other proposed developments that could interact with the effects of this Proposed Development will be carried out in the final ES, when the short-list of other developments has been finalised, as shown in **Chapter 24: Cumulative and Combined Effects. Chapter 24: Cumulative and Combined Effects** will also assess the in-combination effects of multiple aspects on one receptor.

Table 12-9: Summary of Potential Significant Residual Effects (Construction)

Receptor	Sensitivity (value)	Description of Impact	Classification of Effect (prior to Additional Mitigation)	Additional Mitigation / Enhancement Measure	Magnitude of Impact after Additional Mitigation	Residual Effect after Additional Mitigation
Benthic habitats and species	Low to high	Permanent and temporary direct loss and physical disturbance to benthic habitats and species from works carried out below MHWS within the Water Connection Corridor section of the Site	To be further assessed at the ES stage			
	Low	Physical disturbance to marine ecology from temporary increase in SSC and subsequent sediment deposition leading to increased turbidity, smothering effects and possible contaminant mobilisation	Currently negligible – to be further assessed at the ES stage to incorporate construction phase dredging			
	Low	Introduction and spread of INNS from any in-river works	Minor adverse	N/A	Low	Minor adverse
Fish and shellfish	Low	Physical disturbance to marine ecology from temporary increase in SSC and subsequent sediment deposition leading to contaminant mobilisation, turbidity and smothering effects	Currently negligible – to be further assessed at the ES stage to incorporate construction phase dredging			
	Low to high	Underwater sound and vibration disturbance to marine ecology, particularly migratory fish, within the ZoI	Minor adverse	N/A	Very Low	Minor adverse
Marine mammals	Low to high	Underwater sound and vibration disturbance to marine ecology, particularly migratory fish, within the ZoI	Minor adverse	JNCC Guidance for impact piling in marine waters.	Very Low	Minor adverse

Receptor	Sensitivity (value)	Description of Impact	Classification of Effect (prior to Additional Mitigation)	Additional Mitigation / Enhancement Measure	Magnitude of Impact after Additional Mitigation	Residual Effect after Additional Mitigation
	High	Collisions between any project vessels and marine mammals	Minor adverse	International Regulations for Preventing Collisions at Sea	Low	Minor adverse
All marine ecological receptors	Low to high	Indirect effects to marine ecology from changes in marine water quality (excluding turbidity) within the ZoI	Negligible	N/A	Negligible	Negligible
	Low	Indirect effects to marine ecology from hydromorphological changes (e.g. changes to water flow or sediment movement) within the ZoI	Negligible	N/A	N/A	N/A

Table 12-10: Summary of Significant Residual Effects (Operation)

Receptor	Sensitivity (value)	Description of Impact	Classification of Effect (prior to Additional Mitigation)	Additional Mitigation / Enhancement Measure	Magnitude of Impact after Additional Mitigation	Residual Effect after Additional Mitigation
Benthic habitats and species	Low	Direct loss and physical disturbance to benthic habitats and species from works (e.g. air blasting and sediment clearing) carried out below MHWS within the Water Connection Corridor section of the Site	Minor adverse	N/A	N/A	N/A
	Low to high	Indirect effects to benthic ecology from hydromorphological	To be further assessed at the ES stage			

Receptor	Sensitivity (value)	Description of Impact	Classification of Effect (prior to Additional Mitigation)	Additional Mitigation / Enhancement Measure	Magnitude of Impact after Additional Mitigation	Residual Effect after Additional Mitigation
		changes (e.g. changes to water flow or sediment movement) within the ZoI, including ongoing scour				
	Low to high	Temporary increase in suspended sediment concentrations (SSC) sediment deposition from air blasting and screen cleaning leading to contaminant mobilisation turbidity and smothering effects on subtidal habitats and species	To be further assessed at the ES stage			
	Low to high	Effects to intertidal habitats and species (including fish) from the deposition of airborne pollutants (e.g. from emissions from the power plant stacks during operation)	Currently minor adverse – to be further assessed at the ES stage			
Fish and shellfish	Low to high	Temporary increase in suspended sediment concentrations (SSC) sediment deposition from air blasting and screen cleaning leading to contaminant mobilisation turbidity and smothering effects	To be further assessed at the ES stage			

Receptor	Sensitivity (value)	Description of Impact	Classification of Effect (prior to Additional Mitigation)	Additional Mitigation / Enhancement Measure	Magnitude of Impact after Additional Mitigation	Residual Effect after Additional Mitigation
		on subtidal habitats and species				
	Low to high	Effects to intertidal habitats and species (including fish) from the deposition of airborne pollutants (e.g. from emissions from the power plant stacks during operation)	Currently minor adverse – to be further assessed at ES stage			
Marine ecology receptors	Low to high	Indirect effects to marine ecology from any changes to existing thermal and chemical effects from treated water discharge (subject to control under existing permitted limits required for discharges)	To be further assessed at the ES stage			
	Low to high	Physical disturbance and potential mortality to marine ecology from entrainment and impingement within the cooling water abstraction and discharge infrastructure within the Water Connection Corridor	Moderate beneficial	N/A	N/A	N/A

Table 12-11: Summary of Significant Residual Effects (Decommissioning)

Receptor	Sensitivity (value)	Description of Impact	Classification of Effect (prior to Additional Mitigation)	Additional Mitigation / Enhancement Measure	Magnitude of Impact after Additional Mitigation	Residual Effect after Additional Mitigation
Marine ecological receptors	Low to high	Potential impacts and associated effects are assumed to be similar in nature to construction	Negligible to moderate adverse	Same as construction phase	N/A	N/A

References

Ref 12-1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (SI 2017/572). London: HMSO (Accessed 26/02/24).

Ref 12-2 Department for Environment, Food & Rural Affairs (Defra), 2016; Marine and Coastal Access Act 2009 [online]. Available at: https://www.legislation.gov.uk/ukpga/2009/23/notes/division/1 (Accessed 08/04/2024).

Ref 12-3 Department for Environment, Food & Rural Affairs (Defra), 2021. Changes to the Habitats Regulations 2017 [online]. Available at: https://www.gov.uk/government/publications/changes-to-the-habitats-regulations-2017/changes-to-the-habitats-regulations-2017 (Accessed 08/04/2024).

Ref 12-4 HM Government, 2010; The Marine Strategy Regulations [online]. Available at: https://www.legislation.gov.uk/uksi/2010/1627/contents/made (Accessed 08/04/2024).

Ref 12-5 Joint Nature Conservation Committee (JNCC), 2019; Ramsar Convention [online]. Available at: https://jncc.gov.uk/our-work/ramsar-convention/ (Accessed 08/04/2024).

Ref 12-6 Council of Europe, 1979; Convention on the Conservation of European Wildlife and Natural Habitats [online]. Available at: https://rm.coe.int/1680078aff (Accessed 08/04/2024).

Ref 12-7 OSPAR Commission, 2007; Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention') [online]. Available at: https://www.ospar.org/site/assets/files/1169/ospar_convention.pdf (Accessed 08/04/2024).

Ref 12-8 JNCC, 2020; The Wildlife and Countryside Act 1981 [online]. Available at: https://jncc.gov.uk/our-work/wildlife-countryside-act/ (Accessed 08/04/2024).

Ref 12-9 Department for Environment, Food & Rural Affairs (Defra), 2017; The Water Environment (Water Framework Directive (WFD)) (England and Wales) Regulations 2017 – Explanatory Memorandum [online]. Available at: https://www.legislation.gov.uk/uksi/2017/407/pdfs/uksiem_20170407_en.pdf (Accessed 08/04/2024).

Ref 12-10 HM Government, 2021; The Environment Act 2021 [online]. Available at: https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted (Accessed 08/04/2024).

Ref 12-11 Welsh Government, 2024; Environment (Wales) Act (2016) [online]. Available at: https://law.gov.wales/environment-wales-act-2016 (Accessed 08/04/2024).

Ref 12-12 HM Government, 2021; Salmon and Freshwater Fisheries Act (SAFFA) 1975 (as amended) [online]. Available at: https://www.legislation.gov.uk/ukpga/1975/51/introduction (Accessed 08/04/2024).

Ref 12-13 HM Government, 2009; The Eels (England and Wales) Regulations 2009 [online]. Available at: https://www.legislation.gov.uk/uksi/2009/3344/made (Accessed 08/04/2024).

Ref 12-14 HM Government, 1970; Conservation of Seals Act 1970 [online]. Available at: https://www.legislation.gov.uk/ukpga/1970/30 (Accessed 08/04/2024).

Ref 12-15 ASCOBANS, 2018; The Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas 1992 (ASCOBANS) [online]. Available at: https://www.ascobans.org/en/legalinstrument/ascobans (Accessed 08/04/2024).

Ref 12-16 CITES, 2019; Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) [online]. Available at: https://cites.org/eng/disc/what.php (Accessed 08/04/2024).

Ref 12-17 HM Government, 2019; The Invasive Alien Species Order 2019 [online]. Available at: https://www.legislation.gov.uk/uksi/2019/527/made (Accessed 08/04/2024).

Ref 12-18 DESNZ, 2023; Overarching National Policy Statement for Energy (EN-1) [online]. Available at: https://assets.publishing.service.gov.uk/media/65a7864e96a5ec0013731a93/overarching-nps-for-energy-en1.pdf (Accessed 26/02/24).

Ref 12-19 DESNZ, 2023; National Policy Statement for Natural Gas Electricity Generating Infrastructure (EN-2) [online]. Available at: https://assets.publishing.service.gov.uk/media/655dc15a544aea000dfb3239/nps-natural-gas-electricitygenerating-infrastructure-en2.pdf (Accessed 26/02/24).

Ref 12-20 DESNZ, 2023; National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) [online]. Available at: https://assets.publishing.service.gov.uk/media/655dc2d4046ed4000d8b9dd9/nps-natural-gas-supply-infrastructurepipelines-en4.pdf (Accessed 26/02/24).

Ref 12-21 DESNZ, 2023; National Policy Statement for Electricity Networks Infrastructure (EN-5) [online]. Available at: https://assets.publishing.service.gov.uk/media/655dc25e046ed400148b9dca/nps-electricity-networks-infrastructure-en5.pdf (Accessed 26/02/24).

Ref 12-22 Welsh Government, 2021; Planning Policy Wales: Edition 11 [online]. Available at: https://www.gov.wales/sites/default/files/publications/2021-02/planning-policy-wales-edition-11_0.pdf (Accessed 26/02/24).

Ref 12-23 Welsh Government, 2021: The Future Wales: National Plan 2040 [online]. Available at: https://www.gov.wales/future-wales-national-plan-2040 (Accessed 08/04/2024)

Ref 12-24 HM Government, 2011; UK Marine Policy Statement [online]. Available at: https://assets.publishing.service.gov.uk/media/5a795700ed915d042206795b/pb3654-marine-policy-statement-110316.pdf (Accessed 08/04/2024).

Ref 12-25 Welsh Government, 2019; Welsh National Marine Plan [online]. Available at: https://www.gov.wales/sites/default/files/publications/2019-11/welsh-national-marine-plan-document_0.pdf (Accessed 08/04/2024).

Ref 12-26 FCC, 2023; Flintshire Local Development Plan 2015 – 2030. Adopted Plan 24th January 2023. [Online] Available at: https://flintshire.gov.uk/en/PDFFiles/Planning/Examination-Library-Documents/FINAL-LDP-Written-Statement-English.pdf (Accessed 26/02/24).

Ref 12-27 Wright, C., 2021; Habitats Regulations Assessment to inform the assessment of the Flintshire Local Development Plan – HRA Matters Arising Changes Addendum. Available online: https://www.flintshire.gov.uk/en/PDFFiles/Planning/Examination-Library-Documents/FCC/FCC032-Habitat-Regulations-Assessment-HRA-Addendum.pdf (Accessed 26/02/24).

Ref 12-28 Flintshire County Council, 2020; Flintshire County Council Biodiversity Plan 'Supporting Nature in Flintshire 2020- 2023' [online]. Available at: https://committeemeetings.flintshire.gov.uk/documents/s64901/Enc.%202%20-%20Biodiversity%20Duty%20Plan%202020-23.pdf (Accessed 08/04/2024).

Ref 12-29 Chartered Institute of Ecology and Environmental Management (CIEEM), 2019; Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine.

Ref 12-30 CCME, 2001; Canadian Council of Ministers of the Environment. Canadian Sediment Quality Guidelines for the Protection of Aquatic Life [online]. Available at: https://www.pla.co.uk/Environment/Canadian-Sediment-Quality-Guidelines-for-the-Protection-of-Aquatic-Life (Accessed 08/04/2024).

Ref 12-31 OSPAR, Webster, L., Fryer, R., Davies, I., Roose, P. and Moffat, C., 2009; Background Document on CEMP Assessment Criteria for QSR 2010. Monitoring and Assessment Series [online].

Ref 12-32 JNCC, 2010; Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise [online]. Available at: https://data.jncc.gov.uk/data/31662b6a-19ed-4918-9fab-8fbcff752046/JNCC-CNCB-Piling-protocol-August2010-Web.pdf (Accessed 08/04/2024).

Ref 12-33 Environment Agency, 2023; Screening for Intakes: measures to protect eel and elvers. Reference LIT 60516.

Ref 12-34 Planning Inspectorate, 2022; Nationally Significant Infrastructure Projects - Advice Note Ten: Habitats Regulations Assessment relevant to nationally significant infrastructure projects [online]. Available at: https://www.gov.uk/government/publications/nationally-significant-infrastructure-projects-advice-note-ten-habitats-regulations-assessment-relevant-to-nationally-significant-infrastructure-pr/nationally-significant-infrastructure-projects-advice-note-ten-habitats-regulations-assessment-relevant-to-nationally-significant-infrastructure-pr (Accessed 08/04/2024).

Ref 12-35 Planning Inspectorate, 2015; Nationally Significant Infrastructure Projects - Advice Note Seventeen: cumulative effects assessment relevant to nationally significant infrastructure projects [online]. Available at: https://www.gov.uk/government/publications/nationally-significant-infrastructure-projects-advice-note-seventeen-cumulative-effects-assessment-relevant-to-nationally-significant-infrastructur (Accessed 08/04/2024).

Ref 12-36 ABPMer, 2014; Wave and Tidal Further Leasing. HRA Principles Document, Screening Report and Appropriate Assessment Information Report. Report numbers R-2160a to R-2160c for the Crown Estate.

Ref 12-37 Barnes, M.K.S., 2008; Lagenorhynchus albirostris White-beaked dolphin. 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.

Ref 12-38 Edwards, R.V., 2006; Balaenoptera acutorostrata Minke whale. 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.

Ref 12-39 JNCC, 2020; Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs (England, Wales & Northern Ireland). JNCC Report No. 654, JNCC, Peterborough, ISSN 0963-8091.

Ref 12-40 Natural England and Countryside Council for Wales, 2010; The Dee Estuary European Marine Site. Appendix IV: Maps showing the marine habitats of the Dee Estuary/Aber Dyfrdwy Special Area of Conservation – Map 1 – 5: Dee Estuary / Aber Dyfrdwy SAC Marine Habitat Features. [Online] Available at: https://publications.naturalengland.org.uk/publication/2986296 (Accessed 08/05/2024).

Ref 12-41 Defra, 2023; Multi-Agency Geographic Information for the Countryside. [Online]. Available at: https://magic.defra.gov.uk/ (Accessed 03/04/24).

Ref 12-42 Environment Agency, 2021; Ecology and Fish Data Explorer. [Online] Available at: https://environment.data.gov.uk/ecology/explorer/ (Accessed 03/04/2024).

Ref 12-43 Natural England and Countryside Council of Wales, 2010; The Dee Estuary European Marine Site comprising Dee Estuary / Aber Dyfrdwy SAC the Dee Estuary SPA and the Dee Estuary Ramsar Site. [Online] Available at: https://naturalresources.wales/media/673576/dee-estuary-reg33-volume-1-english-091209_1.pdf (Accessed 03/04/24).

Ref 12-44 Woodward, I.D., Calbrade, N.A., Birtles, G.A., Peck, K., Wotton, S.R., Shaw, J.M., Balmer, D.E. and Frost, T.M. 2024. Waterbirds in the UK 2022/23: The Wetland Bird Survey and Goose & Swan Monitoring Programme. BTO/RSPB/JNCC/NatureScot. Thetford.

Ref 12-45 Lyn Byrne, 2014; Dee Catchment Biosecurity Action Plan. Dee Invasive Non Native Species Project. [Online] Available at: https://www.nw-ifca.gov.uk/app/uploads/Dee-Catchment-Biosecurity-Action-Plan.pdf (Accessed 03/04/24).

Ref 12-46 Natural Resource Wales, 2016; Monitoring of Chinese Mitten Crabs (Eriocheir sinensis) on the River Dee. [Online] Available at: https://naturalresources.wales/media/684746/evidence-report-154-chinese-mitten-crabs-eriocheir-sinensis-river-dee.pdf (Accessed 12/04/24).

Ref 12-47 Cohen, A.N. and Weinstein, A., 2001; The potential distribution of Chinese mitten crabs (Eriocheir sinensis) in selected waters of the Western United States with US Bureau of Reclamation Facilities (Vol. 21). US Department of the Interior, Bureau of Reclamation, Mid-Pacific Region and the Technical Service Center.

Ref 12-48 Natural England, 2019; European Site Conservation Objectives: Supplementary advice on conserving and restoring site features. River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid Special Area of Conservation.

Ref 12-49 Natural Resource Wales, 2022; Dee Stock Assessment Angler Report 2022. [Online]. Available at: https://cdn.cyfoethnaturiol.cymru/media/696696/dee-angler-report-2022_icd1.pdf?mode=pad&rnd=133277556034370000#:~:text=Rod%20catch%3A%20Provisional%20licence%20return,170%20salmon%20declared%20in%202021 (Accessed 03/04/24).

Ref 12-50 Coull, K.A., Johnstone, R. and Rogers, S.I., 1998; Fisheries Sensitivity Maps in British Waters. UKOOA Ltd.

Ref 12-51 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. Science Series Technical Report. Cefas, Lowestoft 147, 56 pp.

Ref 12-52 Cowx, I.G. and Fraser, D., 2003; Monitoring the Atlantic Salmon, Conserving Natura 2000 Rivers Monitoring Series No. 7. English Nature, Peterborough.

Ref 12-53 ICES, 2018; Report of the Herring Assessment Working Group for the Area South of 62° N (HAWG). [Online]. (Accessed 03/04/24).

Ref 12-54 Thorstad, E.B., Whoriskey, F., Uglem, I., Moore, A., Rikardsen, A.H. and Finstad, B., 2012; A critical life stage of the Atlantic salmon Salmo salar: Behaviour and survival during the smolt and initial post-smolt migration. Journal of Fish Biology. 81(2), 500 – 542.

Ref 12-55 Heessen, H.J.L., Daan, N. and Ellis, J.R., 2015. Fish atlas of the Celtic Sea, North Sea, and Baltic Sea. Wageningen, Wageningen Academic Publishers.

Ref 12-56 International Council for the Exploration of the Sea (ICES), 2010; Report of the ICES/EIFAC Working Group on Eels (WGEEL). ICES Document CM 2010/ACFM: 18.

Ref 12-57 Behrmann-Godel, J. and Eckmann, R., 2003; A preliminary telemetry study of the migration of silver European eel Anguilla anguilla Lin the River Mosel, Germany. Ecology of Freshwater Fish, 12(3), 196 – 202.

Ref 12-58 Chadwick, S., Knights, B., Thorley, J.L. and Bark, A., 2007; A long-term study of population characteristics and downstream migrations of the European eel Anguilla anguilla (L.) and the effects of a migration barrier in the Girnock Burn, north-east Scotland. Journal of Fish Biology, 70(5), 1535 – 1553.

Ref 12-59 Aerestrup, K., Økland, F., Hansen, M.M., Righton, D., Gargan, P., Castonguay, M., Bernatchez, L., Howey, P., Sparholt, H., Pedersen, M.I. and McKinley, R.S., 2009; Oceanic spawning migration of the European eel (Anguilla anguilla). Science, 325(5948), 1660 – 1660.

Ref 12-60 Laughton, R. and Burns, S., 2003; Assessment of sea lamprey distribution and abundance in the River Spey: Phase III. Scottish Natural Heritage Commissioned Report No. 043 (ROAME No. F02AC604).

Ref 12-61 Joint Nature Conservation Committee (JNCC), 2018; European Community Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC). Supporting documentation for the conservation status assessment for the species: S1099 - River lamprey (Lampetra fluviatilis). Fourth Report by the United Kingdom under Article 17.

Ref 12-62 Joint Nature Conservation Committee (JNCC), 2018; European Community Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC). Supporting documentation for the conservation status assessment for the species: S1095 - Sea lamprey (Petromyzon marinus). Fourth Report by the United Kingdom under Article 17.

Ref 12-63 Garrett., HM., 2016; River Dee & Bala lake SAC population attribute condition assessment for brook, river and sea lamprey 2014. Natural Resources Wales.

Ref 12-64 ICES, 2022; Celtic Seas Ecoregion – Ecosystem Overview. [Online]. Available at: https://www.ices.dk/advice/ESD/Pages/Celtic-Seas_description.aspx#:~:text=The%20Celtic%20Seas%20ecoregion%20is,and%20the%20Celtic%20Sea%20areas (Accessed 03/04/2024).

Ref 12-65 IAMMWG, 2023; Review of Management Unity boundaries for cetaceans in UK waters. JNCC Report 734. Peterborough. [Online] Available at: https://hub.jncc.gov.uk/assets/b48b8332-349f-4358-b080-b4506384f4f7 (Accessed 03/04/24).

Ref 12-66 Gilles, A., Authier, M., Ramirez-Martinez, NC., et al., 2023; Estimates of cetacean abundance in European Atlantic waters in summer 2022 from the SCANS-IV aerial and shipboard surveys. Final report published 29 September 2023. 64 pp.

Ref 12-67 Waggitt, J., Evans, P., Andrade, J., Banks, A. and Bolton, M. 2019; Distribution maps of cetacean and seabird populations in the North-East Atlantic. Journal of Applied Ecology, 57(2), pp. 253-269.

Ref 12-68 JNCC and NRW, 2015; SAC Selection Assessment: North Anglesey Marine / Gogledd Môn Forol. January, 2016. Joint Nature Conservation Committee, UK. [Online] Available at: https://naturalresources.wales/media/681290/northangleseymarineselectionassessmentdocument.pdf.

Ref 12-69 OurDeeEstuary, n.d.; Wildlife - dee estuary [Online]. Available at: https://ourdeeestuary.co.uk/wildlife-2/. (Accessed 08/04/2024).

Ref 12-70 JNCC, 2019; Article 17 Habitats Directive Report 2017. [Online] Available at: https://jncc.gov.uk/our-work/article-17-habitats-directive-report-2019/. (Accessed 08/04/2024).

Ref 12-71 IUCN, 2021; The IUCN Red List of Threatened Species. Version 2021-2. Retrieved from http://www.iucnredlist.org. (Accessed 08/04/2024).

Ref 12-72 Sea Watch Foundation, 2020; Bottlenose dolphin (Tursiops truncatus). [Online] Available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Bottlenose-Dolphin.pdf. (Accessed 08/04/2024).

Ref 12-73 Hague, E., Sinclair, R., and Sparling, C., 2020; Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters. Scottish Marine and Freshwater Series, Ref 5.11(12), 309.

Ref 12-74 Pinn, E., Mitchell, I., and Hawkridge, J., (2018). Abundance and distribution of coastal bottlenose dolphins. UK Marine Online Assessment Tool [Online]. Available at: https://moat.cefas.co.uk/ (Accessed 03/04/2024).

Ref 12-75 Sea Watch Foundation, 2020; Common dolphin (Delphinus delphis). [Online] Available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Common-Dolphin.pdf. (Accessed 08/04/2024).

Ref 12-76 Sea Watch Foundation, 2020; Risso's dolphin (Grampus griseus). [Online] Available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Rissos-Dolphin.pdf. (Accessed 08/04/2024).

Ref 12-77 Sea Watch Foundation, 2020; White-beaked dolphin (Lagenorhynchus albirostris). [Online] Available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/White-beaked-Dolphin.pdf. (Accessed 08/04/2024).

Ref 12-78 Sea Watch Foundation, 2020; Atlantic white-sided dolphin (Lagenorhynchus acutus). [Online] Available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Atlantic-White-sided-Dolphin.pdf. (Accessed 08/04/2024).

Ref 12-79 Sea Watch Foundation, 2020; Fin whale (Balaenoptera physalus). [Online] Available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Fin-Whale.pdf. (Accessed 08/04/2024).

Ref 12-80 Sea Watch Foundation, 2020; Long-finned pilot whale (Globicephala melas). [Online] Available at: https://www.seawatchfoundation.org.uk/wp-content/uploads/2020/07/Long-finned-Pilot-Whale.pdf. (Accessed 08/04/2024).

Ref 12-81 Sea Watch Foundation, 2012; Killer whale (Orcinus orca). [Online] Available at: https://seawatchfoundation.org.uk/wp-content/uploads/2012/07/Killer_Whale.pdf. (Accessed 08/04/2024).

Ref 12-82 SCOS, 2020; Scientific advice on matters related to the management of seal populations: 2020. [Online] Available at: http://www.smru.st-andrews.ac.uk/scos/scos-reports/.(Accessed 08/04/2024).

Ref 12-83 SCOS, 2021; Scientific advice on matters related to the management of seal populations: 2021. [Online] Available at: http://www.smru.st-andrews.ac.uk/scos/scos-reports/. (Accessed 08/04/2024).

Ref 12-84 Westcott, S.M. and Stringell, T.B., 2004; Grey seal distribution and abundance in North Wales, 2002-2003. Countryside Council for Wales.

Ref 12-85 Department of Energy and Climate Change, 2016; UK Offshore Energy Strategic Environmental Assessment: OESEA3 Environmental Report [online]. Available at: https://assets.publishing.service.gov.uk/media/5a74807e40f0b646cbc40557/OESEA3_Environmental_Report_Final.pdf (Accessed 25/04/2024).

Ref 12-86 Rijnsdorp, A.D., Peck, M.A., Engelhard, G.H., Möllmann, C. and Pinnegar, J.K., 2009; Resolving the effect of climate change on fish populations. ICES Journal of Marine Science, 66, 1570-1583.

Ref 12-87 Department of Energy and Climate Change (DECC), 2016; Offshore Energy SEA 3: Appendix 1 Environmental Baseline – Marine and other mammals [online]. Available at: https://assets.publishing.service.gov.uk/media/5a75c023e5274a4368299af4/OESEA3_A1a7_Marine___other_mammals.pdf (Accessed 25/04/2024).

Ref 12-88 MCCIP, 2013; Marine climate change impacts: Report Card [online]. Available at: https://www.mccip.org.uk/sites/default/files/2021-08/mccip-arc2013.pdf [Accessed 25/04/2024].

Ref 12-89 MCCIP, 2016; Marine climate change impacts; implications for the implementation of marine biodiversity legislation. (Ed.) Frost M, Bayliss-Brown G, Buckley P, Cox M, Stoker B & Withers Harvey N. Summary Report. MCCIP, Lowestoft, 16pp.

Ref 12-90 Environment Agency, 2023; Dee Estuary Operational Catchment Waterbodies [online]. Available at: https://environment.data.gov.uk/catchment-planning/OperationalCatchment/3127. [Accessed: 22/04/2024].

Ref 12-91 Hill, J.M., 2008; Echinocardium cordatum Sea potato. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [Plymouth: Marine

Biological Association of the United Kingdom [online]. Available at: https://www.marlin.ac.uk/species/detail/1417 [Accessed: 22/04/2024].

Ref 12-92 Kjelland, M., Woodley, C., Swannack, T., and Smith, D., 2015. A review of the potential effects of suspended sediment on fishes: potential dredging-related physiological, behavioural, and transgenerational implications. Environment Systems and Decisions, 35, 334-350.

Ref 12-93 Van der Kooij, J., Scott, B. E., and Mackinson, S., 2008; The effects of environmental factors on daytime sandeel distribution and abundance on the Dogger Bank. Journal of Sea Research, 60(3), pp. 201 – 209.

Ref 12-94 Parvin, S., Nedwell, J. and Workman, R., 2006; Underwater noise impact modelling in support of the London Array, Greater Gabbard and Thanet offshore wind farm developments. Subacoustech Ltd.

Ref 12-95 .The California Department of Transportation, 2007; Compendium of Pile Driving Sound Data

Ref 12-96 AECOM, 2019; Uig Harbour Redevelopment – Appendix 13.1: Underwater Sound Propagation Modelling and Results.

Ref 12-97 NMFS, 2018; Revision to: Technical Guidance for Assessing Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer, NOAA, National Marine Fisheries Service (NFMS). NOAA Technical Memorandum, NMFS-OPR-59, p. 178.

Ref 12-98 Southall, L., Finneran, J., Reichmuth, C., Nachtigall, E., Kettem, R., Bowles, E., . . . Tyack, L., 2019; Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. Aquatic Mammals, 45(2), 125-232.

Ref 12-99 Hoelzel, A.R., 2002; Marine Mammal Biology: An evolutionary approach. New Jersey: Blackwell Publishing.

Ref 12-100 Wilson, B., Batty, R. S., Daunt, F. and Carter, C., 2007; Collision risks between marine renewable energy devices and mammals, fish and diving birds. Report to the Scottish Executive. Oban, Scotland: Scottish Association for Marine Science.

Ref 12-101 Jones, E. L., Hastie, G. D., Smout, S., Onoufriou, J., Merchant, N. D., Brookes, K. L. and Thompson, D., 2017; Seals and shipping: quantifying population risk and individual exposure to vessel noise. Journal of Applied Ecology, 54(6), 1930-1940.

Ref 12-102 Winkler, C., Panigada, S., Murphy, S. and Ritter, F., 2020; Global numbers of ship strikes: an assessment of collisions between vessels and cetaceans using available data in the IWC ship strike database. Galway, Ireland: Galway-Mayo Institute of Technology.

Ref 12-103 ABPmer (2017). Marine Vessel Traffic Dataset – AIS Portal.

Ref 12-104 Cefas, 2020; The Sizewell C Project: Chapter 22 Marine Ecology and Fisheries – Appendix 22G Predictions of Entrainment by Sizewell C in Relation to Adjacent Fish and Invertebrate Populations, EN010012 [online]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-001942-SZC_Bk6_ES_V2_Ch22_Marine_Ecology_Appx22G_Predictions_of_Entrainment.pdf [Accessed 23/04/2024].

Ref 12-105 WaterProjectsOnline, 2020: Southern Water Eel Screens Programme – 18 site program of work to protect the brook lamprey must meet stringent regulatory dates. River Works and River & Coastal Flood Alleviation 2020.

Ref 12-106 Pacyna, J.M., 2008; Atmospheric Deposition. Encyclopedia of Ecology, Academic Press. Pages 275-285. [Online]. Available at: https://www.sciencedirect.com/science/article/abs/pii/B9780080454054002585 (Accessed 08/04/2024).