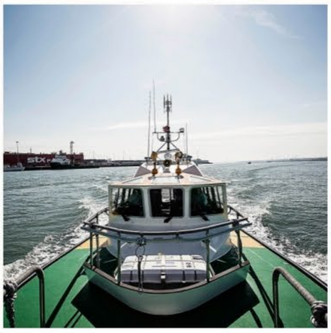
Port of Mostyn

Mostyn Energy Park Extension

Environmental Statement

Chapter 8: Chapter Nature Conservation and Marine Ecology

December 2022



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8 Nature Conservation and Marine Ecology

8.1 Introduction

This chapter provides an assessment of the potential significant effects of the MEPE project on nature conservation and marine ecology. This chapter has been prepared by ABPmer.

The following receptors have been considered as part of the assessment:

- Nature conservation designations and protected species;
- Benthic habitats and species;
- Fish and shellfish;
- Marine mammals;
- Coastal waterbirds; and
- Otters.

Section 8.2 provides a definition of the study area for this topic, Section 8.3 presents the impact assessment approach that has been followed and Section 8.4 details the consultation which has taken place. Section 8.5 describes the legislation, policy and guidance position in respect of this topic and Section 8.6 describes the baseline conditions of the study area. An impact assessment describing changes to the baseline environment is then presented in Section 8.7, mitigation measures and residual effects are reviewed in Section 8.8. Section 8.9 provides an overall final summary of the topic assessment.

A number of figures included in this chapter assist in describing the existing environment (baseline). Figure 8.1 shows the location of the Port of Mostyn coastal waterbird surveys. The results of the Phase 1 intertidal survey are shown in in Figure 8.2 and the location of the project specific intertidal and subtidal benthic sampling stations is shown in Figure 8.3. Internationally and nationally designated conservation sites are shown in Figure 8.4. Figure 8.5 shows the location of transitional and coastal waters (TrAC) fish monitoring stations in the vicinity of the proposed development. In addition, the following baseline survey reports have supported the baseline description of this chapter:

- Appendix 8.1: The results of the project-specific benthic surveys;
- Appendix 8.2: The results of recent fish and marine mammal surveys undertaken on behalf of the Port of Mostyn in the Dee Estuary; and
- Appendix 8.3: The results of the ornithology surveys undertaken on behalf of the Port of Mostyn.

The nature conservation and marine ecology assessment has been informed by the physical processes assessment (Chapter 6), water and sediment quality assessment (Chapter 7) and underwater noise assessment (Appendix 8.4 of the ES).

Relevant aspects of the nature conservation and marine ecology assessment have informed the Habitat Regulations Assessment (HRA) (Appendix 8.5) and Water Framework Directive (WFD) Compliance Assessment (Appendix 7.1 of this ES).

8.2 Definition of study area

The study area is the area over which potential direct and indirect effects of the MEPE Project and ongoing maintenance dredge works may occur during construction and operation. The direct effects on nature conservation and marine ecology receptors are those that occur within the footprint of the proposed development, such as the direct disturbance to benthic habitats and associated species as a result of the capital dredge works and new quay wall construction. Indirect effects are those that may arise outside this footprint, such as the potential noise and visual disturbance effects on waterbirds during construction.

The study area for the nature conservation and marine ecology topic is considered to be the body of water and intertidal areas comprising the Dee Estuary, particularly the subtidal and intertidal areas around Mostyn, as well as the existing licensed disposal sites at the Mostyn Deep (IS102) and the Mostyn Breakwater (IS103), and the adjacent coastline.

8.3 Impact assessment methodology

8.3.1 Data and information sources

A desk-based review of publicly available data has been undertaken to support a detailed understanding of baseline nature conservation and marine ecology features in the study area. This has included a review of benthic habitats and species, fish and shellfish, marine mammals, coastal waterbirds and otters.

The main desk-based sources of information that have been reviewed to inform the current baseline description within the vicinity of the proposed development include:

Nature conservation sites

- **Natura 2000 standard data forms or information sheets for each designation**: Information on the species and habitats listed in the original citations;
- **Natural England (2022):** Multi-Agency Geographic Information for the Countryside (MAGIC) Interactive Map: Information on the boundaries of designated sites;
- **Natural England and CCW (2010):** The Dee Estuary European Marine Site Conservation Advice Package;
- **Natural Resources Wales (NRW) (2018a):** Dee Estuary / Aber Dyfrdwy Special Area of Conservation: Indicative site level feature condition assessments 2018;
- The Wales Biodiversity Partnership website (www.biodiversitywales.org.uk);
- Flintshire and Cheshire Local Biodiversity Partnerships website (www.cheshire-biodiversity.org.uk); and
- The National Biodiversity Network (NBN) website (www.nbn.org.uk/).

Benthic ecology

- **Review of Dredge and Disposal Monitoring**: Overview of survey work carried out by the Port in the Dee Estuary from 2005 to 2016 (ABPmer, 2017);
- **Mostyn Dredge and Disposal Ecological Monitoring Work:** Recent broad-scale intertidal habitat surveys of the Dee Estuary (including the Mostyn Bank) have been undertaken for the Port by ABPmer. These have been carried out as part of the ecological monitoring component of the Port's inner Approach Channel monitoring programme. This ecological monitoring work has been undertaken since 2009. The most recent and reported survey is April 2021 (ABPmer, 2021);

- **The Mostyn Energy Park Benthic Invertebrate Survey:** The Mostyn Energy Park Benthic Invertebrate Survey was undertaken in September 2011 and was undertaken in conjunction with the Autumn 2011 survey. A total of 11 sampling points along three transects were successfully surveyed. At each of the sampling sites, benthic invertebrate and surface sediment samples were retrieved using a hand core (ABPmer, 2012).
- **The Mostyn Energy Park Biotope Survey:** The Mostyn Energy Park Biotope Survey was undertaken in November 2012 jointly by staff members from both ABPmer and NRW. The survey extent approximately covered the Port of Mostyn Statutory Harbour Area (Port of Mostyn, 2013);
- **Mostyn Deep and Welsh Channel Benthic Surveys 2002-2003:** Subtidal invertebrate grab sampling at a total of 10 sites in the Mostyn Deep and Welsh Channel in May 2003 and 8 sites in the Mostyn Deep in August 2002 by Hydrosurveys using a 0.1 m² grab. The purpose of these surveys was to provide environmental baseline data for a proposed dredge disposal area in Mostyn Deep (Hydrosurveys, 2002, Hydrosurveys, 2003);
- **Port of Mostyn Wind Farm Service Vessel Pontoon Facility Benthic Surveys:** Subtidal grab survey to describe the benthic habitats around the Port of Mostyn Wind Farm Service Vessel Pontoon Facility development by Pelorus Surveys in May 2010 (GoBe Consultants, 2011).

Fish and shellfish

- **Outer Dee Estuary Fish Surveys:** The following surveys were conducted by ABPmer on behalf of the Port of Mostyn in the outer Dee Estuary and approaches. These surveys were undertaken to inform a potential lagoon development with the data used here to provide additional contextual baseline information. The methods and results are presented in more detail in Appendix 8.2:
  - *Quarterly Fish Surveys:* Intertidal (involving fyke nets, seine netting and a small 1.5 m scientific light weight beam trawl) and subtidal fish surveys (involving otter and beam trawls). The first quarterly surveys were undertaken in November/early December 2020 with the fourth quarterly survey in August 2021;
  - *Monthly Ichthyoplankton Surveys:* Monthly fish plankton (trawl) surveys which started in November 2020;
  - *Pelagic (Acoustic) Fish Surveys:* Surveys using a combination of echosounders to identify fish shoals and some trawl surveys to identify fish species) in May and August 2021; and

    Environmental DNA (eDNA) Samples: The collection of 10 water samples were collected throughout the outer Dee Estuary and approaches on the 25 August 2021 for Environmental deoxyribonucleic acid (eDNA) analysis.
- **NRW Transitional and Coastal Waters (TraC) Fish Monitoring:** The results of the most recently available WFD fish monitoring for the Dee Estuary (NRW, 2022a);
- **Salmon and Sea Trout Dee Stock Assessment Programme:** The latest available data on the status of the salmon and sea trout populations in the Dee catchment based on data from fish trap monitoring, electrofishing surveys of juveniles (fry and parr) and rod catches (NRW, 2022b);
- **Dee Estuary cockle stock assessment Spring 2022**: The report summarises the findings of the spring survey conducted in March 2022 and provides an estimation of the current biomass and number of cockles within the Dee Estuary and indicates the relative distribution of the various year classes of cockles (NRW, 2022c); and
- **Centre for Environment, Fisheries and Aquaculture Science (Cefas) Spawning and Nursery Grounds of Selected Fish Species in UK waters**: Distribution maps of the main spawning and nursery grounds for 14 commercially important species (cod, haddock, whiting, saithe, Norway pout, blue whiting, mackerel, herring, sprat, sandeels, plaice, lemon sole, sole and Norway lobster) (Ellis *et al*., 2012).

Marine mammals

- **Outer Dee Estuary Marine Mammal Surveys:** The following surveys were conducted by ABPmer on behalf of the Port of Mostyn in the outer Dee Estuary and approaches. These surveys were undertaken to inform a potential lagoon development with the data used here to provide additional contextual baseline information. The methods and results are presented in more detail in Appendix 8.2;
    - Monthly Boat Surveys: Monthly vessel based marine mammal surveys which involved four transects in the outer Dee Estuary (at 1.5 km spacing) and five transects in the approaches to the Dee Estuary within Liverpool Bay (at 2 km spacings). These surveys were undertaken between October 2020 and September 2021; and
    - Passive Acoustic Monitoring (PAM) using F-PODs: These static acoustic detection devices are useful to record continuous long-term datasets at specific locations over extended periods. Four F-PODS were successfully deployed in November 2020: one off the Mostyn Deep, one in channel near Hilbre Island and two in the Dee approaches. The results of 12 months of deployment are summarised.
- **At-sea Distribution Data for Grey and Harbour Seals:** The latest habitat-based predictions of at-sea distribution for grey and harbour seals in the British Isles (including the Dee Estuary region) estimated using data from animal-borne telemetry tags by the Sea Mammal Research Unit (SMRU) (Carter *et al.*, 2020);
- Inter-Agency Marine Mammal Working Group (IAMMWG) Management Units and Management Units Abundance Estimates: In 2015, the IAMMWG defined Management Units (MUs) for the seven most common cetacean species found in UK waters: harbour porpoise, bottlenose dolphin, short-beaked common dolphin, white-beaked dolphin, Atlantic white-sided dolphin, Risso's dolphin and minke whale (IAMMWG, 2015). Updated abundance estimates for these species and their MUs have been obtained from the 'Small Cetaceans in European Atlantic Waters and the North Sea (SCANS)-III' report (Hammond et al. 2021) and the ObSERVE Programme (Rogan *et al.* 2018) (IAMMWG, 2021);
- **Special Committee on Seals Annual Report 2020:** Information on the status of seals around the UK coast is reported annually by the Sea Mammal Research Unit (SMRU) advised Special Committee on Seals (SCOS) (SCOS, 2021);
- **Atlas of the Marine Mammals of Wales:** The most comprehensive information on the distribution of marine mammals in Welsh waters is provided in the Atlas of the Marine Mammals of Wales (Baines and Evans, 2012). The study compiled and analysed data from sixteen projects including a total of 216,031 km of effort from vessel and aerial surveys and 13,399 hours of land-based effort, spanning the 20-year period 1990-2009;
- **Identification of Discrete and Persistent Areas of Relatively High Harbour Porpoise Density in the Wider UK Marine Area:** The report presents the results of 18 years of survey data in the Joint Cetacean Protocol (JCP) undertaken to inform the identification of discrete and persistent areas of relatively high harbour porpoise density in the UK marine area (Heinänen and Skov, 2015);
- **Small Cetaceans in European Atlantic Waters and the North Sea (SCANS) III**: Cetacean surveys to estimate the abundance of cetacean species in shelf and oceanic waters of the European Atlantic undertaken in 2016. Teams of observers searched along 60,000 km of transect line, recording thousands of groups of cetaceans from 19 different species. The survey (SCANS-III) is the third in a series that began in 1994 (SCANS) and continued in 2005 (SCANS-II) (Hammond *et al.*, 2021); and
- **Bottlenose Dolphin Monitoring in Cardigan Bay (2014 – 2016)**: The report summarises the bottlenose dolphin monitoring work conducted by the Sea Watch Foundation between 2014 and 2016 on behalf of Natural Resources Wales. The primary objective of this contract was to monitor the bottlenose dolphin population of Cardigan Bay including both Cardigan Bay SAC and the wider Cardigan Bay area (Lohrengel *et al*, 2018).

Coastal waterbirds

- **Port of Mostyn Ornithology Surveys:** The most recent phase of coastal waterbirds surveys were undertaken from September 2017 to April 2021. The surveys involved monthly counts at high water and low water undertaken within established Wetland Bird Survey (WeBS) sectors (Mostyn Dock, Ffynnongroyw Bay South, Ffynnongroyw Bay North and Point of Ayr) sectors as well as subdivision sectors which focused on key roosting and foraging areas around the Port (Figure 8.1). The methods and results are presented in more detail in Appendix 8.3;
- **WeBS Core Counts Data**: Core count data for data for Ffynnongroyw Bay South and Mostyn Dock Shore which are located in the Port of Mostyn area. Core Count surveys are typically undertaken around high water. The most recent 5-years of data available from the British Trust for Ornithology (BTO) (2015/16 to 2019/20) have been analysed. In addition, estuary-wide WeBS data for the Dee Estuary for the same period has also been reviewed to provide contextual information (Frost *et al*., 2021)[1]; and
- **Dee Estuary Low Tide Count Data**: Estuary-wide low tide counts undertaken in winter 2021/22 (November to February) by the BTO based on the same methods and sectors as undertaken for the WeBS Low Tide Counts scheme. The surveys were undertaken on behalf of the Port of Mostyn (BTO, 2022).

Otters

- NRW (2018b). NRW Evidence Report: Otter Survey Wales 2015-2018.

Project specific surveys that have been undertaken to underpin the assessments include:

- **Phase 1 Intertidal habitat survey**: In order to characterise the intertidal habitats and species present within the footprint of the proposed works, a Phase 1 Intertidal Habitat Survey was undertaken in October 2021 (Figure 8.2). The purpose of the survey was to map the intertidal habitats present, identify the main characterising species and also the presence of any habitats/species of conservation interest;
- **Intertidal benthic sampling:** Ten intertidal stations were sampled in October 2021 using a 0.01 m^2 hand-held core to help better understand the intertidal faunal communities present within the footprint of the proposed development. The location of the survey stations are shown in Figure 8.3; and
- **Subtidal benthic sampling:** Six subtidal stations were sampled in a March 2022 (using a 0.1 m^2 Day Grab) within the proposed development footprint to help better understand the subtidal faunal communities present within the footprint of the proposed development. The location of the survey stations are shown in Figure 8.3.

The approach and findings of these surveys are described further in Appendix 8.1 and summarised in Section 8.6.2.

[1] It should be noted that as a result of COVID-19 lockdowns, the BTO were unable to produce robust data for 2020/21 at an estuary-wide scale and therefore the period 2015/16 to 2019/20 is the most recent 5 years of data available from the BTO.

Figure 8.1. Location of Port of Mostyn bird count sectors

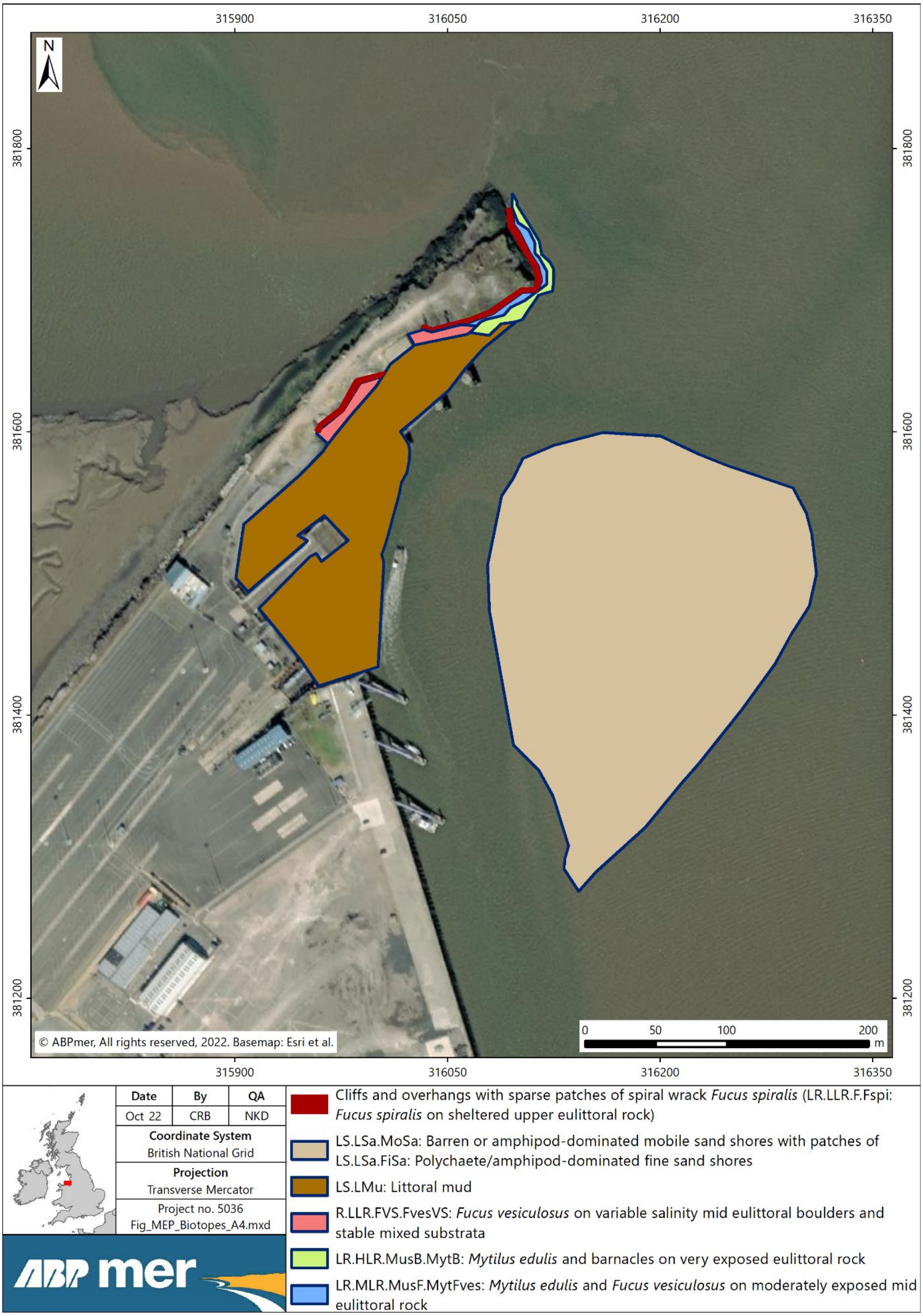

Figure 8.2. Habitats mapped during phase 1 intertidal habitat survey

Date	By	QA
Nov 22	CRB	NKD
Coordinate System British National Grid		
Projection Transverse Mercator		
Project no. 5036 Fig_Survey_Sampling_A5.mxd		

Intertidal sampling stations
Subtidal sampling stations
Reclaim
Capital dredge

Figure 8.3. Location of intertidal and subtidal stations

8.3.2 Determining significance of effects

To facilitate the impact assessment process and ensure consistency in the terminology of significance, a standard assessment methodology has been applied, as described in the Impact Assessment Approach Chapter 5.

The marine ecology impact assessment follows a well-established approach that has been developed specifically for this topic and has been applied in numerous marine EIAs and accepted by relevant stakeholders. It is considered, therefore, the most appropriate methodology to use in the marine ecology assessment of the proposed development.

To assess the significance of effects, the magnitude of the change and the probability of it occurring is evaluated to understand the exposure to change, and this is assessed against the sensitivity of a receptor/feature to understand its vulnerability. Finally, this is compared against the importance of a receptor/feature to generate a level of significance for effects resulting from each impact pathway. The matrices included in the Impact Assessment Approach Chapter 5 have been used to help assess significance.

The manner in which the magnitude of change, sensitivity and importance of receptor/feature and significance of criteria have been applied to the nature conservation and marine ecology assessment is described in the following sections.

Magnitude of change

This initial stage involves understanding the magnitude or scale of any potential change in baseline conditions.

Magnitude of change needs to be considered in spatial and temporal terms (including duration, frequency and seasonality), and against background environmental conditions in a study area. The assessment of magnitude should also be carried out taking account of any inherent design mitigation that forms part of the development description.

The following criteria has been used to assess the magnitude of change:

- Negligible: Changes that are barely discernible from existing baseline conditions;
- Small: Relatively localised changes that are often temporary in nature and / or a receptor has limited exposure to change;
- Medium: Receptors are subject to changes that occur over a large spatial area but the effects are considered temporary; and
- High: Receptors are subject to changes over a large spatial area with effects that are considered permanent / long-term duration.

Once a magnitude has been assessed, this should be considered in terms of the probability of occurrence (i.e. likelihood that the impact will occur) to derive an overall level of exposure.

Sensitivity of receptors

Sensitivity can be described as the intolerance of a habitat, community or individual of a species to an environmental change and essentially considers the response characteristic of the feature. The sensitivity of a marine habitat or species is considered to be a product of the following (Tyler-Walters *et al.*, 2018):

- The likelihood of damage (termed intolerance or resistance) due to a pressure. This could include behavioural effects, physiological damage or even mortality of individuals or populations; and
- The rate of (or time taken for) recovery (termed recoverability, or resilience) of marine species once the pressure has abated or been removed.

The following criteria have been used to assess sensitivity:

- Negligible: Pressures in which there is unlikely to be any damage to individuals or populations;
- Low: Pressures in which the likelihood of damage to individuals or populations is low with recoverability expected to occur over short timescales;
- Moderate: Pressures in which damage to individuals or populations could occur but recoverability is expected to occur over short to moderate timescales; and
- High: Pressures in which damage to individuals or populations is highly likely with either no recoverability or recoverability expected to occur over longer timescales.

Table 8.1 summarises the sensitivity level that has been assigned to different receptors considered in this assessment based on consideration of the criteria highlighted above. Further rationale for the sensitivity levels that have been assigned are included for each pathway in the impact assessment section of this chapter (Section 8.7).

Table 8.1. Assessed sensitivity of marine ecology receptors

Receptor	Sensitivity
Benthic habitats and species	The benthic habitats and species in the dredge footprint and disposal sites are considered to have a **high** sensitivity to habitat loss, a **low** sensitivity to habitat change (due to relatively high recoverability), a **low to moderate** sensitivity to non-native species introductions and release of contaminants, a **low** sensitivity to elevated suspended sediment concentrations (SSCs), and a **negligible to low** sensitivity to underwater noise and vibration depending on the nature of the activity.
Fish and shellfish	Fish and shellfish species in the study area are considered to have a **low** sensitivity to marine habitat change on the scale predicted. They are considered to have a **low to moderate** sensitivity to water quality and underwater noise (depending on the species and activity).
Marine mammals	Marine mammals are generally considered to have a **low** sensitivity to marine habitat change / loss, changes in water quality and collision risk on the scale predicted (due to the high mobility of the species). The species in the study area are considered to have a **moderate** sensitivity to the anticipated level of underwater noise generated by the proposed development from piling and a **low** sensitivity to noise due to dredging activities.
Coastal waterbirds	Coastal waterbirds are generally considered to have a **low** sensitivity to marine habitat change / loss on the scale predicted (due to the high mobility of the species in the study area). The species in the study area are considered to have a **low to moderate** sensitivity (depending on the species) to noise and visual disturbance and changes to feeding and roosting habitat as a result of the presence of marine infrastructure on the scale predicted.
Otters	Otters in the study area are considered to have a **low** sensitivity to marine habitat change / loss on the scale predicted. They are considered to have a **low to moderate sensitivity** to noise and visual disturbance.

Receptor importance

In considering the magnitude of impacts and sensitivity of the receptor, it is also necessary to identify whether an ecological feature is 'important'. As such, where possible, habitats, species and their populations have been valued on the basis of a combination of their conservation status, rarity and ecological/socioeconomic value using contextual information, where it exists.

The CIEEM (2018) guidelines recognise that determining ecological importance is a complex process, which is a matter of professional judgement guided by the importance and relevance of a number of factors. These include designation and legislative protection, as well as biodiversity value and secondary / supporting value (e.g. where habitats may function as a buffer or resource associated with an adjacent designated area).

The importance of each ecological receptor has been determined, based on the following criteria:

- Low: The receptor is not protected or designated and is considered to be of low to moderate biodiversity or supporting value;
- Medium: Statutory protection / designation afforded to a receptor but it is considered to be of low to moderate biodiversity / supporting value or the receptor does not receive statutory protection but is considered to be of high biodiversity or supporting value; and
- High: Statutory protection / designation afforded to a receptor and the receptor is considered to be of high biodiversity or supporting value.

The importance of a receptor has also been considered with regard to the marine geographic frame of reference defined below as recommended in the CIEEM (2018) guidelines:

- International and European;
- National;
- Regional (Dee Estuary); and
- Local (Port of Mostyn area).

Table 8.2 summarises the importance level that has been assigned to the different receptors that have, to date, been assessed based on the criteria highlighted above.

Table 8.2. Assessment of the importance of marine ecology receptors

Receptor	Importance
Benthic habitats and species	**Low to high** importance: Intertidal habitats in the study area are considered to be of **low to high** importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance of subtidal habitats in the vicinity of the proposed development is also considered to be **low**. This is because subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC and 'subtidal sediment communities' is a listed sub-feature of the Dee Estuary SAC (Natural England and CCW, 2010).

Receptor	Importance
Fish and shellfish	**Low to high** importance: Species that are commonly occurring and not protected are considered to be of low importance. Species which are commercially important species (e.g. whiting, Dover sole, plaice and commercial shellfish species) are considered to be of **moderate** importance. Diadromous migratory species which are of conservation interest (European eel, Atlantic salmon, sea trout, sea lamprey, river lamprey, twaite shad, European smelt) are considered to be of **high** importance.
Marine mammals	**High** importance: All species are of conservation interest and protected.
Coastal waterbirds	**High** importance: All species are of conservation interest and protected.
Otters	**High** importance: Species is of conservation interest and protected.

Significance criteria

Determination of the significance of the predicted ecological effects is based on professional judgement having regard to the positive (beneficial) or negative (adverse) nature of a potential impact.

The CIEEM (2018) guidelines state that an effect should be determined as being significant when it "*either supports or undermines biodiversity conservation objectives for important ecological features*". It relates to the weight that should be afforded to effects when decisions are made, and to the consequences, in terms of legislation, policy and / or development control. So, a significant adverse effect on a feature of importance (as defined in Table 8.3) would require mitigation and the possible need for development control mechanisms, such as a marine licence condition.

Whilst this assessment adopts an Ecological Impact Assessment (EcIA) approach and, therefore, expresses the significance of ecological effects with reference to a geographic frame of reference (as advocated in the CIEEM Guidelines), significance is also expressed using a generic EIA significance criteria. The generic criteria used throughout this report is based on an expression of severity, to describe the significance of environmental impacts.

For ease of reference, Table 8.3 provides a means of relating the two approaches and is provided in order to allow the EcIA to be integrated into the wider EIA framework without compromising the CIEEM best practice approach.

To ensure transparency in the impact assessment, it is important to make clear the evidence-based or value-based judgments used at each stage of the assessment, and how they have been attributed to a level of significance. This is presented in the impact assessment section of this chapter for each impact pathway (Section 8.7).

As shown in Table 8.3, effects that are identified as being moderate or major adverse / beneficial are classified as significant effects and those as minor or negligible as not significant.

Table 8.3. Significance Criteria

Significance level		Criteria	CIEEM geographical criteria
Significant	Major	These effects are likely to be important considerations at a local or district scale but, if adverse, are potential concerns to the project and may become key factors in the decision-making process.	Ecological impacts assessed as being significant at the regional scale and that have triggered a response in development control terms are considered to represent impacts that overall, within this assessment, are of major significance.
	Moderate	These effects, if adverse, while important at a local scale, are not likely to be key decision-making issues. Nevertheless, the cumulative effect of such issues may lead to an increase in the overall effects on a particular area or on a particular resource.	Ecological impacts assessed as being significant at the county/metropolitan scale, and that have triggered a response in development control terms, will be considered to represent impacts that overall, within this assessment, are of moderate significance.
Not significant	Minor	These effects may be raised as local issues but are unlikely to be of importance in the decision-making process. Nevertheless, they may be of relevance in enhancing the subsequent design of the project and consideration of mitigation measures.	Ecological impacts assessed as being significant at the local scale, and that have triggered a response in development control terms, will be considered to represent impacts that overall, within this assessment, are of minor significance.
	Insignificant	No effect or effect which is beneath the level of perception, within normal bounds of variation or within the margin of forecasting error.	Ecological impacts that have been assessed as not being significant at any geographic level.

8.4 Consultation

Consultation with regard to the outcomes of the formal scoping process and whether there are any likely effects of the MEPE Project on the nature conservation and marine ecology topic has been undertaken with NRW.

The consultation that has been undertaken, along with the outcome of such consultation and how it has influenced this assessment is provided in Table 8.4.

Table 8.4. Summary of consultation to date

Consultee	Reference, Date	Summary of Response	How Comments have Been Addressed in this Chapter
NRW	Scoping Opinion, 06 January 2022	The survey detailed within Section 5.4.2: "The Mostyn Energy Park Biotope Survey: The Mostyn Energy Park Biotope Survey was undertaken in November 2012 jointly by staff members from both ABPmer and NRW. The survey extent approximately covered the Port of Mostyn Statutory Harbour Area (Port of Mostyn, 2013)" may be useful to inform the EIA, it is also likely the data could be out of date given the highly dynamic environment of the Dee Estuary. For instance, areas that were subtidal and "Estuaries" feature during the 2012 survey may now be part of the intertidal now and thus potentially another feature e.g., "Mudflat and sandflat not covered by seawater at low tide". We therefore advise any data derived from the 2012 survey to inform the EIA should be used with caution and that the recent survey data should be used to define the existing extent of the benthic features that might be potentially impacted by the development. It will be important to have an up to date understanding of the extent of these features in relation to the Project to accurately quantify any potential habitat losses within the specific designated features of the Dee Estuary SAC that might potentially arise as a result of the development.	Recent survey data has been used to define the extent of protected habitat features that might be affected by the proposed development. A summary of the outcomes of this survey is provided in the baseline description section of this chapter (Section 8.6.2) and the detailed survey report is included in Appendix 8.1 of the ES. This information has been used to support the HRA (Appendix 8.5).
NRW	Scoping Opinion, 06 January 2022	We agree with the impact pathways scoped in for benthic ecology for the construction phase; however, NRW TE have advised that the impact pathway "Direct changes to benthic habitats and species as a result of capital dredging and dredge disposal" should be defined further to consider habitat modification - adjacent habitats indirectly affected by activities and infrastructure e.g., scour, change in hydrodynamics, increased sedimentation and/or smothering and introduction of INNS.	The impact pathways that consider habitat modification are "Indirect changes to seabed habitats and species as a result of changes to hydrodynamic and sedimentary processes" and "Introduction and spread of non-native species" (Section 8.7).

Consultee	Reference, Date	Summary of Response	How Comments have Been Addressed in this Chapter
NRW	Scoping Opinion, 06 January 2022	We also agree with the impact pathways scoped in for the operational phase and, as above, also advise that "Direct changes to benthic habitats and species as a result of capital dredging and dredge disposal" should be defined further to consider habitat modification.	Habitat modification during the operational phase is assessed under "Indirect changes to seabed habitats and species as a result of changes to hydrodynamic and sedimentary processes " and "Introduction and spread of non-native species" (Section 8.7).
NRW	Scoping Opinion, 06 January 2022	The impact pathway "Indirect changes to benthic habitats and species as a result of changes to hydrodynamic and sedimentary processes during operation;" should also consider potential indirect habitat losses resulting from coastal squeeze through HTL activities (see Section 5.2.5 above).	Medium to long-term morphology changes brought about by the proposed development – both locally and across the wider Dee Estuary (in terms of changes to sediment transport pathways) – have been assessed in the physical processes assessment (Chapter 6) and this has informed the assessment of indirect changes to the impact pathway benthic habitats and species as a result of changes to hydrodynamic and sedimentary processes (Section 8.7).
NRW	Scoping Opinion, 06 January 2022	We agree with the zone of influence being determined by the outputs of the physical processes modelling and highlight the linkage between topics (as referred to within Section 5.4.4) with the extent of secondary impacts to the benthic habitats and features of the Dee Estuary being informed by the outcomes of other assessments such as coastal processes and water & sediment quality assessments.	Noted. The links to other assessments are described in the introduction to this chapter (Section 8.1). The definition of the study area specific to this topic is included in Section 8.2.
NRW	Scoping Opinion, 06 January 2022	There is the potential for impacts from the Project, particularly those in relation to direct habitat loss of "Mudflats and Sandflats not covered by seawater at low tide" feature, to result in an adverse effect on the site integrity (AEOSI) of the Dee Estuary SAC. NRW TE advise when preparing the EIA and the report to inform appropriate assessment the applicant carefully considers the distribution of habitats in the SAC and quantifies the potential losses resulting from the development to the "Estuaries" and to the "Mudflats and Sandflats not covered by seawater at low tide" features of the Dee Estuary SAC separately.	The distribution of SAC habitat features has been reviewed based on site specific survey data (Section 8.6.2). The assessment section of this chapter has quantified potential losses (Section 8.7). The outcomes of this assessment has informed the HRA which is included in Appendix 8.5.

Consultee	Reference, Date	Summary of Response	How Comments have Been Addressed in this Chapter
NRW	Scoping Opinion, 06 January 2022	The applicant should also consider and assess as noted above, the potential for changes in hydrodynamics and impacts from coastal squeeze to result in indirect habitat loss of the designated features of the Dee Estuary SAC. Indirect habitat losses to designated features also have the potential to result in an adverse effect on the site integrity (AEOSI) of the Dee Estuary SAC.	The assessment of indirect changes to the impact pathway benthic habitats and species as a result of changes to hydrodynamic and sedimentary processes during operation has considered potential indirect losses of designated features (Section 8.7). The outcomes of this assessment has informed the HRA which is included in Appendix 8.5.
NRW	Scoping Opinion, 06 January 2022	It is unclear whether the scope of the Quarterly demersal fish surveys will adequately characterise the fish community for the assessment. Some species, such as sandeels, will be poorly represented by the gears used and no shellfish data has been identified or dedicated shellfish surveys proposed, although beam trawling will collect some epifaunal species.	The Quarterly demersal fish surveys commissioned by the Port of Mostyn along with NRW TraC fish survey data and cockle monitoring have been used to help characterise the broad fish assemblage which is likely to be occurring in the vicinity of the Port of Mostyn. Further details are provided in Section 8.6.3 and Appendix 8.2.
NRW	Scoping Opinion, 06 January 2022	Effects on the fish features of the River Dee and Bala Lake SAC should be scoped into the assessment as they may be migrating through the Dee Estuary and interact with the Project. European smelt (*Osmerus eperlanus*) are also present within the Dee Estuary.	The fish interest features of the River Dee and Bala Lake SAC and European smelt have been considered in the assessment (Section 8.7).
NRW	Scoping Opinion, 06 January 2022	NRW TE would like to bring to your attention that a Bangor University PhD project has recently conducted fish eDNA monitoring of the Dee Estuary, which may be of use to inform the assessment (the PhD project is being managed by Professor Simon Creer).	The PhD thesis from this study has been used to inform the baseline description section of this chapter (Section 8.6.3).
NRW	Scoping Opinion, 06 January 2022	A list of receptor species should be defined within the ES considering the available data and species present, which are of conservation, commercial or recreational importance in the Dee Estuary. NRW TE advise that fish are then assessed by species to ensure the importance/value, sensitivity and magnitude criteria reflects species-specific biological traits and appropriate population scales.	Baseline information on fish receptors based on best available information/data has been included in the ES chapter (Section 8.6.3). The impact assessment is based on the individual sensitivity and importance of fish species that fall into relevant fish groups (Section 8.7).

Consultee	Reference, Date	Summary of Response	How Comments have Been Addressed in this Chapter
NRW	Scoping Opinion, 06 January 2022	Impacts on sub-tidal habitats and secondary impacts to fish species should be scoped in to the assessment and consideration also given to habitat loss due to increased disposal volumes.	These impact pathways have been included in the assessment (Section 8.7).
NRW	Scoping Opinion, 06 January 2022	We also advise that underwater noise disturbance resulting from dredging is scoped in.	The pathways "Underwater noise and vibration disturbance during construction" and "Underwater noise and vibration disturbance during operation" cover the proposed capital and maintenance dredging activity (Section 8.7).
NRW	Scoping Opinion, 06 January 2022	As the scoping out of indirect impacts to fish species and habitats resulting from hydrodynamic changes is dependent upon the physical processes assessment we cannot, at this stage, confirm that it is appropriate to scope this impact pathway out of the assessment.	Further consideration to the relevance of this impact pathway in light of the outcomes of the physical processes assessment has been undertaken in the impact assessment section of this chapter (Section 8.7).
NRW	Scoping Opinion, 06 January 2022	Please note that updated estimates of Marine Mammal Management Unit populations are available from IAMMWG (2021)2 and should be used in place of older estimates where appropriate. IAMMWG (2021) Updated abundance estimates for cetacean Management Units in UK waters. JNCC Report No. 680, JNCC Peterborough, ISSN 0963-8091. Available at; https://hub.jncc.gov.uk/assets/3a401204-aa46-43c8-85b8-5ae42cdd7ff3	IAMMWG (2021) has been used in this assessment to inform the baseline description (Section 8.6.4).
NRW	Scoping Opinion, 06 January 2022	We would expect the following species to be scoped into the EIA for this Project: ▪ Harbour porpoise (*Phocoena phocoena*) ▪ Bottlenose dolphin (*Tursiops truncatus*) ▪ Grey seal (*Halichoerus grypus*) ▪ Minke whale (*Balaenoptera acutorostrata*) ▪ Common dolphin (*Delphinus delphus*) ▪ Risso's dolphin (*Grampus griseus*)	Harbour porpoise, grey seal and bottlenose dolphin are the only species which have been recorded during marine mammal surveys in the outer Dee Estuary and approaches. This compliments other existing data (such as sightings data) which suggests other species of marine mammal are only rarely recorded in this area (Section 8.6.4). On this basis, the assessment has focused on harbour porpoise, grey seal and bottlenose dolphin (Section 8.7).

Consultee	Reference, Date	Summary of Response	How Comments have Been Addressed in this Chapter
NRW	Scoping Opinion, 06 January 2022	We consider the Marine Mammal Management Unit (MMMU) as the most appropriate spatial scale to assess populations of marine mammals and to scope in relevant protected sites. For each Annex II marine mammal species, the SACs in Wales within the relevant MMMU are as follows: Harbour porpoise Management Unit: Celtic & Irish Sea SACs in Welsh waters with harbour porpoise as a feature within the Management Unit: ▪ Gogledd Môn Forol / North Anglesey Marine ▪ Gorllewin Cymru Forol / West Wales Marine • Dynesfeydd Môr Hafren / Bristol Channel Approaches Bottlenose dolphin Management Unit: Irish Sea Welsh SACs with bottlenose dolphin as a feature within the Management Unit: ▪ Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau ▪ Cardigan Bay / Bae Ceredigion Grey Seal Management Unit: OSPAR Region III Welsh SACs with grey seal as a feature within the Management Unit: ▪ Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau ▪ Cardigan Bay / Bae Ceredigion ▪ Pembrokeshire Marine / Sir Benfro Forol	The MMMU has been used as the spatial scale to screen in relevant protected sites and interest features as advised. Further details are provided in the HRA (Appendix 8.5).
NRW	Scoping Opinion, 06 January 2022	During the construction phase, injury from underwater noise must be scoped into the assessment, in addition to disturbance.	Potential injury, in addition to disturbance, has been scoped into the assessment under the all-encompassing pathway "Underwater noise and vibration disturbance during construction" (Section 8.7).

Consultee	Reference, Date	Summary of Response	How Comments have Been Addressed in this Chapter
NRW	Scoping Opinion, 06 January 2022	We also recommend the inclusion of increased collision risk to marine mammals during both the construction and operational phases as a direct result of the increase in vessel activity or change in vessel type and/or size.	Collision risk has been considered in the impact assessment section of the ES chapter (Section 8.7).
NRW	Scoping Opinion, 06 January 2022	NRW TE were unable to comment on this section of the report; however, we consider the information provided on protected sites for ornithology is correct and the pathways through the construction phase and operating phase have been identified correctly.	Noted.
NRW	Scoping Opinion, 06 January 2022	The RSPB have also highlighted the Dee Estuary as being one of the top five sites for wintering water birds in the UK and have requested that additional site-specific ornithological surveys are undertaken to inform understanding of the coastal bird usage within the vicinity of the Project at different periods of the tide to inform the assessment.	The methods for the Port of Mostyn ornithological surveys (2017 to 2021) were developed to be broadly consistent with WeBS survey approaches. Counts for these surveys were undertaken on an hourly basis two hours before and after high or low water respectively (four counts in total). Given that much of the areas of potential habitat loss or change are also located in low elevation areas (such as the sandflat habitat of Bug Bank or mussel beds on the breakwater) undertaking low water focused surveys provides detailed information on the usage of these feeding habitats. The high water surveys are focused on understanding key roosting areas in the area.

8.5 Implications of legislation, policy and guidance

This section of the chapter sets out key aspects and implications of policy and guidance that are relevant to the assessment of likely impacts on nature conservation and marine ecology. It builds upon the overarching chapter covering Legislative and Consenting Framework (Chapter 4).

8.5.1 Legislation

The Marine and Coastal Access Act 2009 (MCAA)

The MCAA provides the legal mechanism to help ensure clean, healthy, safe, productive and biologically diverse oceans and seas by putting in place a new system for improved management and protection of the marine and coastal environment.

- The MCAA comprises the following key elements:
- The establishment of a Strategic Marine Planning System;
- The establishment of a Streamlined Marine Licensing System;
- The designation of Marine Conservation Zones (MCZs);
- The establishment of Inshore Fisheries Conservation Authorities (IFCAs);
- The introduction of a new licensing and authorisation system for fishing activities including emergency bylaws that respond to unforeseen threats to fish stocks;
- The creation of a continuous, well signed and managed route around the entirety of the English and Welsh coastline; and
- The establishment of a system of Integrated Coastal Zone Management.

The Wildlife and Countryside Act 1981 (WCA)

The Wildlife and Countryside Act 1981 is the principal mechanism for the legislative protection of wildlife in Great Britain.

The Act is the means by which the Bern Convention, the Birds Directive (79/409/EEC) and the Natural Habitats and Wild Fauna and Flora Directive (92/43/FFC) are implemented in Great Britain.

The Act applies to the terrestrial environment and inshore waters (0-12 nautical miles) and concerns the protection of wild animals and the designation of protected areas, including Sites of Special Scientific Interest (SSSI).

The Countryside and Rights of Way Act 2000 (CRoW Act)

The CRoW applies to England and Wales only. Part III of the CRoW deals specifically with wildlife protection and nature conservation.

The CRoW places a duty on Government Departments and the National Assembly for Wales to have regard for the conservation of biodiversity and maintain lists of species and habitats for which conservation steps should be taken or promoted, in accordance with the Convention on Biological Diversity.

Schedule 9 of the CRoW amends the SSSI provisions of the WCA, including increased powers for the protection and management of SSSIs. The provisions extend powers for entering into management agreements; place a duty on public bodies to further the conservation and enhancement of SSSIs; increase penalties on conviction where the provisions are breached; and include an offence whereby third parties can be convicted for damaging SSSIs

The Natural Environment and Rural Communities (NERC) Act 2006

Under the biodiversity duty, which is part of the NERC Act, public authorities must show regard for conserving biodiversity in all their actions. Consequently, regard must be had to priority species and habitats that are of principle importance for the purpose of conserving biodiversity and that may be adversely affected during the construction and operation of the proposed development.

The Habitat Regulations

The Habitats Regulations[2] transpose the Habitats Directive (Directive 92/43/EEC) and the Birds Directive (2009/147/EC) into English law.

The Habitats Regulations provide for the designation and protection of 'European sites', the protection of 'European protected species' and the adaptation of planning and other controls for the protection of European Sites. The Regulations also require the compilation and maintenance of a register of European sites, to include SACs (classified under the Habitats Directive) and SPAs (classified under the Birds Directive). These sites form the Natura 2000 network. These regulations also apply to Ramsar sites (designated under the 1971 Ramsar Convention for their internationally important wetlands), candidate SACs (cSAC), potential Special Protection Areas (pSPA), and proposed and existing European offshore marine sites.

Where a development project is located close to, or within, a European/Ramsar Site, the Habitats Regulations apply. This requires the Competent Authority to determine whether the proposed development has the potential for a likely significant effect (LSE) on the interest features and/or supporting habitat of a European/Ramsar site either alone or in-combination with other plans, projects and activities and, if so, to undertake an Appropriate Assessment (AA) of the implications of the proposals in light of the site's conservation objectives.

The entire Dee Estuary is designated as a SAC and a SPA under the Habitats and Birds Directives. It is also classified as a 'Ramsar site' under the Ramsar Convention due to the presence of internationally important wetlands[3]. These designations form the Dee Estuary European Marine Site (EMS). Given that the proposed development falls within these designated sites, it triggers the requirement for a HRA to be undertaken. Information to support the Competent Authority's assessment of the proposed development against the requirements of the Habitats Regulations has been provided as an appendix to the ES (Appendix 8.5), drawing on information included within the Nature Conservation and Marine Ecology chapter and other chapters within the ES.

The Water Framework Regulations

The Water Framework Directive (2000/60/EEC)[4] (WFD) establishes a framework for the management and protection of Europe's water resources. It is implemented in England and Wales through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (as amended), known as the Water Framework Regulations[5].

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2 Following the UK leaving the EU, the Conservation of Habitats and Species Regulations 2017 have been modified by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019. Available at: https://www.legislation.gov.uk/uksi/2019/579/contents/made (accessed October 2022).

3 It should be noted that the Dee Estuary is also on the Montreux Record. The Montreux Record is a register of wetland sites on the List of Ramsar wetlands of international importance where changes in ecological character have occurred, are occurring, or are likely to occur as a result of technological developments, pollution or other human interference. It is a voluntary mechanism to highlight specific wetlands of international importance that are facing immediate challenges. It is maintained as part of the List of Ramsar wetlands of international importance.

4 European Union (2000) Directive 2000/60/EEC.

5 Following the UK leaving the EU, the main provisions of the WFD have been retained in English law through The Floods and Water (Amendment etc.) (EU Exit) Regulations 2019.

The overall objectives of the WFD, as implemented by the Water Framework Regulations, is to achieve "*good ecological and good chemical status*" in all inland and coastal waters by 2021 unless alternative objectives are set or there are grounds for time limited derogation. For example, where pressures preclude the achievement of good status (e.g. navigation, coastal defence) in heavily modified water bodies (HMWBs), the WFD provides that an alternative objective of "*good ecological potential*" is set.

A WFD assessment has been undertaken to determine whether the proposed development complies with the objectives of the WFD (Appendix 7.1). This includes consideration of the potential risks for several key biological receptors, specifically habitats, fish, protected areas and invasive non-native species (INNS). The WFD has therefore been informed by the outcomes of the assessment reported within this ES chapter.

8.5.2 National policy

National Policy Statement for Ports (NPSfP)

The NPSfP provides the framework for decisions on proposals for new port developments (DfT, 2012). This policy requires that in order to meet the requirements of the Government's policies on sustainable development, new port infrastructure should also, amongst other things, assess the impact on the biodiversity, particularly bird and fish life given that ports are located on coasts and estuaries which can act as key nursery grounds for a range of commercial species and as critical mitigation pathways for other species.

Section 5.1 of the NPSfP advises that applicants should assess the impacts of the proposed project on biodiversity and geological conservation. Where an EIA is required, the ES should:

- Assess any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance;
- Assess any effects on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity; and
- Demonstrate how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests.

UK Marine Policy Statement (MPS)

The MPS is the framework for preparing marine plans and taking decisions affecting the marine environment (HM Government, 2011). The MPS also sets out the general environmental, social and economic considerations that need to be taken into account in marine planning and provides guidance on the pressures and impacts that decision makers need to consider when planning for and permitting development in the UK marine areas.

Section 2.6.1 of the MPS is relevant to the nature conservation and marine ecology assessment. In particular, paragraph 2.6.1.3 states, amongst other things, that –

> *"As a general principle, development should aim to avoid harm to marine ecology, biodiversity and geological conservation interests (including geological and morphological features), including through location, mitigation and consideration of reasonable alternatives. Where significant harm cannot be avoided, then appropriate compensatory measures should be sought….". In addition, paragraph 2.6.1.4 notes that "Development proposals may provide, where appropriate, opportunities for building-in beneficial features for marine ecology, biodiversity and geodiversity as part of good design…".*

Welsh National Marine Plan

The Welsh National Marine Plan (Welsh Government, 2019) is the first marine plan for Wales and represents that start of a process to shape seas to support economic, social, cultural and environmental objectives. The plan was prepared and adopted under the MCAA 2009 for the purposes of Section 51 of the MCAA and in accordance with the UK MPS.

The following marine plan policies are of particular relevance to the nature conservation and marine ecology topic:

- **Policy ENV_01 Resilient marine ecosystems**: Proposals should demonstrate how potential impacts on marine ecosystems have been taken into consideration and should, in order of preference: a) avoid adverse impacts; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding. Proposals that contribute to the protection, restoration and/or enhancement of marine ecosystems are encouraged;
- **Policy ENV_02 Marine Protected Areas**: Proposals should demonstrate how they: avoid adverse impacts on individual Marine Protected Areas (MPAs) and the coherence of the network as a whole; have regard to the measures to manage MPAs; and avoid adverse impacts on designated sites that are not part of the MPA network;
- **Policy ENV_03 Invasive non-native species**: Proposals should demonstrate how they avoid or minimise the risk of introducing and spreading invasive non-native species. Where appropriate, proposals should include biosecurity measures to reduce the risk of introducing and spreading of invasive non-native species;
- **Policy ENV_05 Underwater noise**: Proposals should demonstrate that they have considered man-made noise impacts on the marine environment and, in order of preference: a) avoid adverse impacts; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding; and
- **Policy ENV_05 Fish species and habitats**: Proposals potentially affecting important feeding, breeding (including spawning & nursery) and migration areas or habitats for key fish and shellfish species of commercial or ecological importance should demonstrate how they, in order of preference: a) avoid adverse impacts on those areas; and/or b) minimise adverse impacts where they cannot be avoided; and/or c) mitigate adverse impacts where they cannot be minimised; If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding.

The implications of the proposed development on these policies and other WNMP policies are reviewed in the marine plan conformance assessment included in Appendix 4.1 of this ES.

Well-being of Future Generations (Wales) Act

The Well-being of Future Generations (Wales) Act is concerned with improving the social, economic, environmental and cultural well-being of Wales. It requires public bodies to consider the long-term issues, work better with people and communities and each other, look to prevent problems and take a more joined-up approach. One of its well-being goals is for a Resilient Wales "*A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change*". The MEPE Project is considered to provide a positive contribution to this goal as detailed further in the Legislative and Consenting Framework Chapter 4 of the ES.

Environment (Wales) Act

The Environment (Wales) Act 2016 sets out the legislative framework to promote the 'Sustainable Management of Natural Resources in Wales'. The Act received Royal Assent in 2016. It delivers against Welsh Government Programme for Government commitment to introduce new legislation for the environment (Welsh Government, 2016).

UK Biodiversity Action Plan

The UK Post-2010 Biodiversity Framework (JNCC and Defra 2012) which covers the period from 2011 to 2020, supersedes the UK Biodiversity Action Plan (UK BAP), although many of the tools developed under UK BAP remain of use, for example, background information about the lists of priority habitats and species. The majority of priority Welsh BAP habitats and species are now those listed as Habitats of Principal Importance (HoPI) and Species of Principal Importance (SoPI) in Wales listed under Section 42 of the Natural Environment and Rural Communities (NERC) Act 2006.

UK Marine Strategy

The aim of the UK Marine Strategy is to more effectively protect the marine environment across the UK. The Strategy sets out a comprehensive framework for assessing, monitoring and taking action to achieve the UK's shared vision for clean, healthy, safe, productive and biologically diverse seas (Defra, 2019). It aims to achieve good environmental status of marine waters by 2020 (followed by a six-year review) and to protect the resource base upon which marine-related economic and social activities depend. The Strategy constitutes the vital environmental component of future maritime policy, designed to achieve the full economic potential of oceans and seas in harmony with the marine environment.

The UK Marine Strategy applies to the landward boundary of coastal waters as defined under the WFD (i.e. from MHWS) to the outer limit of the UK Exclusive Economic Zone (EEZ), as well as the area of UK continental shelf beyond the EEZ. Reporting against the Strategy is a cyclical process, and updated assessments and Marine Strategy documents are anticipated in due course. The anticipated pressures exerted on the marine environment by the MEPE Project are considered to be of small magnitude in the context of UK Marine Regions that they are unlikely to be a significant issue. The Strategy is, therefore, not considered further in this ES with regards to the marine ecology assessment.

North West Marine Plan

The North West Marine Plan covers the north west inshore and north west offshore marine plan areas. The Plan introduces a strategic approach to planning within the English inshore and offshore waters between the Solway Firth border with Scotland and the River Dee border with Wales. It provides a clear, evidence-based approach to inform decision-making by marine users and regulators on where, when or how activities might take place within the north west inshore and north west offshore marine plan areas. The plan was prepared and adopted under the MCAA 2009 for the purposes of Section 51 of the MCAA and in accordance with the UK MPS.

Given the MPAs in Dee Estuary overlap both the Welsh and English jurisdictions, the following marine plan policies are of particular relevance to the nature conservation and marine ecology topic:

- **Policy NW-MPA-1**: Proposals that support the objectives of marine protected areas and the ecological coherence of the marine protected area network will be supported. Proposals that may have adverse impacts on the objectives of marine protected areas must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate -adverse impacts, with due regard given to statutory advice on an ecologically coherent network; and

- **Policy NW-MPA-2**: Proposals that enhance a marine protected area's ability to adapt to climate change, enhancing the resilience of the marine protected area network, will be supported. Proposals that may have adverse impacts on an individual marine protected area's ability to adapt to the effects of climate change, and so reduce the resilience of the marine protected area network, must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate -adverse impacts.

These policies complement and are in line with WNMP Policy ENV_02 Marine Protected Areas. The implications of the proposed development on WNMP policies are reviewed in the marine plan conformance assessment included in Appendix 4.1 of this ES.

8.5.3 Local policy

Flintshire Local Development Plan (FLDP)

The draft FLDP, together with relevant supporting documents and evidence, sets out the planning strategy for Flintshire up to 2030, along with the policy framework that will be used to guide how this strategy will be followed and achieved (Flintshire County Council, 2019).

The following FLDP policies are of particular relevance to the water and sediment quality topic:

- **PC11: Mostyn Docks**: Development proposals which enhance the transport and employment role of the docks will be permitted provided that such proposals do not have a significant adverse effect on the ecological, landscape, historic, recreational integrity and water and air quality of the Dee Estuary; and

8.5.4 Guidance

Flintshire County Council Guidance on Nature Conservation and Development

This guidance note provides information and advice on nature conservation interests when considering development proposals including EIA and HRA (Flintshire County Council, 2017). The overall aim of the guidance is to improve the quality of new development and facilitate a consistent and transparent approach to decision making.

8.6 Description of the existing environment

8.6.1 Nature conservation sites and protected species

Designated sites

The Dee Estuary is an area of high conservation value and is designated under a range of national and international nature conservation legislations. The proposed development and marine disposal sites (Mostyn Deep (IS102) and Mostyn Breakwater (IS103)) are located within the Dee Estuary Special Protection Area (SPA), Special Area of Conservation (SAC) and Ramsar Site. They are also adjacent to the Liverpool Bay SPA (Figure 8.4). The potential effects on these sites are considered in detail within the HRA (Appendix 8.5).

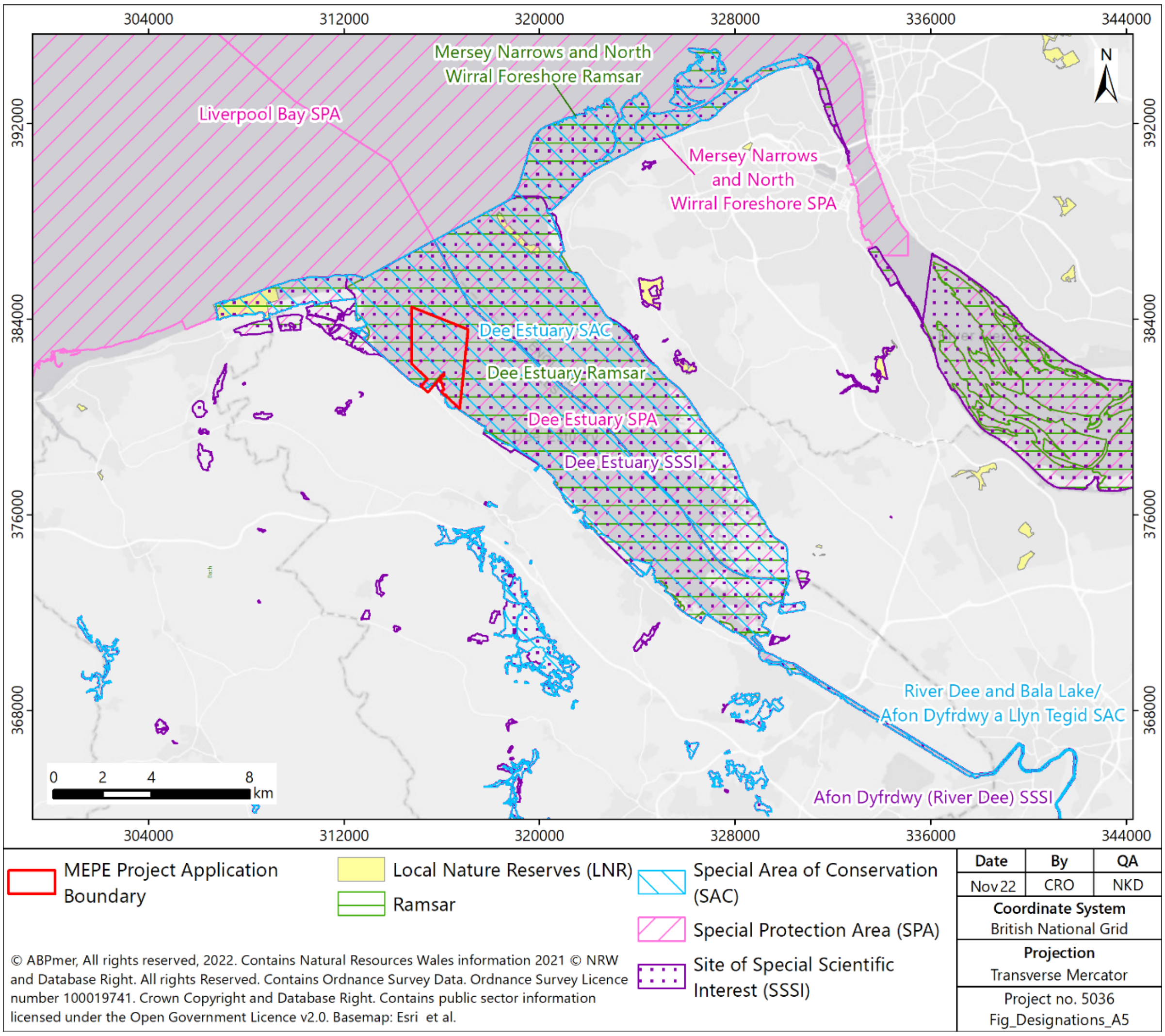

Figure 8.4. Location of nature conservation sites

Table 8.5 to Table 8.8 show the qualifying features of these European and internationally designated sites. In addition, the Mersey Narrows and North Wirral Foreshore SPA and Ramsar site are located approximately 8 km away. These sites support a variety of coastal waterbird species. The River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC is located approximately 18 km away from the proposed development. This site supports a variety of species including migratory fish species (Atlantic salmon, sea lamprey and river lamprey) and otter.

Table 8.5. Qualifying features of the two Special Protection Areas in the vicinity of the proposed development

Internationally Important Populations Within the Dee Estuary SPA	
Internationally Important Populations of Regularly Occurring Annex I Species (Article 4.1)	
Breeding Population (5 year peak mean 1994 -1999)	
Little Tern	69 (2.9 % of the GB Population)
Common Tern	392 (3.2 % of the GB Population)
Wintering Population (5 year peak mean 1994 -1999)	
Bar-tailed Godwit	1,150 (2.2 % of the GB Population)
On passage Population (5 year mean 1994 -1999)	
Sandwich tern	957 (2.3 % of the GB Population)
Internationally Important Populations of Regularly Occurring Migratory Species (Article 4.2)	
Wintering Population (5 year peak mean 1994-1999)	
Pintail	5,407 (9 % of the North-western Europe Population)
Teal	5,251 (1.3 % of the North-western Europe Population)
Dunlin	27,769 (2 % of the Northern Siberia/Europe/Western Africa population)
Knot	12,394 (3.5 % of the North-eastern Canada/Greenland/Iceland/ North-western Europe Population)
Oystercatcher	22,677 (2.5 % of the Europe and Northern/Western Africa Population)
Black-tailed Godwit	1,747 (2.5 % of the Icelandic Breeding Population)
Curlew	3,899 (1.1 % of the European Breeding Population)
Grey Plover	1,643 (1.1 % of the Eastern Atlantic Wintering Population)
Shelduck	7,725 (2.6 % of the North-western Europe Population)
Redshank	5,293 (3.5 % of the Eastern Atlantic Wintering Population)
On passage Population (5 year peak mean 1994-1999)	
Redshank	8,795 (5.9 % of the Eastern Atlantic Wintering Population)
Internationally Important Assemblage of Waterfowl (Article 4.2)	
Wintering waterfowl assemblage	120,726 waterfowl
Internationally Important Populations Within the Liverpool Bay SPA	
Internationally Important Populations of Regularly Occurring Annex I Species (Article 4.1)	
Breeding Population	
Little Tern	130 occupied nests (2.9 % of the GB Population)
Common Tern	180 pairs (1.8 % of the GB Population)
Wintering Population	
Red-throated Diver	1,171 (6.9 % of the GB Population)
Little Gull	319 (% of population not assessed)
Internationally Important Populations of Regularly Occurring Migratory Species (Article 4.2)	
Wintering Population	
Common Scoter	56,679 (10.4 % of the North West European Population)
Internationally Important Assemblage of Waterfowl (Article 4.2)	
Wintering waterfowl assemblage	69,687 waterfowl

Table 8.6. Qualifying features of the Dee Estuary Ramsar Site

Ramsar Criterion	
Ramsar Criterion 1 – Internationally important wetland habitat	
Extensive intertidal mud and sand flats (20 km by 9 km) with large expanses of saltmarsh towards the head of the estuary.	Also present are the Habitats Directive Annex I features: Estuaries; Mudflats and sandflats not covered by seawater at low tide; Annual vegetation of drift lines; Vegetated sea cliffs of the Atlantic and Baltic coasts; *Salicornia* and other annuals colonising mud and sand; Atlantic salt meadows (*Glauco-Puccinellietalia maritiame*); Embryonic shifting dunes; Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes"); Fixed dunes with herbaceous vegetation ("grey dunes"); and Humid dune slacks.
Ramsar Criterion 2 – Supports populations of vulnerable or endangered species	
Natterjack Toad, *Epidalea calamita*	Breeding colony in Red Rocks SSSI dune system
Ramsar Criterion 5 - Assemblages of international importance waterbirds	
Wintering Population (5 year peak mean 1994-1999)	
Wintering waterfowl assemblage	120,726 waterfowl
Ramsar Criterion 6 - Species/populations occurring at levels of international importance	
Spring/Autumn Population (5 year peak mean 1994-1999)	
Redshank	8,795 (5.9% of the Eastern Atlantic Population)
Wintering Population (5 year peak mean 1994-1999)	
Teal	5,251 (1.3% of the North-western Europe Population)
Shelduck	7,725 (2.6% of the North-western Europe Population)
Oystercatcher	22,677 (2.5% of the Europe and Northern/Western Africa population)
Curlew	3,899 (1.1% of the Europe Population)
Pintail	5,407 (9% of the North-western Europe Population)
Grey Plover	1,643 (1.1% of the GB Population)
Knot	12,394 (3.5% of the GB Population)
Dunlin	27,769 (2% of the European Breeding Population)
Black-tailed Godwit	1,747 (2.5% of the Icelandic Breeding Population)
Bar-tailed Godwit	1,150 (1.2% of the Europe Population)
Redshank	5,293 (3.5% of the Eastern Atlantic Population)

Table 8.7 Qualifying features of the Dee Estuary Special Area of Conservation

SAC Qualifying Features
Annex I habitats that are primary reason for selection
Mudflats and sandflats not covered by seawater at low tide
Salicornia and other annuals colonising mud and sand
Atlantic salt meadows (*Glauco-Puccinellietalia maritiame*)
Annex I habitats present as a qualifying feature, but not a primary reason
Estuaries
Annual vegetation of drift lines
Vegetated sea cliffs of the Atlantic and Baltic coasts
Embryonic shifting dunes
Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")
Fixed dunes with herbaceous vegetation ("grey dunes")
Humid dune slacks

SAC Qualifying Features
Annex II species present as a qualifying feature, but not a primary reason
Sea lamprey *Petromyzon marinus*
River lamprey *Lampetra fluviatilis*
Petalwort *Petalophyllum ralfsii*

The project is located within the Dee Estuary/Aber Afon Dyfrdwy SSSI (see Figure 8.4). The qualifying features of this site are summarised in Table 8.8.

Table 8.8. Qualifying features of the two SSSIs in the vicinity of the proposed development

SSSI	Qualifying Feature
Dee Estuary/ Aber Afon Dyfrdwy	Species
	Common Tern *Sterna hirundo*
	Great Cormorant *Phalacrocorax carbo*
	Redshank *Tringa tetanus*
	Bar-tailed Godwit *Limosa lapponica*
	Black-tailed Godwit *Limosa limosa islandica*
	Curlew *Numenius arquata*
	Dunlin *Calidris alpina*
	Great Crested Grebe *Podiceps cristatus*
	Grey Plover *Pluvialis squatarola*
	Knot *Calidris canutus*
	Oystercatcher *Haematopus ostralegus*
	Pintail *Anas acuta*
	Ringed Plover *Charadrius hiaticula*
	Shelduck *Tadorna tadorna*
	Teal *Anas crecca*
	Wigeon *Anas penelope*
	Sandhill rustic moth *Luperina nickerlii*
	Sea lamprey *Petromyzon marinus*
	River lamprey *Lampetra fluviatilis*
	Petalwort *Petalophyllum ralfsii*
	Habitats
	Estuaries
	Intertidal mud and sandflats
	Floodplain fen (lowland)
	Hard maritime cliff and slope
	Lowland wet neutral grassland
	Reeds and swamp/other freshwater transitions
	Saltmarsh
	Vascular plant assemblage
	Hard inter-tidal habitat including rocky shores
Gronant Dunes and Talacre Warren	Species
	Sanderling *Calidris alba*
	Great Cormorant *Phalacrocorax carbo*
	Little Tern *Sterna albifrons*
	Sandwich Tern *Thalasseus sandvicensis*
	Petalwort *Petalophyllum ralfsii*
	An assemblage of and individual invertebrate species (including Sandhill rustic moth *Luperina nickerlii*, mining bee *Colletes cunicularis* and sand

SSSI	Qualifying Feature
	wasp *Podalonia affinisl*)
	An assemblage of dune fungal species
	Habitats
	Areas of semi-fixed/fixed sand dune grassland communities
	Dune slacks
	An assemblage of higher plants
	Saltmarsh and transitions to swamp and reedbeds

Protected species

The Wildlife and Countryside Act 1981 (as amended) (WCA) protects various animals, plants, habitats in the UK. Relevant protected WCA species recorded in the Dee Estuary region include:

- Twaite shad *Alosa fallax*;
- Cetacean (whale and dolphin) species;
- All bird species; and
- European otter (*Lutra lutra*).

Marine species are also protected from being killed, injured or disturbed both inside and outside designated sites under the provisions of the European Habitats Directive. Of relevance to the Dee Estuary are:

- Common seal *Phoca vitulina* and grey seal *Halichoerus grypus* (listed in Annex II and V);
- Bottlenose dolphin *Tursiops truncatus* and harbour porpoise *Phocoena phocoena* (listed in Annex II and IV);
- Sea lamprey *Petromyzon marinus* (listed in Annex II) and river lamprey (listed in Annex II and V);
- Twaite shad *A. fallax* (listed in Annex II and V);
- Atlantic salmon *Salmo salar* (listed in Annex II and V); and
- European otter *L. lutra* (listed in Annex II and Annex IV).

Seals are also protected under the Conservation of Seals Act 1970.

All naturally occurring wild bird species, their eggs, nests and habitats are strictly protected under the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019.

In addition, some marine fauna and habitats are listed as priority species and habitats of principle importance in England, as required under Section 42 of the NERC Act 2006 Wales. Species of principal importance which are of relevance to the Dee Estuary include various species of waterbird, commercial fish (such as sole *Solea solea* and herring *Clupea harengus*), migratory fish (such as lampreys, shads, European smelt *Osmerus eperlanus*, Atlantic salmon *Salmo salar* and European eel *Anguilla anguilla*). Habitats of principle importance of relevance to the Dee Estuary include intertidal mudflats, coastal saltmarsh, peat and clay exposures, estuarine rocky habitats and sand dunes.

European eels are also afforded protection as part of the Eels (England and Wales) Regulations 2009. The regulations which apply to all freshwater and estuarine waters of England and Wales gives powers to statutory bodies to implement measures for the recovery of European eel stocks including improving access, habitat quality and fishing pressure.

8.6.2 Benthic ecology

This section has been structured as follows:

- **Regional overview**: Provides contextual information on benthic habitats and species in the Dee Estuary region; and
- **Project specific benthic surveys:** Summarises the results of surveys to characterise intertidal and subtidal benthic habitats and species specifically in the proposed development footprint.

Regional overview

The majority of the outer Dee Estuary in which the proposed development and marine disposal sites are situated consists of tide swept sandflat habitat with patches of muddy sand habitat and mixed substrate also present. Extensive mudflat habitat occurs along the inner Mostyn Bank with the majority of saltmarsh occurring on the upper sections of Gayton Sands and around Talacre. Small areas of rocky shore habitat and eroding clay features are also present in the Dee Estuary.

Intertidal habitats

Mudflat along the inner southern part of the Mostyn Bank in the vicinity of the Port of Mostyn, generally has a high number of taxa and species, characterised by typical mud dwelling species such as the bivalves (peppery furrow shell *Scrobicularia plana*, common cockle *Cerastoderma edule*, Baltic tellin *Limecola balthica*), the polychaete *Hediste diversicolor*, mud snail *Peringia ulvae,* the amphipods *Corophium volutator* and *C. arenaria,* and the oligochaete *Tubificoides* spp. (CCW, 2002; Port of Mostyn, 2013; ABPmer, 2012; ABPmer, 2017; ABPmer, 2021; ABPmer, 2012).

Much of the Salisbury Bank adjacent to the Port of Mostyn consists of tide-swept sandflat habitat which consists of a clean sand substratum (with no or very low silt content) and a relatively species poor, macrofaunal community. However, areas of muddy sand habitat rich in cockles occur in several areas on the Salisbury Bank. Along with abundant cockles, previous surveys in these areas have recorded a range of species including the mud snail *P. ulvae,* Baltic tellin *L. balthica,* sand mason *Lanice conchilega,* peppery furrow shell *S. plana*, lugworm *Arenicola marina* and mud shrimps *Corophium spp*. Clumps of mussels *Mytilus edulis* attached to surface cockles have also been observed at these sites (ABPmer, 2017; ABPmer, 2021; ABPmer, 2012).

Rocky shore habitat is generally restricted to around Hilbre Island and the Port of Mostyn (Natural England and CCW, 2010; Port of Mostyn, 2013). The largest extent of hard substrate at the Port of Mostyn is the breakwater which comprises tipped slag deposits which grade into sand and silt closer to the lower shore. Commonly intertidal species recorded in rocky areas of the Dee Estuary include wracks *Fucus* spp., green seaweeds *Ulva* spp., the edible periwinkle *Littorina littorea,* barnacles and blue mussels *M. edulis*. The common starfish *Asterias rubens* has also been recorded on lower shore mussel beds in the area (Port of Mostyn, 2013).

Subtidal habitats

The infaunal community of the subtidal habitats of the outer Dee Estuary has been characterised by catworms such as *N. cirrosa* and *N. hombergii* along with paddleworm *Eumida bathusiensis*, mobile crustaceans (such as the mysid shrimp *Gastrosaccus spinifera* and amphipod *Bathyporeia* spp.) and bivalve *Abra alba*. Epifaunal species recorded include the common starfish *A. rubens* (which have been recorded occurring in large densities), the soft coral *Alcyonium digitatum* the common heart urchin *Echinocardium cordatum,* brittlestar *Ophiura ophiura*, green sea urchin *Psammechinus miliaris*, hermit crabs *Pagurus bernhardus* and brown shrimps *Crangon crangon* (Hydrosurveys, 2002; Hydrosurveys, 2003; ABPmer, 2022).

Specifically, within the vicinity of Mostyn Deep (IS102) disposal site, a very impoverished infaunal community with a low number of taxa (total of five species) and abundance (up to 190 individuals per m^2) has been recorded (Hydrosurveys, 2002, Hydrosurveys, 2003). The most numerous species in the grab samples was the catworm *Nephtys cirrosa* which is typically recorded in mobile subtidal sandy sediments. In addition, small numbers of the mysid shrimp *Gastrosaccus spinifera* and mollusc *Abra* spp. were recorded.

Subtidal habitats in the Port of Mostyn area have been characterised generally by an impoverished fauna consisting of errant polychaetes (such as *Nephtys hombergii*), the oligiochaete *T. benedii* and juvenile mussel *M. edulis* (GoBe Consultants Ltd., 2011; ERM, 2009).

Non-native species

Invasive marine species known to occur in the Dee Estuary region include the Chinese mitten crab *Eriocheir sinensis* and acorn barnacle *Austrominius modestus* (Falkingham *et al.,* 2016; NW IFCA. 2014; NBN, 2022).

Project specific benthic surveys

A Phase 1 intertidal habitat survey, within the footprint of the proposed development, was undertaken in October 2021. The purpose of the survey was to map the intertidal habitats present, identify the main characterising species and also the presence of any habitats/species of conservation interest.

In addition, in order to characterise the infaunal benthic communities present within the proposed development boundary of the proposed development, intertidal and subtidal sampling was undertaken in October 2021 and March 2022 respectively. The intertidal samples were collected using a 0.01 m^2 hand-held core and the subtidal stations using a 0.1 m^2 Day Grab. At each station, a sample was analysed for macrofaunal analysis (faunal composition, abundance and biomass), PSA and TOC.

The results of these surveys are summarised below and in Table 8.9 and Table 8.10, with the methods and results described in more detail in Appendix 8.1.

Phase 1 intertidal habitat survey

This section has been structured so that habitats and species recorded on the upper and mid shore are described first, followed by those habitats observed on the lower shore. Finally, ornithology observations made during the survey are summarised. The spatial distribution of intertidal habitats recorded are shown in Figure 8.2.

Upper and mid shore habitats

The eastern side of the breakwater comprised of tipped slag waste deposits from the historic iron industry[6] which have partly fragmented into artificial hard substrate of varying sizes (rock, boulders and cobble-sized deposits) grading into mud closer to the lower shore. The upper shore consisted of steep crags and overhangs which were colonised in relatively sparse patches by the spiral wrack *Fucus spiralis* (*LR.LLR.F.Fspi: Fucus spiralis* on sheltered upper eulittoral rock) although it is noted that the

[6] The 1899 breakwater was constructed from industrial slag waste from the Darwen and Mostyn Iron Works. Slag is a by-product of smelting ores and used metals.

slag waste deposits are an artificial rather than natural form of rock and generally considered more porous in nature. Above this zone, green algae and lichens were present.

Lower and mid shore habitats

Mid shore habitats consisted of areas of hardened rock and boulder-sized slag waste deposits which were colonised by the bladder wrack *Fucus vesiculosus,* along with barnacles and patches of mussels *Mytilus edulis*. The common periwinkle *Littorina littorea* was also recorded and shore crabs *Carcinus maenas* were observed under boulder-sized slag deposits and in crevices. The habitat is most appropriately assigned to LR.MLR.MusF.MytFves (*Mytilus edulis* and *Fucus vesiculosus* on moderately exposed mid eulittoral rock) and R.LLR.FVS.FvesVS (*Fucus vesiculosus* on variable salinity mid eulittoral boulders and stable mixed substrata) although, as noted above, this hard substrate is a by-product of the historic iron industry rather than naturally formed.

The lower shore consisted predominantly of barnacle covered rock-sized slag deposits with aggregations of mussels *Mytilus edulis*. A layer of mud was present overlying some of the boulder-sized slag deposits in the area. Macroalgae was largely absent. Occasional common starfish *Asterias rubens* were also recorded on the lower shore near the sublittoral fringe. The habitat is most appropriately assigned to LR.HLR.MusB.MytB (*Mytilus edulis* and barnacles on very exposed eulittoral rock[7]) although, as noted above, this hard substrate is artificial and not naturally formed.

The hard substrate habitat of the breakwater provides a similar ecological function to the 'estuarine rocky habitats' Habitat of Principal Importance in Wales listed under the Natural Environment and Rural Communities (NERC) Act 2006 Section 42 but given its artificial nature, it is not strictly considered to be characteristic of this habitat.

Intertidal benthic sampling

The sediment from the samples collected around the ferry structures and below the breakwater (Stations INT 1 to INT3) consisted of soft/fluid sandy mud (Table 8.9).

The infaunal samples were impoverished and characterised by low numbers of the mud shrimp *Corophium volutator*, mud snail *Peringia ulvae*, the oligochaete *Tubificoides benedii,* polychaetes (including the tube-dwelling deposit feeder *Streblospio shrubsolii*, and tube-dwelling *Pygospio elegans* which is a deposit/suspension feeder) and clams (*Tellinoidea* spp. and Baltic tellin *Limecola balthica*). These species are all considered commonly occurring, not protected and typical of estuarine mudflat habitat. However, the number of species and abundance levels recorded in the samples are much lower than recorded in ecologically richer mudflat habitats in the nearby local area. For example, over 20 taxa and number of organisms typically in the range of 20,000-50,000 per m^2 have been regularly recorded in benthic core samples collected on the inner Mostyn Bank (ABPmer, 2012; ABPmer, 2013; Port of Mostyn, 2013). This is expected given that the mudflat habitat on the Mostyn Bank is considered much more stable than the fluid/soft sandy mud observed within the harbour.

The sediment from the samples collected from the lower shore sandflat habitat of Bug Bank (Stations INT 4 to INT 7) consisted of fine sand or muddy sand with a limited silt content and TOC (Table 8.9). Samples were impoverished and characterised by low numbers of the polychaete *Nephtys* spp., isopod *Eurydice pulchra,* mud shrimp *Corophium volutator,* bivalve *Kurtiella bidentata,* mud snail *Peringia ulvae* and oligochaete *Tubificoides benedii.* All the species recorded from the samples in this sandflat habitat are considered commonly occurring in the region and not protected.

7 This biotope is also known to occur on vertical and steep bedrock on moderately exposed shores (https://mhc.jncc.gov.uk/biotopes/jnccmncr00000358) as is the case on the breakwater.

Table 8.9. Intertidal benthic survey results

Station	Sediment Type	TOC (%)	No. of Taxa (per m²)	No. of Individuals (per m²)	Total Biomass (g per m²)	Key Characterising Species (Number per m² shown in brackets)
INT 1	Sandy mud	3.68	5	800	0.26	*Corophium volutator* (300) *Streblospio shrubsolii* (200) *Nematoda* (100) *Tubificoides benedii* (100) *Tellinoidea* (100)
INT 2	Sandy mud	4.19	5	1,400	0.25	*Pygospio elegans* (600) *Nematoda* (300) *Streblospio shrubsolii* (200) *Peringia ulvae* (200) *Limecola balthica* (100)
INT 3	Sandy mud	4.84	4	400	0.10	*Nematoda* (100) *Streblospio shrubsolii* (100) *Corophium volutator* (100) *Peringia ulvae* (100)
INT 4	Muddy sand	0.53	7	1,000	1.01	*Nephtys* (200) *Corophium volutator* (200) *Peringia ulvae* (200) *Eteone longa* (100) *Nephtys cirrosa* (100) *Eurydice pulchra* (100) *Kurtiella bidentata* (100)
INT 5	Sand	0.36	4	500	0.05	*Tellinoidea* (200) *Pygospio elegans* (100) *Tubificoides benedii* (100) *Corophium volutator* (100)
INT 6	Sand	0.45	0	0	0	
INT 7	Sand	0.69	2	200	0.02	*Nematoda* (100) *Nephtys* (100)

Subtidal benthic sampling

The sediment in samples collected on the subtidal survey consisted of gravel with muddy sand, sandy mud or sand (Table 8.10). The samples were impoverished and predominantly characterised by low numbers of the polychaete *Nephtys sp.* (particularly *Nephtys hombergii),* oligochaete *Tubificoides benedii*, nematodes and juvenile blue mussel *Mytilus edulis*. These characterising species dominated the assemblage and contributed almost entirely to the total abundances of organisms recorded at most of the sites. Other species recorded included the bivalve *Limecola balthica* and polychaete *Eteone longa*. The species recorded from the samples are all considered commonly occurring and the assemblage is very similar to that recorded in previous surveys in this area (GoBe Consultants Ltd., 2011; ERM, 2009). No protected species were recorded, with only one non-native species recorded (the acorn barnacle *Austrominius modestus*).

Table 8.10. Subtidal benthic survey results

Station	Sediment Type	TOC (%)	No. of Taxa (per m^2)	No. of Individuals (per m^2)	Total Biomass (g per m^2)	Key Characterising Species (Number per m^2 shown in brackets)
SUB 1	Slightly Gravelly Sandy Mud	3.27	2	30	0.008	*Mytilus edulis* (20) *Austrominius modestus* (10)
SUB 2	Slightly Gravelly Sandy Mud	4.55	10	400	0.98	*Tubificoides benedii* (130) *Nematoda* (120) *Limecola balthica* (40) *Mytilus edulis* (30) *Streblospio shrubsolii* (20)
SUB 3	Slightly Gravelly Sandy Mud	3.46	6	650	4.78	*Nephtys hombergii* (470) *Nephtys* (60) *Mytilus edulis* (50) *Tharyx* (40) *Limecola balthica* (20)
SUB 4	Slightly Gravelly Muddy Sand	0.74	8	140	52.60	*Nephtys hombergii* (60) *Tubificoides benedii (20)* *Nematoda* (10) *Eteone longa* (10) *Tubificoides pseudogaster* (10) *Carcinus maenas* (10) *Tellinoidea* (10) *Macomangulus tenuis* (10)
SUB 5	Slightly Gravelly Sand	0.51	6	160	6.26	*Tubificoides benedii* (70) *Nephtys* (30) *Eteone longa* (20) *Peringia ulvae* (20) *Nephtys hombergii* (10) *Limecola balthica* (10)
SUB 6	Slightly Gravelly Sand	0.37	10	270	0.59	*Nephtys* (80) *Tubificoides benedii* (60) *Nephtys cirrosa* (50) *Nephtys hombergii* (20)

8.6.3 Fish and shellfish

This section has been structured as follows:

- Regional overview: Provides contextual information on fish and shellfish populations in the Dee Estuary region; and
- Fish and shellfish populations in the Port of Mostyn area: Summarises data which describes fish and shellfish populations nearby to the Port of Mostyn.

Regional overview

Fish

The Dee Estuary contains a varied fish fauna, with the majority common to most UK estuaries. The Dee Estuary fish assemblage comprises resident, nursery, seasonal and migratory species, typical of estuarine fish communities.

The Dee Estuary provides nursery grounds for tope shark *Galeorhinus galeus*, thornback ray *Raja clavata*, herring *Clupea harengus*, cod *Gadus morhua*, whiting *Merlangius merlangus,* anglerfish *Lophius piscatorius*, sandeel *Ammodytes* sp., plaice *Pleuronectes platessa*, as well as sole *Solea* and spawning grounds for cod, whiting, sandeel, mackerel *Scomber scombrus*, plaice and sole (Ellis *et al*., 2012). The Dee Estuary is also a designated sea bass *Dicentrarchus labrax* nursery area (Port of Mostyn, 2013).

Other species considered commonly occurring in the region include sand goby *Pomatoschistus minutus*, lesser weaver *Echiichthys viper,* small-spotted catshark *Scyliorhinus canicular* and flatfish species such as dab *Limanda limanda* and flounder *Platichthys flesus* (Port of Mostyn, 2013; ABPmer, 2022; NRW, 2022a; Gibson, 2022).

The most comprehensive contemporary data available on fish populations in the outer Dee Estuary is from surveys undertaken on behalf of the Port of Mostyn in 2020/21. Further details of these surveys are provided in Section 8.3.1 with the methods and results of the surveys described in more detail in Appendix 8.2. The key findings from these surveys are briefly summarised below:

- **Quarterly intertidal and subtidal fish surveys** recorded a range of fish and epifaunal species, with the assemblage considered typical to inshore waters and outer estuaries in the region. The most abundant species recorded in the quarterly intertidal surveys were clupeids (particularly herring *Clupea harengus*), flatfish (such as founder *Platichthys flesus* and plaice *Pleuronectes platessa*) and gobies. European eel *Anguilla anguilla* were also recorded in these surveys. Larger catches of fish were recorded in the subtidal demersal trawls surveys with the flatfish dab *Limanda limanda*, commercially important whiting *Merlangius merlangus* and lesser weaver *Echiichthys viper* typically the most abundant. The largest numbers of these species were generally recorded in the spring surveys. The flatfish species, flounder *Platichthys flesus* and plaice *Pleuronectes platessa,* as well as other species such as thornback ray *Raja clavata*, sand goby *Pomatoschistus minutus* and sprats *Sprattus sprattus* were also some of the most abundant species recorded. In addition, the quarterly fish surveys recorded a large proportion of juvenile fish, particularly during the intertidal surveys (including commercially important species such as herring *Clupea harengus*, whiting *Merlangius merlangus*, plaice *Pleuronectes platessa* and sole *Solea solea*) which suggests the Dee Estuary and approaches provides nursery habitat for these fish. This is consistent with other data for the region which has found that the area provides an important nursery function for these species (Ellis *et al*., 2012);
- **Ichthyoplankton surveys** recorded the largest abundances of fish larvae in the spring and early summer months for sprat *Sprattus sprattus*, sandeels *Ammodyte*s spp., whiting *Merlangius merlangus*, gobies and flatfish (such as sole species and dab *Limanda limanda*) and in the winter (November) for herring *Clupea harengus*. The months with the largest abundances of larvae for these species is consistent with broad known spawning/larval periods for these species in the region[8];
- **Acoustic fish surveys** recorded large shoals of clupeids (herring *Clupea harengus* and sprat *Sprattus sprattus*). While the total amount of clupeids were similar between months, in May they were recorded both in the Mostyn Deep and Hilbre Channel but in August they were almost entirely absent from the Mostyn Deep and largely contained in the Hilbre Channel. The biomass density of clupeids recorded in the Mostyn Deep and Hilbre Channel and to a lesser extent to the higher densities in Hilbre Channel in August were broadly comparable to the approximate mean biomass density of clupeids found more widely in the Irish Sea; and

8 Sprat *Sprattus* larvae was also recorded in similar abundance levels in April and May to that recorded in March. Sandeels *Ammodytes* spp. typically hatch from eggs during February or March with sprat *Sprattus sprattus* spawning known to occur through the late spring/early summer months (Green, 2017; Coombs, 1992). The data is therefore broadly consistent with spawning information for the wider region. The larvae of other species such as whiting *Merlangius merlangus*, dab *Limanda limanda*, sole *Solea solea* and gobies were also recorded in the spring/early summer months (March to June) which overlaps with the main spawning periods for these species (DECC, 2016: Ellis *et al*., 2012). Herring *Clupea harengus* larvae was mainly recorded in November 2020. This species is known to spawn from September to November in the Irish Sea region with eggs hatching in 1-3 weeks (ICES, 2013; DECC, 2016).

- **eDNA surveys** recorded a similar assemblage of fish to that recorded using more traditional survey methods including herring *Clupea harengus*, sprat *Sprattus sprattus*, whiting *Merlangius merlangus* and sandeel *Ammodyte*s spp.

Diadromous fish (which migrate between salt and freshwater) recorded in the Dee Estuary include European eel *Anguilla anguilla*, Atlantic salmon *Salmo salar,* sea trout *Salmo trutta*, river lamprey *Lampetra fluviatilis*, sea lamprey *Petromyzon marinus* and twaite shad *Alosa fallax* (Port of Mostyn, 2013; Natural England and CCW, 2010). These species are all afforded protection under various legislation as described in Section 8.6.1. Further information on the ecology and migration of these species in the Dee Estuary is provided in Table 8.11.

Table 8.11. Background information on the ecology and distribution of diadromous migratory fish

Species	Ecology
European eel	European eel is catadromous species which migrates to the marine environment (Sargasso Sea) to spawn. The larvae (leptocephali) then drift in the Gulf Stream and the North Atlantic Drift current for 2 to 3 years across the Atlantic Ocean to Europe and metamorphose into juveniles (elvers). The eels usually migrate into freshwater where they remain for many years. However, not all eels migrate into freshwater and some, predominantly males, remain in inshore coastal areas. The adults, commonly referred to as 'silver eels' during the spawning migration, leave river systems to return to the Sargasso Sea. The European eel is widely distributed in the Dee catchment: Glass eels/elvers generally immigrate in spring and early summer, whereas the majority of silver eel emigrate in late summer and autumn. There is evidence that glass eels migrate upstream using 'Selective Tidal Stream Transport' (STST) whereby individuals with low locomotive capability, such as glass eels, move into the water column during flood tides to move up estuaries toward freshwater, typically remaining on or in the bottom substrate on ebb tides to avoid currents. Glass eel behaviour can be influenced by light levels, and although glass eels do migrate during the day there is an increase in activity during the night time, particularly in the first hours of darkness, when they also distribute closer to the surface. Some research suggests an increased abundance in glass eel catches during the new moon phase, but not the full moon, despite the fact that the tidal amplitude during both periods is similar. This could potentially be explained by the influence of light intensity on migration patterns. This effect of the lunar cycle and, hence, moonlight intensity is modulated by cloud cover and turbidity; therefore, one consequence is the fact that any lunar effect is not usually observed in highly turbid estuaries (Harrison *et al.*, 2014).
European smelt	European smelt is a small anadromous species, widely distributed throughout the Atlantic and European waters, that migrates from estuaries and coastal waters into the lower reaches of rivers to spawn in spring.
River and sea lamprey	River lamprey and sea lamprey are anadromous species, spawning in freshwater but completing part of their lifecycle in estuaries or at sea. The river Dee catchment is considered to support important populations of both river lamprey and sea lamprey.

Species	Ecology
	The sea lamprey adult growth phase is short and lasts around two years. In this time, the species is parasitic, feeding on a variety of marine and anadromous fishes, including shad and salmon as well as herring, cod, haddock and basking sharks. The spawning migration of sea lamprey usually takes place in April and May when the adults start to migrate back into freshwater. Unlike sea lamprey, the growth phase of river lamprey is primarily restricted to estuaries. The upstream migration of river lamprey takes place almost exclusively at night, with adults being sedentary and resting under rocks and riverbanks during the day. Having spent up to two years in estuaries, river lamprey migrate up rivers to spawning grounds during winter and spring and mate March and April, when water temperatures are at least 10°C.
Twaite shad	Twaite shad is an anadromous species. Adult twaite shad stop feeding and gather in the estuaries of suitable rivers in early summer (April and May), moving upstream to spawn from mid-May to mid-July.
Atlantic salmon and sea trout	Atlantic salmon and sea trout are anadromous species which migrate to freshwater to spawn, whilst spending much of their life in the marine environment. They spawn in the upper reaches of rivers, where they live for one to three years before migrating to sea as smolts. Atlantic salmon and sea trout smolts move out of the rivers and migrate downstream to the sea in spring, with the main movements in the Dee occurring between April and June[1]. At sea, salmon grow rapidly and after one to three years return to their natal river to spawn. The majority of adult salmon return to their natal rivers in the late summer and autumn (particularly August and September), although a small proportion return in the spring[1]. The River Dee is one of very few 'index' monitored rivers for Atlantic salmon and sea trout in Europe. This includes the long-term monitoring of fish at the Chester Weir fish trap. This trap is designed to capture and sample upstream migrating adult fish and estimate their total return, as well as provide information on their biology (e.g. size, age, sex, etc.). In recent years a recent marked reduction in the overall abundance of returning Atlantic salmon linked to a decline in grilse numbers has been recorded on the River Dee. The same pattern of decline is also evident on most other monitored rivers in England and Wales. It is currently unclear if this is part of a cyclical pattern or linked to other factors such as climate change (NRW, 2022b).
[1] This information has been derived from data received from NRW following a data request to understand the seasonal movements of migrating smolts and adult salmon/sea trout in the Dee.	

Sources: Maitland and Hatton-Ellis, 2003; Maitland, 2003; Harrison *et al.*, 2014; Teague *et al.*, 2012; Garret, 2015; NRW, 2022b.

Shellfish

The Dee Estuary supports commercially important cockle *Cerastoderma edule* beds (Control Union (UK) Limited, 2022). The location of the cockle beds as well cockle biomass and count distribution data is shown in Image 8.1 (NRW, 2022c). Cockle beds on the Welsh side of the Dee Estuary are located on the Mostyn Bank near Ffynnongroyw, a recently exposed bed near the Mostyn Bank between the Mostyn and Salisbury channels (known as New Bed), and along the Salisbury Middle and on the Salisbury Flats. Cockle beds on the English side are located in the vicinity of Thurstaston, West

Kirby and Caldy. Stock assessment surveys of these cockle beds are carried out bi-annually (Spring and Autumn) by NRW with the most recent survey undertaken in March 2022.

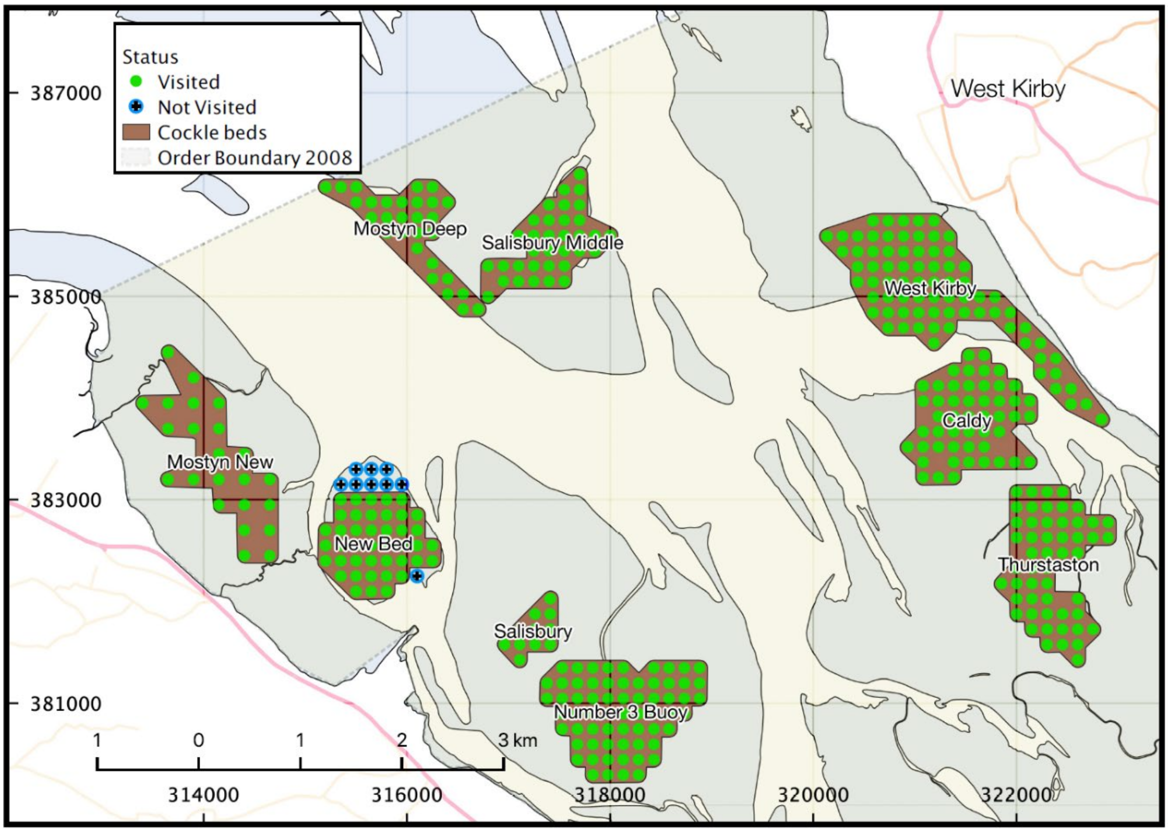

Image 8.1. Location of the cockle beds in the Dee Estuary (NRW, 2022c)

Mussels are also present throughout the Dee Estuary, although they are more randomly distributed than cockles. Within the estuary, mussels occur on hard substrates, especially the 'artificial' rocky shores around the Port of Mostyn, and the rocky shore of the Hilbre Islands, as well as on the intertidal mudflats and sandflats off West Kirby and Thurstaston. Mussel settlement may also take place on very dense cockle beds (Natural England and CCW, 2010). Commercially exploited mussel beds are located on the English side of the Dee Estuary at West Kirby and Thurstaston (NWIFCA, 2017).

Fish and shellfish populations in the Port of Mostyn area

Fish sampling locations surveyed as part of the Port of Mostyn commissioned fish surveys in 2021/22 (Appendix 8.2), as well as NRW TraC fish survey data (NRW, 2022a) within approximately 2 km of the proposed development have been reviewed to better understand the fish assemblages that are likely to be occurring in the immediate Port of Mostyn area[9] (Figure 8.5).

[9] Fyke net site F5 and F4, seine net site S5 and scientific 1.5 m beam trawl locations B5 and B6 are all located within approximately 2 km of the proposed development (Appendix 8.2). With respect to TraC fish data, 'Mostyn Beam' and 'Mostyn Fyke' sample stations were sampled in spring and autumn in 2014 to 2016. In addition, 'Dee Outer Seine sites 23 to 27 were sampled in October 2018. These sites are all located within 2 km of the proposed development (NRW, 2022a).

Commonly recorded species in these surveys included flatfish species (such as flounder *Platichthys flesus,* plaice *Pleuronectes platessa*) and sole *Solea solea*), whiting *Merlangius merlangus*, European eel *Anguilla anguilla* and gobies (such as the sand goby *Pomatoschistus minutus* and common goby *Pomatoschistus microps*). Other species recorded included lesser weever *Echiichthys vipera* and sandeels *Ammodytes* spp. Pelagic fish such as clupeids (herring *Clupea harengus* and sprat *Sprattus sprattus*) and sea bass *Dicentrarchus labrax* have also been recorded in proximity to the Port of Mostyn.

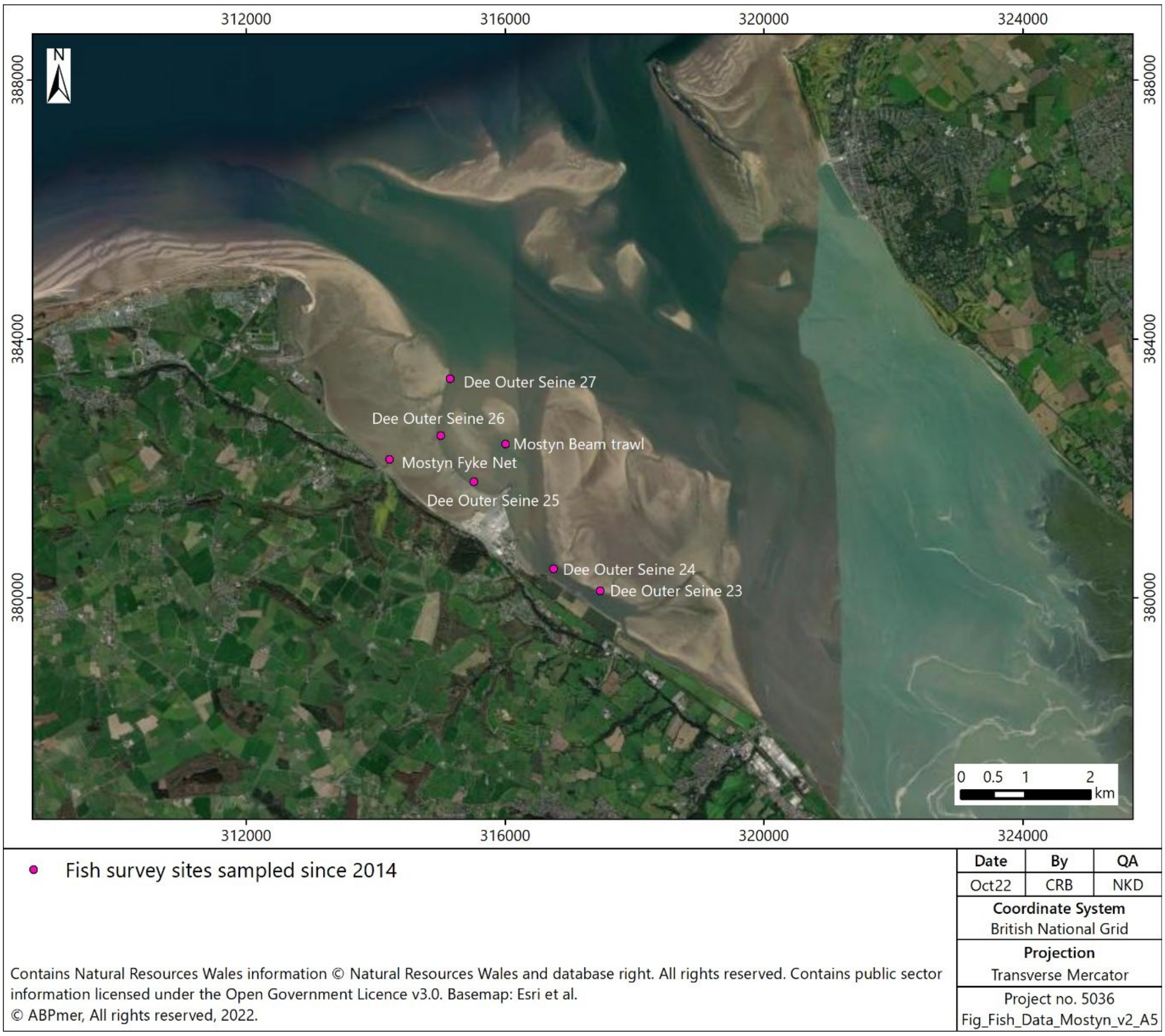

Figure 8.5. NRW TraC Fish survey sites located in the vicinity of the Port of Mostyn

The nearest commercial cockles beds to the Port of Mostyn is New Bed and Salisbury (located approximately 400 m and 700 m away respectively) (Image 8.1).

8.6.4 Marine mammals

This section has been structured as follows:

- **Regional overview**: Provides contextual information on marine mammal populations in the wider Irish Sea/Liverpool Bay region; and
- **Marine mammal populations in the Dee Estuary:** Summarises data which describes marine mammal populations specifically in the Dee Estuary.

Regional overview

The most commonly recorded marine mammals recorded in Liverpool Bay are grey seals *Halichoerus grypus*, as well as the cetaceans harbour porpoise *Phocoena phocoena* and bottlenose dolphin *Tursiops truncates*. Other species are recorded more rarely.

There is an estimated population of approximately 5,000 grey seals in Wales with the latest pup production estimate of 2,250 pups per year born annually (SCOS, 2021). In North Wales specifically (Dee Estuary- Aberystwyth), the latest pup production estimate is 216 pups (SCOS, 2021). Grey seal colonies occur around Anglesey, the Llŷn Peninsula, Bardsey Island and Hilbre Island (see below).

Tracking of individual seals at colonies around the UK has shown that most foraging probably occurs within 100 km of a haul out site (SCOS, 2021). However, long distance movements (sometimes at distances of over 1,000 km) between different colonies along the southwest British Isles (including Wales) ,as well as between these colonies and sites in Ireland and France have been recorded (Vincent *et al.,* 2017; Kiely *et al*. 2000; Cronin, 2011).

Harbour porpoise are widespread across much of the Irish Sea, with high densities recorded within Cardigan Bay, Pembrokeshire and offshore from North Anglesey (Heinänen and Skov, 2015; IAMMWG, 2015b; Evans *et al*., 2015; DECC. 2016; Hammond *et al.,* 2017). High densities have also been recorded within Liverpool Bay (Heinänen and Skov, 2015; DECC, 2016). An abundance of 1,056 harbour porpoises was estimated for the eastern Irish Sea region based on (SCANS) III data (Hammond *et al.,* 2021), with 16,777 harbour porpoise estimated for the UK portion of the Celtic and Irish Seas (CIS) harbour porpoise Management Unit (MU) (IAMMWG, 2021).

The *Atlas of the Marine Mammals of Wales* (Baines and Evans, 2012) recorded the highest densities of bottlenose dolphin sightings in Southern Cardigan Bay but with moderately high sighting rates also extending North into Tremadog Bay. The species also occurs off the North coast of Wales, particularly North and East of Anglesey (Baines and Evans, 2012).

The Lleyn Peninsula and the Sarnau Special SAC and Cardigan Bay SAC are the nearest designated sites to the proposed development that have bottlenose dolphin as a qualifying feature. The bottlenose dolphin population of the wider Cardigan Bay area (which includes both SACs) was estimated at 174 in 2016 (Lohrengel *et al.,* 2018). In recent years, bottlenose dolphins have also been sighted increasingly in Liverpool Bay and off the coast of mainland North-east Wales, in both winter and summer with a relatively large proportion of these having been positively matched to the Cardigan Bay catalogue (Lohrengel *et al.,* 2018).

Marine mammal populations in the Dee Estuary

On the eastern (English) side of the Dee Estuary a large grey seal 'haul out' of 300 to 800 individuals can be found on the West Hoyle sandbank adjacent to Hilbre Island (Natural England and CCW, 2010; Baines and Evans, 2012; Westcott and Stringell, 2004). However, grey seals do not breed at this site as it is used solely for moulting and during feeding trips (Baines and Evans, 2012). Specific tagging studies of seals from the West Hoyle Bank colony has shown foraging to occur almost exclusively within the Liverpool Bay and Irish Sea area, including the Dee Estuary (Baines and Evans, 2012; Carter *et al*., 2020). This is reflected in high predicted at-sea densities of grey seals in Liverpool Bay (Carter *et al*., 2020). The analysis of records of individual female seals identified by means of photo-identification have found the greatest connectivity of seals recorded in the Dee Estuary, with haul out sites in North Wales (such as Anglesey, and the Skerries) but also with other sites in Wales, including as far as Skomer Island, West Wales (230 km from the Dee) (Langley *et al*., 2018; Langley *et al*., 2020).

Harbour porpoise are frequently recorded in the outer Dee Estuary region, with bottlenose recorded more occasionally in the area (Heinänen and Skov, 2015; Baines and Evans, 2012).

The most comprehensive contemporary data available on marine mammal populations in the outer Dee Estuary is from surveys undertaken on behalf of the Port of Mostyn in 2020/21 (ABPmer, 2022). Further details of these surveys are provided in Section 8.3.1 with the methods and results of the surveys described in more detail in Appendix 8.2. The key findings from these surveys are briefly summarised below:

- **Grey seals:** The vessel based transect surveys regularly recorded grey seals foraging throughout the outer Dee Estuary and approaches to the estuary in Liverpool Bay. Seals were recorded during every monthly survey. Sighting rates over 12 months averaged at 0.111 sightings/km, with the highest monthly rates being recorded in August (0.508 sightings/km), November (0.263 sightings/km), July (0.156 sightings/km) and October (0.131 sightings/km). Grey seals were widely distributed throughout the survey area with the highest sighting rates from the transects within the Dee Estuary (Figure 15a in Appendix 8.2). Grey seals were recorded within 500 m to 1 km of the proposed development during the surveys;
- **Harbour porpoise:** The F-PODs record high levels of daily harbour porpoise activity year-round at the deployment locations in Liverpool Bay (in the approaches to the Dee Estuary) and also relatively high levels at the deployment locations within the outer Dee Estuary. Harbour porpoises were also frequently sighted (and widely distributed) in Liverpool Bay and the outer Dee Estuary during the vessel-based surveys (with sightings on 67 % of the survey trips with a peak of 0.068 sightings/km in February). This include sightings of harbour porpoise within several kilometres of the proposed development. The data suggests that Liverpool Bay and the outer Dee Estuary region provides an important foraging habitat for this species year-round; and
- **Bottlenose dolphin:** Bottlenose dolphin were recorded during one of the vessel-based surveys (in December 2020) in the approaches to the Dee Estuary. The individuals observed had probable or possible matches in the Cardigan Bay photo-identification catalogue suggesting the dolphins were part of this population. Individuals from the Cardigan Bay population have previously been recorded in Liverpool Bay as described above. Dolphin activity was also recorded on the F-PODS located in the approaches to the Dee Estuary. Activity was highest in the summer period, but they were also recorded during all the other seasons. While it is not possible to identify dolphins to species level with F-PODS, based on an understanding of dolphin abundance and distribution in the area, these records are most likely to be bottlenose dolphin.

8.6.5 Coastal waterbirds

This section has been structured as follows:

- **Regional overview**: Provides contextual information in waterbird populations in the Dee Estuary region;
- **Waterbird populations in the Port of Mostyn area:** Summarises data which describes waterbird populations in the local area near the Port of Mostyn; and
- **Waterbird populations directly overlapping the proposed development footprint**: Summarises data which describes waterbird populations specifically occurring in the proposed development footprint.

Regional overview

The Dee Estuary is one of the most important estuaries in Britain for its populations of waterbirds and is also important in a European context, supporting internationally important bird populations with in in excess of 150,000 waterbirds recorded annually in the estuary (Frost *et al*., 2021).

To provide information on estuary-wide trends in the Dee Estuary, the 2021/22 BTO Low Tide count data (BTO, 2022) and recent WeBS Core Count (high water) data for the period 2015/16 to 19/20 has been reviewed (Frost *et al*., 2021)[10] (as described in Section 8.3.1). Table 8.12 presents this data together with a summary of the ecology of key waterbird species occurring in the Dee Estuary.

Oystercatcher is the most abundant wading bird species recorded in the estuary (with approximately 43,000 birds recorded during the 2021/22 BTO estuary-wide Low Tide count and approximately 14,000 to 30,000 birds during recent estuary-wide WeBS Core Counts). This species is typically distributed throughout the estuary at low water with major concentrations occurring on Salisbury Middle and Salisbury Bank. Oystercatcher typically roost at several sites on the saltmarsh in the inner estuary on the English shore and at sites along the Welsh shore at Point of Ayr, Mostyn Bank, near the Port of Mostyn, and on the English side at Hilbre Island.

Knot and Dunlin also occur in large numbers in the Dee Estuary (up to approximately 20,000 to 25,000 birds recorded during both the 2021/22 BTO estuary-wide Low Tide count and recent estuary-wide WeBS Core Counts). Knot favour feeding areas around Salisbury Middle and Salisbury Bank (Natural England and CCW, 2010; Frost *et al.,* 2021). Dunlin is widespread in the estuary at low water, with major feeding concentrations on Mostyn Bank, Bagillt Bank and Gayton Sands. Dunlin and Knot roost in the inner estuary on the saltmarsh, and also at Hilbre Island and at Point of Ayr, forming mixed flocks with other waders at all sites (Port of Mostyn, 2013).

Redshank is primarily recorded feeding and roosting on the Mostyn Bank and in the lower Dee towards Flint (with estuary-wide abundances of approximately 4,500 birds recorded during the 2021/22 BTO estuary-wide Low Tide count and 10,000 birds recorded in recent estuary-wide WeBS Core Counts). Lapwing is primarily recorded making use of a variety of habitats across the estuary including the intertidal flats, saltmarsh and coastal fields, with the North Wirral foreshore, Burton Marsh and the saltmarsh at Oakenholt considered important areas for this species (estuary-wide abundances of approximately 6,000 birds were recorded during the 2021/22 BTO estuary-wide Low Tide count and 6,000 to 10,000 birds recorded in recent estuary-wide WeBS Core Counts). Other waders are generally recorded in peak numbers <4,000 birds in the Dee Estuary (Natural England and CCW, 2010; Frost *et al*., 2021).

The most commonly occurring duck species recorded in the Dee Estuary at low water are Wigeon, Teal and Shelduck (recent counts of approximately 9,000 Wigeon and 2,500-3,000 Shelduck and Teal during the 2021/22 BTO estuary-wide Low Tide count, and around 10,000 Shelduck, 8,000 Wigeon and 6,000 Teal in recent estuary-wide WeBS Core Counts). Wigeon and Teal are most abundant on the lower sections of the Dee Estuary, on the English coast between Parkgate and Neston and around Point of Ayr (Natural England and CCW, 2010). These species predominantly roost on the saltmarsh on the inner estuary. Shelduck is widely distributed throughout the Dee Estuary, and roosts near the mudflats at Mostyn Bank, Dawpool Bank and Gayton Sands, near to the boundary with the saltmarsh. The peak counts for all duck species occurred from September to December when overwintering aggregations were at their largest. The Dee Estuary also supports important populations of roosting Pink-footed Goose and Canada Goose in the inner Estuary (Natural England and CCW, 2010).

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10 It should be noted that as a result of COVID-19 lockdowns, the BTO were unable to produce robust data for 2020/21 at an estuary-wide scale and, therefore, the period 2015/16 to 2019/20 is the most recent 5 years of data available from the BTO.

Large numbers of Common Scoter have been recorded in the outer Dee Estuary in recent years. For example, over 10,000 birds were reported in the outer Dee Estuary in 2019/20 based on WeBS Core Count data for the area. Other commonly occurring diving birds species in the Dee Estuary recorded in WeBS surveys include Cormorants and Great Crested Grebes (with estuary-wide counts of typically over 1,500 and 300 birds respectively recorded annually). With respect to gulls, Black-headed Gulls and Herring Gulls are the most numerous (with estuary-wide Core Counts of over 12,000 birds recorded in recent years for both species).

Terns breed in the Dee Estuary region with Little Terns breeding within the Gronant dune system. The Little Tern report for the 2020 season indicated there were 89 breeding pairs with an estimated 31 fledglings (Bird Recording North Wales, 2020). This is lower than recent previous years where over 150 breeding pairs and around 200 successfully fledged youngsters have been recorded. It is thought that some birds may have moved on to breed at Point of Ayr instead, following high tides and nest losses. At Point of Ayr, a total of 21 breeding pairs were recorded and 28 fledglings. Common Terns nest at Shotton Steelworks (approximately 17 km to the south-east of the Port of Mostyn) with over 400 pairs typically breeding at the site annually (Deeside News, 2021).

Table 8.12. Summary information for key species of coastal waterbird in Dee Estuary

Species group	Species	Feeding behaviour in the marine environment [1]	Diet [2]	Dee Estuary Low Tide Data winter 2021/22 [3]	WeBS Core Count 5-year estuary-wide mean peaks (2015/16 to 2019/20) [4]
Wader	Oystercatcher	Intertidal benthivore	Predominantly bivalves especially large cockles *Cerastoderma edule* of >15 mm, mussels *Mytilus edulis* of 30-60 mm and tellins *Limecola spp*.. Diet might also include polychaete worms on mudflats and earthworms from wet fields.	43,425	23,309
	Knot		Mainly molluscs, including the bivalve *Limecola balthica*, cockles *Cerastoderma edulis* and mud snail *Peringia ulvae*, the latter especially in early winter. Diet proportions of 75 % bivalves, 1 % worms and 24 % 'other'. Prey is eaten whole and crushed within the gizzard.	24,360	17,197
	Dunlin		Oligochaetes, polychaete worms (such as *Hediste diversicolor, Nephtys* spp., *Pygospio elegans* and *Scoloplos armiger*), bivalves (such as *Limecola balthica*) and the mud snail *Peringia ulvae*. Diet proportions of 70 % worms, 14 % bivalves and 16 % 'other'.	17,528	16,922
	Redshank		Polychaete worms (such as *Hediste diversicolor, Nephtys spp., Pygospio elegans and Scoloplos armiger*), the bivalve *Limecola balthica,* crustaceans (such as brown shrimp *Crangon* and mud shrimp *Corophium* spp.) and the mud snail *Peringia ulvae*. Will also consume terrestrial invertebrates, including insects and spiders. Diet proportions of 46 % worms, 7 % bivalves and 47 % 'other'.	4,498	9,614
	Black-tailed Godwit		Invertebrates, including beetles, polychaete worms (such as *Hediste diversicolor, Nephtys, Pygospio elegans* and *Scoloplos armiger*), molluscs (such as *Limecola balthica)* crustaceans and some plant material.	4,678	6,206

Species group	Species	Feeding behaviour in the marine environment [1]	Diet [2]	Dee Estuary Low Tide Data winter 2021/22 [3]	WeBS Core Count 5-year estuary-wide mean peaks (2015/16 to 2019/20) [4]
	Curlew		Primarily bivalves (such as *Cerastoderma edule* and *Limecola balthica)*, the ragworm *Hediste diversicolor* and lugworm *Arenicola marina).* Earthworms on terrestrial habitats. Diet proportions during winter of 46 % bivalves, 35 % worms and 19 % 'other'.	3,009	3,553
	Ringed Plover		In winter, mainly marine worms, crustaceans (such as *Corophium* spp.) and molluscs (such as *Peringia ulvae*).	104	1,075
	Grey Plover		Polychaete worms (such as *Hediste diversicolor* and *Arenicola marina*), bivalves (such as *Limecola balthica*) and the muds snail *Peringia ulvae.*	375	910
	Sanderling		Polychaete worms (such as *Hediste diversicolor*), crustaceans and insects. Diet proportions comprise 60 % worms, 1 % molluscs and 39 % 'other'.	874	558
	Bar-tailed Godwit		Polychaete worms are the principal food source during winter such as *Hediste diversicolor, Nephtys, Pygospio elegans and Scoloplos armiger*. Diet proportions comprise 94 % worms. Other species sometimes consumed include the shrimp *Crangon* and bivalve *Limecola balthica.*	588	359
	Turnstone		A wide range of invertebrates and other food sources, including polychaete worms and mud shrimp *Corophium* spp. on mudflats. Also feeds on rocky shore species, including mussels, amphipods, molluscs (such as periwinkles) and crabs. Diet proportions comprise 20 % bivalves, 5 % worms and 75 % 'other'.	352	204
	Lapwing	Roosts but rarely feeds in the intertidal	Wide range of invertebrates including beetles and earthworms.	6,746	8,402

Species group	Species	Feeding behaviour in the marine environment [1]	Diet [2]	Dee Estuary Low Tide Data winter 2021/22 [3]	WeBS Core Count 5-year estuary-wide mean peaks (2015/16 to 2019/20) [4]
Waterfowl	Common Scoter	Benthivorous diving duck	Molluscs.	662	21,870
	Pink-footed Goose	Herbivorous waterfowl	Herbivorous. Outside the breeding season this species feeds on improved grasslands, cereal stubbles and vegetables (e.g. potatoes, sugar beet, carrots).	11,248	12,681
	Shelduck	Intertidal benthivore	Invertebrates, with small molluscs predominant in north and west Europe, especially mud snail *Peringia* spp.. Other species consumed include the mud shrimp *Corophium volutator*, bivalves and polychaetes.	2,453	9,602
	Wigeon	Herbivorous waterfowl	Plants (leaves, stems, stolons, bulbils and rhizomes).	9,063	7,600
	Teal	Omnivorous waterfowl	Seeds of saltmarsh and other wetland plants, including glasswort *Salicornia* spp. and oraches *Atriplex* spp., and invertebrates (especially small oligochaetes) sifted from the benthos.	3,005	6,062
	Pintail	Omnivorous waterfowl	Mostly herbivorous taking seeds of *Suaeda*, *Rubus, Potamogeton, Zostera, Polygonum, Rumex and Salicornia*, but also takes insects and molluscs, including mud snails *Hydrobia spp*.	6,361	5,355
Gulls	Herring Gull	Omnivorous/ scavenging gull	Carrion, offal, seeds, fruits, young birds, eggs, crustaceans, small mammals, insects and fish.	14,909	10,302
	Black-headed Gull		Worms, insects, small fish, crustacea and carrion.	3,431	12,288
Terns and other diving birds	Cormorant	Piscivorous pursuit diver	Feeds on fish such as flatfish, blennies gadoids, sandeel, salmonid and eels.	981	1,539
	Little Egret	Piscivorous stalking ardeid	Small fish (<6 cm), crustaceans (*Gammarus* spp., crabs, prawns).	177	305

Species group	Species	Feeding behaviour in the marine environment [1]	Diet [2]	Dee Estuary Low Tide Data winter 2021/22 [3]	WeBS Core Count 5-year estuary-wide mean peaks (2015/16 to 2019/20) [4]
	Little Tern	Piscivorous plunge diver	Primarily small clupeids (including larval stages), sandeels, marine invertebrates	-	348
	Common Tern		Fish and crustaceans in some areas.	-	388
	Sandwich Tern		Fish such as sandeels, herring, sprats and whiting.	-	1,623

[1] Feeding behaviour based on Mander *et al.* (2021) and Camphuysen and Webb (1999):

- Intertidal benthivore: Waterbird species feeding on infaunal and/or epibenthic invertebrates in intertidal habitats;
- Herbivorous waterfowl: Geese, swans and ducks feeding on plant material;
- Omnivorous waterfowl: Ducks feeding on a range of animal and plant food;
- Benthivorous diving duck: Diving ducks/seaducks feeding on epibenthic and infaunal invertebrates on the seabed;
- Omnivorous/scavenging gull: Gulls feeding on a range of animal and plant food including through scavenging;
- Omnivorous surface feeder: Gulls feeding on a range of animal and plant food by dipping for items from the surface;
- Piscivorous plunge diver: Seabirds foraging for fish through plunge diving;
- Piscivorous pursuit diver: Seabirds foraging for fish through pursuit diving; and
- Piscivorous stalking ardeid: egret/heron/bittern foraging for fish by stalking prey.

[2] Based on Stillman *et al.* (2005); Stillman, and Wood (2013); Woodward *et al.* (2014); Naylor *et al.*, (2017) and RSPB (2022).

[3] Data from BTO (2022).

[4] Data from Frost *et al.* (2021).

Waterbird populations in the Port of Mostyn area

The results of monthly coastal waterbirds surveys commissioned by the Port of Mostyn undertaken from September 2017 to April 2021 (during high and low water periods) for the following count sectors which are located in the Port of Mostyn area of the Dee Estuary (Figure 8.1) are described in more detail in this section:

- **Ffynnongroyw Bay South:** This sector covers the southern section of the Mostyn Bank from Ffynnongroyw to the Port of Mostyn and offshore as far as the middle of the estuary. The extent of the area is the same area as for the WeBS Core Count sector of the same name;
- **Breakwater West:** The western side of the breakwater is a subdivision sector of Ffynnongroyw Bay South and was specifically counted as part of the surveys; and
- **Mostyn Dock Shore:** This sector overlaps with the Port of Mostyn and extends as far downstream as Llannerch-y-Môr and offshore to the middle of the estuary. The extent of the area is the same area as for the WeBS Core Count sector of the same name.

The methods used for these surveys and the results are described in more detail in Appendix 8.3. The results for each of these count sectors are presented in Table 8.13 to Table 8.17. This includes the annual peak counts for the high water and low water counts respectively, and the 4-year average of the annual peak counts for each species (referred to as the mean peak). The most recently available 5-year WeBS Core Count summary data from the BTO (2015/16 to 2019/20) for Ffynnongroyw Bay South and Mostyn Dock Shore are also presented.

The tables presenting the annual peak counts for the high water and low water counts also compare the survey area mean peak against the thresholds and values outlined below, to provide objective criteria to help determine the value of the area in a national and regional context:

- **Nationally important threshold level:** The threshold for an individual species (or subspecies) is set at 1 % of the British population[11], i.e. if a site supports more than 1 % of the British population it is considered nationally important (for that species or subspecies);
- **The Dee Estuary SPA qualifying numbers:** The count numbers identified in the Dee Estuary SPA citation[12]; and
- **Latest Dee Estuary WeBS Core Counts 5-year average:** The mean of the annual peak count (mean peak) from the latest Dee Estuary WeBS Core Counts for the period 2015/16 to 2019/20 (Frost *et al.*, 2021).

For those species exceeding nationally important threshold levels, the table also highlights those species which have exceeded internationally important threshold levels[13].

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11 The thresholds levels are available at BTO: https://www.bto.org/volunteer-surveys/webs/data/species-threshold-levels (accessed November 2022). Where 1 % of the national population is less than 50 birds, 50 is normally used as a minimum qualifying threshold for the designation of sites of national or international importance.

12 Natura 2000 – Standard Data Form https://jncc.gov.uk/jncc-assets/SPA-N2K/UK9013011.pdf (accessed November 2022).

13 A site is considered internationally important if it regularly holds at least 1 % of the individuals in a population of one species or subspecies of waterbird, while criterion 5 states that any site regularly supporting 20,000 or more waterbirds also qualifies. Britain and Ireland's wildfowl belong, in most cases, to the northwest European population and the waders to the east Atlantic flyway population.

Ffynnongroyw Bay South

The Ffynnongroyw Bay South count sector covers the inner section of the Mostyn Bank to the west of the Mostyn Dock and also extends onto the Salisbury Bank (Figure 8.1). In total, 33 coastal waterbird species were recorded using the sector including a range of wading bird species in large numbers. This included nationally important numbers of both Black-tailed Godwit and Knot during low water surveys (4-year mean peak counts of approximately 2,000 birds) (Table 8.13). Peak counts of Black-tailed Godwit typically occurred from September to December and peak counts of Knot from September to February (all these months had peak counts of over 1,000 birds).

Nationally important numbers of Redshank and Oystercatcher were also recorded during both high water (4-year mean peak counts of 1,031 and 4,150 birds respectively) and low water surveys (4-year mean peak counts of 1,850 and 4,645 birds respectively). The largest numbers of Redshank typically occurred during the period September to November (with all counts over 1,000 birds occurring during this period with the exception of a count of 1,500 birds in March 2020/21). Peak counts of Oystercatcher typically occurred during the winter months of November to February.

Dunlin, as well as lower numbers of other waders, including Turnstone, Lapwing and Ringed Plover, were also recorded feeding and roosting in the area.

With respect to duck species, Shelduck (4-year mean peak count of 450 birds during high water surveys and 260 birds during low water surveys) as well as Pintail and Teal (4-year mean peak counts of approximately 140 and 90 birds respectively during both high and low water surveys) were the main species recorded.

The main roost within this area of the Mostyn Bank is the upper foreshore between Mostyn and Ffynnongroyw (known as count sector 'H' as shown on Figure 8.1). This roost is used extensively by waders, particularly Oystercatcher, Knot and Redshank. Waterbirds (mainly Oystercatcher and Redshank) have also been recorded roosting in flocks along the artificial 'rock' ledge on the North West side (downstream) of the breakwater usually at mid-high water (see 'Breakwater West' section below).

The main feeding area for wading birds such as Oystercatcher and Redshank was the mudflat habitat of the Mostyn Bank and Salisbury Bank near the Approach Channel in the northern part of this count sector.

The numbers recorded are also broadly similar to that recorded in recent WeBS Core Count surveys for the Ffynnongroyw Bay South sector (Table 8.14). For example, mean peak numbers of Oystercatcher were approximately 4,000 birds for both the Port of Mostyn high water and WeBS Core Count surveys.

Table 8.13. Low water and high water annual peak counts of all waterbirds within the Ffynnongroyw Bay South sector (September 2017 to April 2021)

Survey	Species	2017/18	2018/19	2019/20	2020/21	4 year mean peak	MoP as a % of citation value	MoP as a % of latest WeBS MoP	MoP as a % of the NT
High Water	Light-bellied Brent Goose				45	11		4	70
	Canada Goose		180			45		1	N/A
	Pink-footed Goose	1				< 1		< 1	< 1
	Shelduck	700	300	250	550	450	6	5	96

Survey	Species	2017/18	2018/19	2019/20	2020/21	4 year mean peak	MoP as a % of citation value	MoP as a % of latest WeBS MoP	MoP as a % of the NT
	Mallard	34	36	23	23	29		2	< 1
	Pintail	63	120	250	125	140	3	3	70
	Teal		230	80	60	93	2	2	2
	Great Crested Grebe			1	1	1		< 1	< 1
	Oystercatcher	3,770	3,050	4,450	5,330	4,150	18	18	143
	Ringed Plover		1	1	3	1		< 1	< 1
	Whimbrel	1	28	8		9		12	925
	Curlew	194	97	210	38	135	3	4	11
	Bar-tailed Godwit		3		1	1	< 1	< 1	< 1
	Black-tailed Godwit		145	1	500	162	9	3	41
	Turnstone	21	10	1	2	9		4	2
	Knot	150	800	800	2,001	938	8	5	36
	Dunlin	500	500	50	500	388	1	2	11
	Common Sandpiper	1				< 1		3	25
	Redshank	2,202	821	720	380	1031	19	11	110
	Black-headed Gull	414	1,800	995	700	977		10	4
	Common Gull	150	300	200	1,000	413		20	6
	Great Black-backed Gull		4	2	9	4		1	< 1
	Herring Gull	350	600	700	770	605		6	8
	Lesser Black-backed Gull	3	6	5		4		1	< 1
	Sandwich Tern	32	65		35	33	3	2	3300*
	Grey Heron	4	4	2	1	3		4	1
	Little Egret		2	3	2	2		1	2
	Cormorant	6	8	15	15	11		1	2
Low Water	Light-bellied Brent Goose			12	13	6		2	39
	Canada Goose			10		3		< 1	N/A
	Greylag Goose		1	4	800	201		38	14
	Shelduck	214	190	175	461	260	3	3	55
	Mallard	19	8	2	8	9		1	< 1
	Pintail	200	70	20	290	145	3	3	73
	Teal	50	260	16	30	89	2	1	2
	Great Crested Grebe		1		1	1		< 1	< 1
	Oystercatcher	1,880	3,200	7,500	6,000	4,645	20	20	160
	Lapwing	5				1		< 1	< 1
	Grey Plover				1	< 1	< 1	< 1	< 1
	Ringed Plover	5				1		< 1	< 1
	Whimbrel				1	< 1		< 1	25
	Curlew	168	170	200	120	165	4	5	14
	Bar-tailed Godwit			2		1	< 1	< 1	< 1
	Black-tailed Godwit	37	4,070	450	4,000	2139	122	34	549
	Knot		1,800	1,000	10,000	3,200	26	19	123
	Dunlin	4,000	2,000	900	1,000	1,975	7	12	58
	Redshank	3,200	1,400	800	2,000	1,850	35	19	197
	Black-headed Gull	320	300	600	10	308		3	1
	Common Gull	50	20	3		18		1	< 1
	Great Black-backed Gull	7	7	1	9	6		2	1
	Herring Gull	400	304	190	43	234		2	3
	Lesser Black-backed Gull	20	30	12	8	18		3	1
	Grey Heron	2	2	3		2		2	< 1
	Little Egret	1	4	3	1	2		1	2
	Cormorant	17	36	3	13	17		1	3

Bold species are features of the Dee Estuary SPA.
*The national importance threshold for Sandwich Tern is set as 1.

Table 8.14. WeBS five-year annual peak counts of bird species in the Ffynnongroyw Bay South sector (2015/17 to 2019/20)

Species	2015/16	2016/17	2017/18	2018/19	2019/20	Mean Peak
Greylag Goose	0	0	150 Sep	0	0	30
Pink-footed Goose	0	0	1 Jan	0	0	0
Shelduck	170 Oct	280 Jul	84 Sep	70 Jul	65 Nov	134
Mallard	60 Aug	45 Sep	50 Aug	36 Sep	5 Jul	39
Pintail	2 Sep	2 Mar	80 Mar	0	17 Nov	20
Teal	0	0	8 Mar	0	20 Nov	6
Grey Heron	2 Oct	6 Jul	0	4 Sep	0	2
Little Egret	0	0	0	1 Aug	0	0
Cormorant	2 Sep	0	5 Aug	8 Sep	4 Jul	4
Oystercatcher	5,000 Aug	3,000 Sep	5,000 Oct	3,050 Sep	4,450 Nov	4100
Lapwing	0	0	24 Apr	0	0	5
Whimbrel	0	0	0	28 Jul	8 Aug	7
Curlew	300 Oct	0	12 Mar	4 Jul	200 Nov	103
Black-tailed Godwit	0	0	0	80 Nov	0	16
Turnstone	1 Dec	1 Feb	4 Apr	6 Feb	0	2
Knot	300 Dec	0	0	800 Nov	800 Jan	380
Dunlin	0	100 Oct	65 Mar	0	0	33
Redshank	1,000 Oct	450 Nov	300 Oct	500 Oct	400 Oct	530
Black-headed Gull	0	3,000 Jul	1,000 Jul	950 Jul	600 Aug	1110
Common Gull	2,000 Aug	0	0	10 Oct	100 Aug	422
Great Black-backed Gull	0	0	1 Oct	4 Jun	2 Feb	1
Herring Gull	200 Aug	0	5 May	600 Jun	425 Aug	246
Lesser Black-backed Gull	0	0	2 Mar	6 Jun	0	2
Sandwich Tern	2 Aug	0	0	1 Sep	0	1

Breakwater West

The artificial 'rock' ledge on the western side of the breakwater (the Breakwater West count sector, Figure 8.1) is used as a roost by birds that have been feeding on the Mostyn Bank and then move to this area during high water periods. This includes large numbers of Oystercatcher and Redshank (4-year mean peaks of 1,350 and 708 birds respectively) (Table 8.15). The largest numbers of Oystercatcher were generally recorded in spring months (April and May) and during the winter (for example the peak count in 2020/21 of 2,000 birds was recorded in April). Redshank numbers were typically greatest in September (with the peak count in 2017/18 and peak count in 2020/21 both recorded in these months). Knot are also regularly recorded in relatively large numbers roosting in some years (4-year mean peaks of 242 birds). Other species recorded include low numbers of Shelduck and waders such as Whimbrel, Curlew, Turnstone, Black-tailed Godwit and Knot (all with year mean peak of <10 birds).

Large numbers of Herring Gull also roost on the western side of the breakwater (4-year mean peak of 460 birds), as well as low numbers of other gulls, Cormorant and Grey Heron.

During low water periods, the western side of the breakwater is only used intermittently by a small number of loafing waterbirds in generally low abundances (4-year mean peaks of 58 Oystercatcher, 8 Redshank and two Herring Gull).

Table 8.15. Low water and high water annual peak counts of all waterbirds within the Breakwater West sector (September 2017 to April 2021)

Survey	Species	2017/18	2018/19	2019/20	2020/21	4 year mean peak	MoP as a % of citation value	MoP as a % of latest WeBS MoP	MoP as a % of the NT
High Water	**Shelduck**	12	2	9	1	6	< 1	< 1	1
	Cormorant	5	9	15	14	11		1	2
	Oystercatcher	1,200	1,400	800	2,000	1,350	5	6	47
	Whimbrel	1	28	8		9		12	925*
	Curlew	4	5	4	5	5	< 1	< 1	< 1
	Bar-tailed Godwit				1	< 1	< 1	< 1	< 1
	Black-tailed Godwit				9	2	< 1	< 1	1
	Turnstone	21	10	1	2	9		4	2
	Knot	150	16		800	242	2	1	9
	Dunlin				2	1	< 1	< 1	< 1
	Redshank	2,200	200	80	350	708	13	7	75
	Great Black-backed Gull		4	2	2	2		1	< 1
	Herring Gull	140	600	600	500	460		5	6
	Lesser Black-backed Gull	1	5			2		< 1	< 1
	Grey Heron		5	2	1	2		3	< 1
	Sandwich Tern		25			6	1	< 1	625*
Low Water	**Oystercatcher**	170	60			58	< 1	< 1	2
	Redshank	30				8	< 1	< 1	1
	Herring Gull	4	4			2		< 1	< 1

Bold species are features of the Dee Estuary SPA.
* The national importance threshold for Whimbrel and Sandwich Tern is set as 1.

Mostyn Dock Shore

The intertidal habitat to the east of the Port of Mostyn (The Mostyn Dock Shore count sector, Figure 8.1) was used by a total of 36 coastal waterbird species. The most common species were Oystercatcher and Redshank, with the largest counts occurring during high water (4-year mean peak counts of 2,074 birds and 1,077 birds, respectively) (Table 8.16). Oystercatcher in this area predominantly roost on the shingle beach below Warwick Chemicals (Sector D). Redshank which were recorded in nationally important numbers, predominantly roost on the pebble beaches and boulder areas on the eastern side of the Mostyn Dock (Sector G).

Other wading birds recorded roosting and feeding in this area included Knot, Lapwing and Curlew. Waders roosting in this area often undertake short flights to the sandbanks on and around Salisbury Middle as they become exposed during low water for foraging.

The most numerous duck species during the monitoring period in this sector was Shelduck which was recorded in nationally important numbers (4-year mean peak count of 813 birds recorded during the low water surveys).

The numbers recorded during the monthly surveys commissioned by the Port of Mostyn are broadly similar to that recorded in recent WeBS Core Count surveys for the Mostyn Dock Shore (Table 8.17). For example, mean peak numbers of Redshank were approximately 1,000 birds for both the Port of Mostyn high water and WeBS Core Count surveys.

Table 8.16. Low water and high water annual peak counts of all waterbirds within the Mostyn Dock Shore) sector (September 2017 to April 2021)

Survey	Species	2017/18	2018/19	2019/20	2020/21	4 year mean peak	MoP as a % of citation value	MoP as a % of latest WeBS MoP	MoP as a % of the NT
High Water	Canada Goose	4				1		< 1	N/A
	Mute Swan		2			1		2	< 1
	Shelduck	6	18	24	25	18	< 1	< 1	4
	Shoveler	1				< 1		< 1	< 1
	Mallard	1	4	15	30	13		1	< 1
	Teal			8		2	< 1	< 1	< 1
	Scoter		1			< 1		< 1	< 1
	Great Crested Grebe	3			1	1		< 1	1
	Oystercatcher	2,550	746	2,373	2,628	2,074	9	9	72
	Lapwing	80		1		20		< 1	< 1
	Grey Plover			6		2	< 1	< 1	< 1
	Ringed Plover	5				1		< 1	< 1
	Curlew	56	18	31	75	45	1	1	4
	Black-tailed Godwit		90	1		23	1	< 1	6
	Turnstone	71	45	91	55	66		32	16
	Knot	650	45		20	179	1	1	7
	Sanderling		9			2		< 1	1
	Dunlin	760	590	269	150	442	2	3	13
	Common Sandpiper		1	1		1		11	50
	Redshank	1,380	1,387	888	651	1,077	20	11	115
	Black-headed Gull	127	306	823	149	351		4	2
	Great Black-backed Gull	12	22	14	12	15		6	2
	Herring Gull	230	296	712	83	330		3	5
	Lesser Black-backed Gull	82	116	54		63		10	5

Survey	Species	2017/18	2018/19	2019/20	2020/21	4 year mean peak	MoP as a % of citation value	MoP as a % of latest WeBS MoP	MoP as a % of the NT
	Sandwich Tern	155	210	105	37	127	13	8	12,675*
	Grey Heron	3	7	6	2	5		7	1
	Little Egret	3	13	9	1	7		2	6
	Cormorant	9	15	12	9	11		1	2
Low Water	Light-bellied Brent Goose		1	15	3	5		2	30
	Canada Goose				40	10		< 1	N/A
	Mute Swan	2			1	1		2	< 1
	Shelduck	492	1,061	146	1,551	813	11	8	173
	Mallard	2	19	22	8	13		1	< 1
	Red-breasted Merganser				1	< 1		1	< 1
	Great Crested Grebe	2	3	1	2	2		< 1	1
	Oystercatcher	1,600	1,288	1,261	1,755	1,476	7	6	51
	Lapwing				1	< 1		< 1	< 1
	Curlew	70	82	205	338	174	4	5	14
	Bar-tailed Godwit		2			1	< 1	< 1	< 1
	Black-tailed Godwit		80		2	21	1	< 1	5
	Turnstone	35	23	23	33	29		14	7
	Knot	245	180	4	168	149	1	1	6
	Sanderling				2	1		< 1	< 1
	Dunlin	400	21	46		117	< 1	1	3
	Common Sandpiper			1	2	1		11	75
	Redshank	312	191	509	147	290	5	3	31
	Black-headed Gull	78	137	243	856	329		3	1
	Great Black-backed Gull	27	64	58	42	48		18	6
	Herring Gull	692	619	202	963	619		6	8
	Lesser Black-backed Gull	42	100	53	9	51	1	8	4
	Sandwich Tern	9	2	23	11	11		1	1125*
	Grey Heron	9	8	6	6	7		9	2
	Little Egret	6	19	6	16	12		4	11
	Cormorant	42	7	5	132	47		3	8
	Kingfisher	1				< 1		8	< 1
Bold species are features of the Dee Estuary SPA. *The national importance threshold for Whimbrel and Sandwich Tern is set as 1.									

Table 8.17. WeBS five-year annual peak counts of bird species in the Mostyn Dock Shore sector (2015/17 to 2019/20)

Species	2015/16	2016/17	2017/18	2018/19	2019/20	Mean Peak
Greylag Goose	0	0	0	700 Nov	0	140
Mute Swan	0	0	0	2 Sep	0	0
Shelduck	2 Feb	7 Feb	6 Dec	18 Jun	24 Nov	11
Mallard	0	0	0	4 Jun	15 Jan	4
Common Scoter	0	0	0	1 Dec	0	0
Grey Heron	0	2 Nov	0	7 Aug	6 Nov	3
Little Egret	0	0	0	13 Jun	0	3
Cormorant	1	2	0	15	12	6

Species	2015/16	2016/17	2017/18	2018/19	2019/20	Mean Peak
	Aug	Jul		Sep	Aug	
Oystercatcher	1,120 Nov	800 Nov	1,400 Dec	850 Jan	2,373 Fed	1309
Lapwing	0	0	0	0	1 Ma	0
Grey Plover	0	0	0	0	6 Feb	1
Whimbrel	2 Aug	0	11 Jul	0	0	3
Curlew	4 Nov	5 Oct	13 Dec	20 Nov	31 Jan	15
Bar-tailed Godwit	0	0	0	3 Jan	0	1
Black-tailed Godwit	0	0	0	90 Oct	0	18
Turnstone	9 Oct	50 Nov	68 Dec	45 Sep	91 Nov	53
Knot	0	0	0	45 Nov	0	9
Sanderling	0	0	0	9 Feb	0	2
Dunlin	320 Oct	80 Nov	640 Dec	280 Nov	270 Dec	318
Common Sandpiper	0	0	0	0	1 Dec	0
Redshank	1100 Aug	1200 Sep	500 Sep	1345 Sep	1000 Sep	1029
Black-headed Gull	0	1 Dec	28 Jul	300 Jul	823 Nov	230
Great Black-backed Gull	0	1 Jul	0	22 Jul	12 Nov	7
Herring Gull	0	6 Oct	1 Mar	300 Sep	712 Nov	204
Lesser Black-backed Gull	0	0	0	116 Sep	28 Aug	29
Sandwich Tern	31 May	16 Aug	200 Sep	85 Sep	10 Aug	68
Common Tern	0	2 Jul	0	0	1 Sep	1

Waterbird populations directly overlapping the proposed development footprint

Data from the monthly coastal waterbirds surveys commissioned by the Port of Mostyn undertaken from September 2017 to April 2021 (during high and low water periods) has been used to describe the utilisation of the following areas which directly overlap with the reclamation and new berth for the proposed development:

- **Breakwater East**: The eastern side of the breakwater is a subdivision sector of the Mostyn Dock Shore count sector and was specifically counted as part of the surveys. This sector includes the breakwater as well as the nearby area of fluid/soft sandy mud around the ferry Ro-Ro terminal and old Airbus berthing facility (Figure 8.1); and
- **Bug Bank:** The sandflat habitat of Bug Bank in Mostyn harbour (which is in the capital dredge footprint) has been counted more broadly as part of the Mostyn Dock Shore sector (rather than as a specific subdivision). The location of Bug Bank is shown in Figure 8.1. On this basis bird distribution mapping data and observations from the ornithology surveys, as well as anecdotal observations during the Phase 1 intertidal habitat, have been used to develop an understanding of the use of this area by waterbirds.

Breakwater East

During both high and low water periods, survey data has found the eastern side of the breakwater to be used by a small number of waterbird species in low abundances (Table 8.18).

Herring Gulls and Cormorants were the most abundant species recorded on this side of the breakwater during high water periods (4-year mean peaks of 170 and 10 birds respectively). These species typically roost on the top of the breakwater and on mooring dolphins just off from the breakwater. All other species had mean peaks of less than 10 birds, with species recorded including very low numbers of roosting waders (Oystercatcher, Turnstone and Curlew), gulls (Black-headed Gull, Great Black-backed Gull and Lesser Black-backed Gull), as well as Grey Heron and Little Egret.

At high water, the majority of the breakwater consists of steep crags and overhangs which, along with its exposed aspect, is likely to prevent the breakwater being used as a roost at high water.

During low water periods, small numbers of waders including Turnstone and Oystercatcher (4-year mean peak of nine and four birds respectively) were recorded foraging. It is worth noting that the number of Turnstone is likely to be an undercount as they are not conspicuous between the boulder and rock-sized slag deposits and crevices present on the breakwater. Very low numbers of Curlew (4-year mean peak of 3 birds), as well as Dunlin and Redshank (4-year mean peak of one bird for both species) were also recorded during low water periods. Other species recorded at low water included Herring Gull (4-year mean peak of 28 birds), as well as much lower numbers of other gull species, Grey Heron, Shelduck and Cormorant (all with 4-year mean peak of <3 birds).

All the species were predominately recorded around the breakwater rather than on the fluid/soft sandy mud around the ferry Ro-Ro terminal and old Airbus berthing facility which appears to have very limited functionality for birds other than low numbers of loafing gulls and more infrequently Oystercatchers or Redshank (several individuals) loafing and more rarely feeding.

Table 8.18. Low water and high water annual peak counts of all waterbirds within the Breakwater (East) sector (September 2017 to April 2021)

Survey	Species	2017/18	2018/19	2019/20	2020/21	4-yr mean peak	4-yr MoP as a % of citation value	4-yr MoP as a % of latest WeBS MoP	MoP as a % of the NT
High Water	Cormorant	9	14	11	5	10		1	2
	Oystercatcher	4	4	3	4	4	< 1	< 1	< 1
	Curlew	1			1	1	< 1	< 1	< 1
	Turnstone	12	11	9		8		4	2
	Black-headed Gull		7	18		6		< 1	< 1
	Great Black-backed Gull	4	6	5	3	5		2	1
	Herring Gull	36	230	402	12	170		2	2
	Lesser Black-backed Gull	2	6	2		3		< 1	< 1
	Grey Heron		7	6	1	4		5	1
	Little Egret		4			1		< 1	1
Low Water	**Shelduck**	8				2	< 1	< 1	< 1
	Cormorant	2	1	1		1		< 1	< 1
	Oystercatcher	8	5	2	2	4	< 1	< 1	< 1
	Curlew	10		1		3	< 1	< 1	< 1
	Turnstone	17	2	12	4	9		4	2
	Dunlin	2	2			1	< 1	< 1	< 1

Survey	Species	2017/18	2018/19	2019/20	2020/21	4-yr mean peak	4-yr MoP as a % of citation value	4-yr MoP as a % of latest WeBS MoP	MoP as a % of the NT
	Redshank	5				1	< 1	< 1	< 1
	Black-headed Gull	3	1			1		< 1	< 1
	Great Black-backed Gull		1		1	1		< 1	< 1
	Herring Gull	21	40	33	18	28		< 1	< 1
	Lesser Black-backed Gull	1			2	1		< 1	< 1
	Grey Heron	1	2	2	1	2		3	< 1

Bold species are features of the Dee Estuary SPA.

Bug Bank

The sandflat habitat of Bug Bank in Mostyn Harbour is only exposed for a relatively short amount of time during low water periods with much of this bank only becoming exposed during spring tidal phases.

Bird distribution mapping data and observations from the ornithology surveys as well as anecdotal observations during the Phase 1 intertidal habitat survey (Appendix 8.1) suggests Bug Bank is used primarily by loafing Herring Gulls (flocks of typically 15 to 100 birds), as well as very low numbers of Oystercatcher (<10 birds) which are primarily recorded loafing and occasionally foraging.

Low numbers of other species, such as Black-headed Gulls, Great Black-backed Gulls and Cormorants consisting of a few individuals are also occasionally recorded on Bug Bank.

8.6.6 Otter

The European otter *Lutra lutra* is native to the UK. It belongs to the Mustelid family that includes weasels, stoats, badgers, polecats, pine martins and mink. Populations of otters in England and Wales are confined mainly to freshwater but coastal habitats can be exploited. Coastal holts are typically found within 100 m of the shore but can be further inland (Chanin, 2003; Kruuk, 1995).

Otters have large ranges with average linear territories along rivers of 40 to 50 km recorded for dog (male) otters and about half this distance for females (Strachan, 2007; Kruuk *et al*. 1993; Birkeland, 2003; Chanin, 2003; Mason and Macdonald, 2008). The range of otters utilising coastal areas is less well understood. In Shetland, resident females have been recorded living in ranges of 5 to 14 km along the coast, males had larger ranges of up to 19 km. Transient dog otters have been recorded moving 40 km along the coast (Kruuk, 1995).

Otters make use of shallow, sheltered, inshore marine areas. Feeding is usually within 100 m of the shore (Kruuk *et al*. 1998). Kruuk and Moorhouse (1991) found that on 500 otter dives, 84 % occurred within 50 m of the coast. Otters also typically dive to less than the 10 m depth contour with deeper water generally avoided (Scottish Executive, 2007).

The preference for foraging in shallow water is thought to be related to energetic costs (with deep dives more demanding and allowing less time for foraging along the bottom (Nolet *et al*., 1993).

Although otters are known to forage in coastal areas, they need to keep their fur free of salt using freshwater for it to remain effective as insulation (NatureScot, 2022). Otters that live in freshwater habitats are largely nocturnal and occupy very large home ranges as noted above. Coastal otters generally have much smaller home ranges than their riverine counterparts (NatureScot, 2022).

Sites in the River Dee catchment were surveyed by NRW between June 2017 and April 2018 (NRW, 2018b). The survey sites (n=59) were those surveyed in previous national otter surveys. Otter signs were found at 85 % of sites. A 9 % decline in the number of sites with otter signs were found since the last survey undertaken in 2009/2010 but this was not a statistically significant decline. A small number of sites (n=7) which had positive otter field signs in 2009/2010 no longer had otter signs in 2017/2018. This change was not statistically significant, and the change is within what could be considered normal variation rather than a real decline. No sites were surveyed within the Dee Estuary. The nearest site surveyed to the proposed development that had positive signs of otter was a site located in Liverpool Bay just outside the Dee Estuary (Image 8.2). This site had negative signs of otters in the previous surveys undertaken in 2002 and 2009/2010 (NRW, 2015) and was, therefore, considered a new positive site (NRW, 2018b).

Otter is unlikely to be using the area in the direct vicinity of the proposed development which is disturbed by the existing regular movements of vessels and operational activities at the Port of Mostyn. There is also considered to be no potential for any holts to be present within and in the immediate vicinity of the Port given the habitat is not suitable due to the regular disturbance from noise and lighting. However, there have been sightings of otters around the beached TSS Duke of Lancaster (Mostyn Funship) located approximately 2.3 km upstream of the Port of Mostyn (Rowland Sharp, NRW, *pers. comm*.). Otter is also a protected feature in unfavourable condition of the River Dee SAC which is located over 18 km upstream of the proposed development (Section 8.6.1).

8.6.7 Future baseline

If the proposed development were not to take place, nature conservation and marine ecology receptors, namely protected sites, benthic ecology, fish and shellfish, marine mammals, coastal waterbirds and otters, will continue to be influenced by natural and human-induced variability, ongoing cyclic patterns and trends. The future baseline will also be influenced by climate change, ocean acidification and increases in non-native species. These could lead to changes in distribution, abundance, health and reproduction in marine species, potentially affecting future populations.

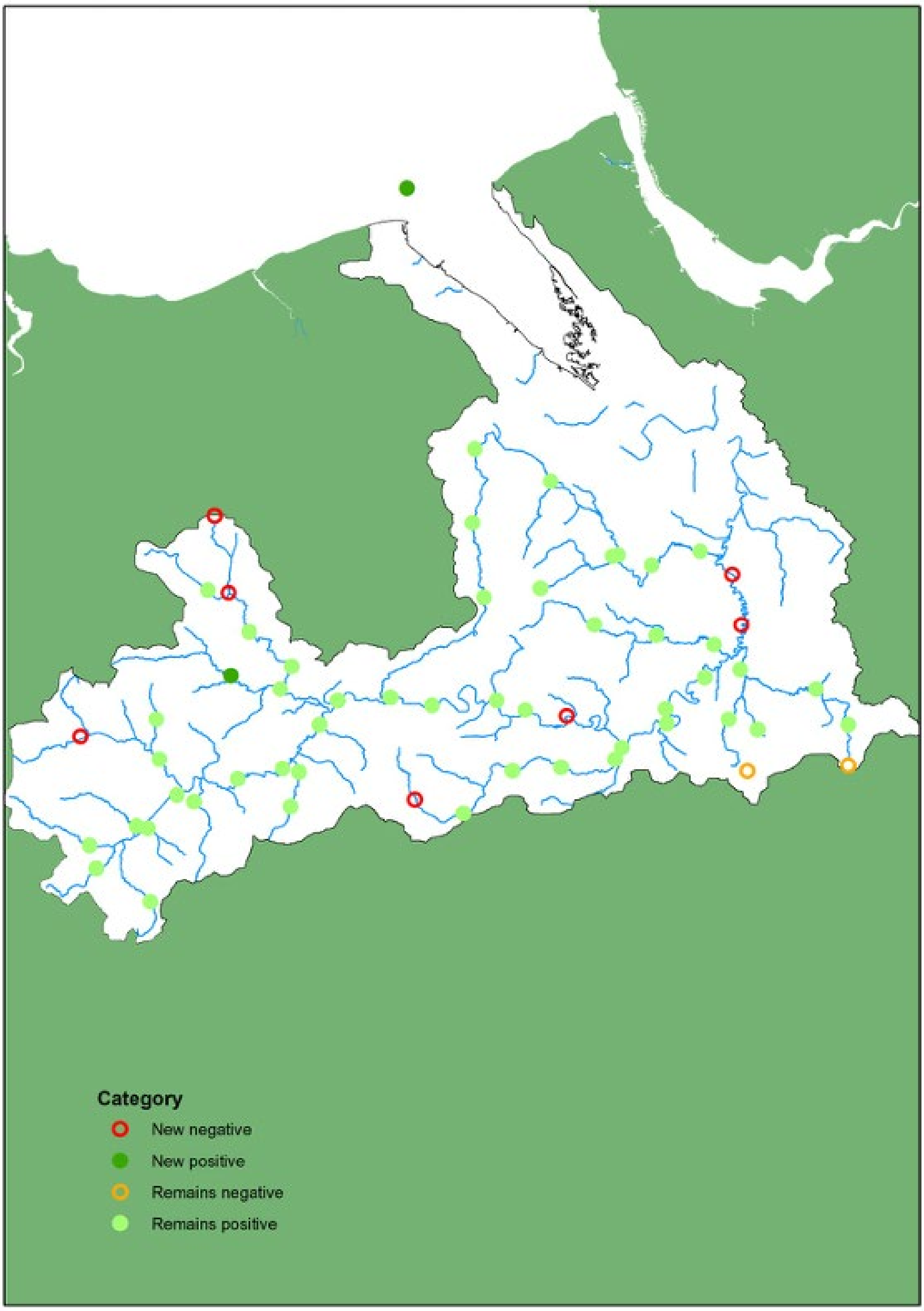

Image 8.2. Location of otter survey sites within River Dee catchment (NRW, 2018b)

8.7 Impact assessment

This section identifies the potential likely effects on marine ecology receptors as a result of the construction and subsequent operation of the MEPE Project.

The physical processes assessment (Chapter 6), water and sediment quality assessment (Chapter 7) and underwater noise assessment (Appendix 8.4) have informed the outcomes of the marine ecology assessment.

Potential impacts on features of internationally designated sites (SACs, SPAs and Ramsar sites) have been assessed within the HRA which is included in Appendix 8.5 of the ES.

The nearest MCZ (Fylde) is located over 35 km from the proposed development and does not overlap with the zone of influence. This site is designated for subtidal mud. Furthermore, there are no mobile Features of Conservation Interest (FOCI) that could overlap with any of the marine effects resulting from the proposed development. Overall, therefore, there is considered to be no potential for direct or indirect impacts on FOCI at this site. On this basis an MCZ Assessment is not considered to be required.

The Gronant Dunes and Talacre Warren SSSI is located approximately 5 km from the proposed development application boundary with Little Tern a notified feature of the SSSI. Data suggests that this species forages within 5 km of nesting sites (Woodward *et al*., 2019). The proposed development is, therefore, on the outer limit of the foraging range of this species, with ornithology data suggesting this species is considered very rare within the Port of Mostyn area. On this basis, this notified feature is unlikely to overlap with any potential direct or indirect changes resulting from the construction and operational activities associated with the proposed development which are limited to within the vicinity of the Port of Mostyn.

The potential risks to human health, the potential impacts on climate and the vulnerability of the proposed development to climate change, as well as to risks of major accidents and/or disasters have been considered in the context of the potential likely effects on marine ecology receptors.

Cumulative impacts on marine ecology receptors could arise as a result of other coastal and marine developments and activities. These have been considered as necessary as part of the cumulative impacts and in-combination effects assessment included in Chapter 13 of this ES.

8.7.1 Construction phase

Based on an understanding of the nature and scale of the proposed development, together with the environmental baseline and stakeholder comments from the Scoping Opinion, the potential effects during the construction phase that are considered to be potentially relevant are reviewed in Table 8.19. This includes the rationale for scoping in or out individual pathways for further assessment.

Table 8.19. Potential effects during construction scoped in and out of further detailed assessment

Receptor	Impact pathways/ potential effects	Project activity	Included in assessment?	Justification
Benthic habitats and species	Direct loss of seabed habitat as a result of the new quay wall	Quayside works[14]	Yes	The creation of the new quay wall and associated reclamation will result in the direct loss of marine habitat. This impact pathway has, therefore, been scoped into the assessment.
	Direct loss of intertidal habitat as a result of capital dredging	Capital dredge	Yes	Capital dredging will cause a direct loss of intertidal habitat which will be changed to subtidal habitat as a result of the deepening. This impact pathway has, therefore, been scoped into the assessment.
	Changes to subtidal benthic habitats and species as result of seabed removal during dredging	Capital dredge	Yes	Capital dredging causes the direct physical removal of marine sediments from the dredge footprint, resulting in the modification of existing marine habitats. The impacts to benthic fauna associated with the dredging activity include changes to abundance and distribution through damage or morality. This impact pathway has, therefore, been scoped into the assessment.
	Changes to benthic habitats and species as a result of sediment deposition	Quayside works	No	Piling has the potential to result in the localised resuspension of sediment as a result of seabed disturbance. The amount of sediment that settles out of suspension back onto the seabed as a result of piling is expected to be negligible, and benthic habitats and species are not expected to be sensitive to this level of change. This impact pathway has, therefore, been scoped out of further detailed assessment.
		Capital dredge	Yes	Capital dredging has the potential to result in localised physical disturbance and smothering of seabed habitats and species (where the sediment settles out of suspension back onto the seabed). This impact pathway has, therefore, been scoped into the assessment.
		Dredge disposal	Yes	Dredge disposal will result in the deposition of sediments which has the potential to cause physical disturbance and smothering of seabed habitats. This impact pathway has, therefore, been scoped into the assessment.

14 The MEPE Project may also involve the potential relocation of existing dolphins comprising 4 piles using the same installation methods as the quay wall (see Project Methodology Chapter 3). The potential impacts of these four piles are considered to be similar and/or less than the piling required for the new quay wall and are therefore considered to be represented within all the relevant impact pathways related to quayside and/or piling works.

Receptor	Impact pathways/ potential effects	Project activity	Included in assessment?	Justification
	Indirect changes to seabed habitats and species as a result of changes to hydrodynamic and sedimentary processes	Marine works (capital dredging and quayside)	No	The capital dredge and quayside have the potential to result in changes to hydrodynamic and sedimentary processes (e.g. water levels, flow rates, changes to tidal prism, accretion and erosion patterns). However, as described in more detail in the physical processes assessment (Chapter 6), these changes are assessed as insignificant/minor adverse locally and insignificant in the wider estuary. The predicted changes are unlikely to be discernible against background natural processes and are not expected to modify existing seabed habitat types found in the area. Indirect effects on benthic habitats and species are, therefore, considered to be negligible. On this basis, this pathway has been scoped out of further detailed assessment.
		Dredge disposal	No	The disposal of dredged material at the disposal sites has the potential to result in changes to hydrodynamic and sedimentary processes (e.g. water levels, flow rates, changes to tidal prism, accretion and erosion patterns). However, as described in more detail in the physical processes assessment (Chapter 6), changes to hydrodynamics (tidal currents and the wave climate) at the disposal sites as a result of the dredge disposal is expected to be negligible. In addition, the highly localised changes in bathymetry at the disposal sites is not expected to cause significant changes to seabed morphology or sedimentary processes in the wider area. Any changes that do occur will be immeasurable against those caused by ongoing sediment transport mechanisms operating in the area. The marine habitats which will be potentially affected are considered to be tolerant to the level of change in conditions expected. On this basis, this pathway has been scoped out of further detailed assessment.
	Changes in water and sediment quality	Quayside works	No	The expected negligible, highly localised and temporary changes in suspended sediment levels (and related changes in sediment bound contaminants and dissolved oxygen) associated with bed disturbance during the quay wall construction works is considered unlikely to produce adverse effects in any species. The potential for accidental spillages will also be negligible during construction by following established industry guidance and protocols. This impact pathway has, therefore, been scoped out of further detailed assessment.
		Capital dredge	Yes	Changes in water quality during capital dredging could impact benthic habitats and species through an increase in SSC and the release of toxic contaminants bound in sediments. This impact pathway has, therefore, been scoped into the assessment.
		Dredge disposal	Yes	Changes in water quality could occur during dredged material disposal through the deposition of material causing elevated SSC and contaminant levels. This could potentially impact on benthic habitats and species. This impact pathway has, therefore, been scoped into the assessment.
	Underwater noise disturbance	Quayside works	Yes	Underwater noise generated by quayside works has the potential to affect benthic species. This will require further assessment and has, therefore, been scoped in.
		Capital dredge and dredge disposal	Yes	Underwater noise generated by dredging and the movement of the dredging vessel has the potential to affect benthic species. This will require further assessment and has, therefore, been scoped in.

Receptor	Impact pathways/ potential effects	Project activity	Included in assessment?	Justification
	The potential introduction and spread of non-native species	Quayside works	Yes	Non-native species have the potential to be transported as a result of quay wall construction activity. In addition, the presence of the quay wall would introduce a new surface in the marine environment which has the potential to facilitate the spread of invasive non-native species. This impact pathway has, therefore, been scoped into the assessment.
		Capital dredge and dredge disposal	Yes	Non-native species have the potential to be transported into the local area on the hulls of dredging vessels. Non-native invasive species also have the potential to be transported via vessel ballast water. This impact pathway has, therefore, been scoped into the assessment.
Fish and shellfish	Direct loss or changes to fish and shellfish populations and habitat	Quayside works and capital dredge	Yes	There is the potential for impacts to fish and shellfish as a result of habitat loss due to the footprint of the proposed development. Dredging by cutter suction dredger also has the potential to result in the direct uptake of fish and fish eggs by the action of the suction pump (entrainment). Capital dredging also has the potential to result in seabed disturbance and smothering of seabed habitats and species. These changes have the potential to impact on fish species, through potential changes in prey resources and the quality of foraging, nursery and spawning habitats, and also shellfish beds. This impact pathway has, therefore, been scoped into the assessment.
		Dredge disposal	Yes	Disposal at the marine disposal sites will result in the deposition of sediments which has the potential to cause physical disturbance and smothering of seabed habitats. These changes have the potential to impact on fish species through potential changes in prey resources and the quality of foraging, nursery and spawning habitats, and also shellfish beds. This impact pathway has, therefore, been scoped into the assessment.
	Indirect changes to seabed habitats for fish	Marine works (capital dredging and quayside)	No	The capital dredge and quayside have the potential to result in changes to hydrodynamic and sedimentary processes (e.g. water levels, flow rates, changes to tidal prism, accretion and erosion patterns). However, as described in more detail in the physical processes assessment (Chapter 6), insignificant/minor adverse locally and insignificant in the wider estuary. The predicted changes are unlikely to be discernible against background natural processes and are not expected to modify existing seabed habitat types found in the area. Indirect effects on fish habitats (feeding, spawning and nursery areas) are, therefore, considered to be negligible. On this basis, this pathway has been scoped out of further detailed assessment.
		Dredge disposal	No	The disposal of dredged material at the disposal sites has the potential to result in changes to hydrodynamic and sedimentary processes (e.g. water levels, flow rates, changes to tidal prism, accretion and erosion patterns). However, as described in more detail in the physical processes assessment (Chapter 6), changes to hydrodynamics (tidal currents and the wave climate) at the disposal sites as a result of the dredge disposal is expected to be negligible. In addition, the highly localised changes in bathymetry at the disposal sites is not expected to cause significant changes to seabed morphology or sedimentary processes in the wider area. Any changes that do occur will be immeasurable against those caused by ongoing sediment transport mechanisms operating in the area. The marine habitats which will be potentially affected are

Receptor	Impact pathways/ potential effects	Project activity	Included in assessment?	Justification
				considered to be tolerant to the level of change in conditions expected. Indirect effects on fish habitats (feeding, spawning and nursery areas) are, therefore, considered to be negligible. On this basis, this pathway has been scoped out of further detailed assessment
	Changes in water and sediment quality	Quayside works	No	The negligible, highly localised and temporary changes in suspended sediment levels (Chapter 6) and related changes in sediment bound contaminants and dissolved oxygen (Chapter 7) associated with bed disturbance during the quay wall construction works is considered highly unlikely to produce adverse effects in any fish species. The potential for accidental spillages will also be negligible during construction by following established industry guidance and protocols. This impact pathway has, therefore, been scoped out of further detailed assessment.
		Capital dredge	Yes	Changes in water quality during capital dredging could impact fish species through an increase in SSC and the release of toxic contaminants bound in sediments. This impact pathway has, therefore, been scoped into the assessment.
		Dredge disposal	Yes	Changes in water quality could occur during dredged material disposal through the deposition of material causing elevated SSC and contaminant levels. This could potentially impact on fish species. This impact pathway has, therefore, been scoped into the assessment.
	Underwater noise disturbance	Quayside works	Yes	During quay wall construction, there is the potential for noise disturbance to fish. Percussive (impact) and vibro piling will produce underwater noise above background conditions and at a level that may cause a risk of injury and behavioural responses in fish near to the proposed development. This impact pathway has, therefore, been scoped into the assessment. The potential impacts on shellfish, as noted above for benthic ecology receptors, have been scoped out of further detailed assessment.
		Capital dredge and dredge disposal	Yes	Elevated underwater noise and vibration levels caused by the action of the dredger and movement of the dredging vessel could potentially affect fish. This impact pathway has, therefore, been scoped into the assessment. The potential impacts on shellfish, as noted above for benthic ecology receptors, have been scoped out of further detailed assessment.
Marine mammals	Direct loss or changes in marine mammal foraging habitat	Construction (quayside works, capital dredge and dredge disposal)	No	There is the potential for impacts to marine mammals as a result of habitat loss and change as a result of construction of the new quay wall. However, the footprint of the proposed development only covers a highly localised area that constitutes a negligible fraction of the known ranges of local marine mammal populations. This impact pathway has, therefore, been scoped out of further detailed assessment.
	Changes in water and sediment quality	Quayside works	No	The expected negligible, highly localised and temporary changes in suspended sediment levels (Chapter 6) and related changes in sediment bound contaminants and dissolved oxygen (Chapter 7) associated with bed disturbance during the quay wall construction works is considered highly unlikely to produce adverse effects in any marine mammal species. The potential for accidental spillages will also be negligible during construction by following established industry guidance and protocols. This impact pathway has, therefore, been scoped out of further detailed assessment.
		Capital dredge and dredge disposal	No	The plumes resulting from dredging and dredge disposal are expected to have a relatively minimal and local effect on SSC (Chapter 6). Marine mammals are well adapted to turbid

Receptor	Impact pathways/ potential effects	Project activity	Included in assessment?	Justification
				conditions and, therefore, not sensitive to the scale of changes in SSC predicted during capital dredging and dredge disposal (Todd *et al*., 2015). The extent of sediment dispersal is not expected to cause significant elevations in water column contamination (Chapter 7). In addition, the temporary and localised changes in water column contamination levels are considered unlikely to produce any lethal and sub-lethal effects in these highly mobile species (the concentrations required to produce these effects are generally acquired through long-term, chronic exposure to prey species in which contaminants have bioaccumulated) (Todd *et al.*, 2015). Furthermore, potential for accidental spillages will also be negligible during all phases by the application of established industry guidance and protocols. This impact pathway has, therefore, been scoped out of further detailed assessment.
	Collision risk	Construction (quayside works, capital dredge and dredge disposal)	No	Vessels involved in construction and dredging will be mainly stationary or travelling at low speeds (2 to 6 knots), making the risk of collision very low. Although all types of vessels may collide with marine mammals, vessels traveling at a speeds over 10 knots are considered to have a much higher probability of causing lethal injury (Schoeman *et al.,* 2020). Furthermore, the region is already characterised by heavy shipping traffic. The additional movements due to construction activity (including capital dredging) will only constitute a small increase in vessel traffic in the area which will also be temporary in nature. In general, incidents of mortality or injury of marine mammals caused by vessels remain a relatively rare occurrence in UK waters (ABP Research 1999; CSIP, 2020). For example, out of 144 post mortem examinations carried out on cetaceans in 2018, only two (1.4 %) were attributed to boat collision with the biggest causes of mortality including starvation and by-catch, although some incidents are likely to remain unreported (CSIP, 2020). In addition, marine mammals foraging within the Dee Estuary region will routinely need to avoid collision with existing vessels and are, therefore, considered adapted to living in an environment with high levels of vessel activity. This impact pathway has, therefore, been scoped out of further detailed assessment.
	Visual disturbance of hauled out seals	Construction (quayside works, capital dredge and dredge disposal)	No	The nearest haul out site to the proposed development is located on the West Hoyle sandbank near Hilbre Island (approximately 5 km away from the Port of Mostyn). No established seal haul out sites are known to occur nearer to the proposed development. Seals which are hauled out on land, either resting or breeding, are considered particularly sensitive to visual disturbance (Hoover-Miller *et al,* 2013). The level of response of seals is dependent on a range of factors, such as the species at risk, age, weather conditions and the degree of habituation to the disturbance source. Hauled out seals have been recorded becoming alert to powered craft at distances of up to 800 m although seals generally only disperse into the water at distances <150 to 200 m (Wilson, 2014; Mathews, *et al*., 2016; Henry and Hammill, 2001; Strong and Morris, 2010). For example, in a study focusing on a colony of grey seals on the South Devon coast, vessels approaching at distances between 5 m and 25 m resulted in over 64 % of seals entering the water, but at distances of between 50 m and 100 m only 1 % entered the water (Curtin *et al*., 2009). Recent disturbance research has also found no large-scale redistribution of seals after disturbance with most seals returning to the same haul out site within a tidal cycle (Paterson *et*

Receptor	Impact pathways/ potential effects	Project activity	Included in assessment?	Justification
				al., 2019). Based on this evidence, seals hauled out on the West Hoyle sandbank are out of the zone of influence of any potential visual disturbance effects as a result of construction activity, dredging and dredge disposal. The potential for disturbance to hauled out seals has, therefore, been scoped out of further detailed assessment.
	Underwater noise disturbance	Quayside works	Yes	During quay wall construction, there is the potential for noise disturbance to marine mammals. Percussive (impact) and vibro piling will produce underwater noise above background conditions and at a level that may cause a risk of injury and behavioural responses in marine mammals near to the proposed development. This impact pathway has, therefore, been scoped into the assessment.
		Capital dredge and dredge disposal	Yes	Elevated noise and vibration levels caused by the action of the dredger and the movement of the dredging vessel could potentially affect marine mammals by inducing adverse behavioural reactions. This impact pathway has, therefore, been scoped into the assessment.
Coastal waterbirds	Direct loss or change to coastal waterbird habitat	Quayside works	Yes	The reclamation will cause a direct loss of intertidal habitat which could cause changes to the prey resources available for coastal waterbirds. This impact pathway has, therefore, been scoped into the assessment.
		Capital dredge	Yes	Capital dredging will cause a direct loss of intertidal habitat as well as potential changes which could cause changes to the prey resources available for coastal waterbirds. This impact pathway has, therefore, been scoped into the assessment.
		Capital dredge disposal	Yes	Dredge disposal at sea has the potential to cause impacts to seabed habitats which could cause changes to the prey resources available for seabirds and other diving birds. However, the seabed at the disposal sites is highly dynamic and subject to regular physical disturbance as a result of maintenance dredging and strong tidal currents. This is reflected in an impoverished subtidal assemblage (Section 8.6.2 of this chapter) which provides a limited prey resource. This impact pathway has, therefore, been scoped out of the assessment.
	Noise and visual disturbance	Construction activity (including capital dredging)	Yes	During construction, there is the potential for airborne noise and visual disturbance to affect coastal waterbirds. This impact pathway has, therefore, been scoped into the assessment.
Otter	Direct loss or changes to otter populations and habitat	Quayside works	Yes	There is the potential for impacts to otter as a result of foraging habitat loss due to the footprint of the proposed development. These changes have the potential to impact on otter through potential changes in prey resources and the extent and quality of foraging habitat. This impact pathway has, therefore, been scoped into the assessment.
		Capital dredge	Yes	Capital dredging has the potential to result in seabed disturbance and smothering of seabed habitats and species. These changes have the potential to impact on otter through potential changes in prey resources and the extent and quality of foraging habitat. This impact pathway has, therefore, been scoped into the assessment.
	Noise and visual disturbance during construction	Construction activity (including capital dredging)	Yes	During construction, there is the potential for noise and visual disturbance to affect otters. This impact pathway has, therefore, been scoped into the assessment.

Benthic habitats and species

This section assesses the potential for impacts on benthic ecology receptors as a result of the proposed development during construction. The following impact pathways have been assessed:

- Direct loss of intertidal and subtidal habitats and species as a result of the new quay wall;
- Direct loss of intertidal habitat as a result of capital dredging;
- Changes to subtidal habitats and species as result of the removal of seabed material during dredging;
- Changes to habitats and species as a result of sediment deposition during dredging and dredge disposal;
- Changes in water and sediment quality during capital dredging and dredge disposal;
- Underwater noise and vibration disturbance during construction; and
- Introduction and spread of non-native species.

Direct loss of intertidal and subtidal habitats and species as a result of the new quay wall

General scientific context

The impact of direct habitat loss (e.g. piling or land reclamation) mainly relates to the temporary or permanent physical removal of substratum and associated organisms from the seabed.

Both intertidal and subtidal habitats are sensitive to physical loss at locations where new structures are introduced onto the seabed (i.e. within the development 'footprint' of these structures). The significance of such losses will vary on a site by site basis in response to differences in the extent and duration of the losses as well as the relative value of the habitats in question. The value of the habitats is, in turn, reflected by the species that are present and level of statutory and non-statutory protection afforded to them. As any effects are very much dependent upon site specific considerations, a generic scientific review is not appropriate in this case and the focus of the impact assessment is based on site-specific considerations.

Project impact assessment

The proposed development will involve an area of reclamation behind the new quay wall (see Section 3.1 in Project Methodology Chapter 3). Based on the latest available bathymetry data (October 2022) and LiDAR data (2021), the new quay wall and reclamation will result in the physical loss of approximately 3.49 ha of marine habitat, of which approximately 2.84 ha consists of intertidal habitat with the remaining approximately 0.65 ha consisting of subtidal habitat.

The area to be reclaimed consists of the following habitats:

- Intertidal hard substrate habitat (0.27 ha): The eastern side of the breakwater comprises tipped slag waste deposits which have partly fragmented into hard substrate of varying sizes (rock, boulders and cobble-sized deposits) grading into sand and silt closer to the lower shore. This artificial habitat was colonised by algae (including wracks *Fucus* spp.), barnacles, blue mussel *Mytilus edulis* aggregations, periwinkles *Littorina littorea*, shore crabs *Carcinus maenas* and also the common starfish *Asterias rubens* on the lower shore around the sublittoral fringe. This habitat provides a similar ecological function to the 'estuarine rocky habitats' Habitat of Principal Importance in Wales listed under the NERC Act 2006 Section 42 and is also considered to be of some functional value for feeding and roosting waterbirds such as Turnstone (Section 8.6.5). Naturally formed rocky habitat is also relatively limited within the Dee Estuary (see below);

- Intertidal mud habitat (2.57 ha): Intertidal habitat adjacent to the eastern side of the breakwater in the area of the ferry Ro-Ro terminal and old Airbus berthing facility consisted of sandy mud habitat which was fluid in nature and highly impoverished with a very low number of species recorded within it. Although this soft/fluid sandy mud habitat did not have the standard and more stable structure and form characteristic of intertidal mudflat, it should be noted that 'Intertidal mudflats' are a Habitat of Principal Importance in Wales listed under the NERC Act 2006 Section 42 and mudflat '*mudflats and sandflats not covered by seawater at low tide*' is a qualifying feature of the Dee Estuary SAC and supporting habitat of the Dee SPA and Ramsar. However, all the species recorded in the samples are considered commonly occurring, not protected and typical of estuarine mudflat habitat. Furthermore, the number of species and abundance levels recorded in the samples are much lower than have been recorded in the ecologically richer and more stable mudflat habitats of the nearby local area such as on the Mostyn Bank. This soft/fluid sandy mud is, therefore, considered to comprise a poorer quality and more unstable habitat that is not representative of the ecological structure and function of intertidal mudflat found beyond the immediate area of the harbour. This mud habitat is also considered to be of limited functional value for coastal waterbirds (Section 8.6.5); and
- Subtidal channel habitat (0.65 ha): The subtidal benthic samples from within the channel consisted predominantly of slightly gravelly sand or slightly gravelly muddy sand mud. Samples were typically impoverished and characterised by low numbers of the polychaete *Nephtys sp.* (particularly *Nephtys hombergii),* oligochaete *Tubificoides benedii*, nematodes and juvenile blue mussel *Mytilus edulis*. These characterising species dominated the assemblage and contributed almost entirely to the total abundances of organisms recorded at most of the sites. No subtidal species considered nationally rare or protected were recorded, with the assemblages observed considered characteristic of estuarine communities found more widely in the Dee Estuary.
- These habitats are described in more detail in Section 8.6.2 and Appendix 8.1.
- The loss of intertidal mud represents approximately 0.016 % the Dee Estuary SAC and specifically 0.024 % of the 'mudflats and sandflats not covered by seawater at low tide' feature of the Dee Estuary SAC[15]. This loss also represents 0.018 % of the Dee Estuary SPA/Ramsar site [16].

Based on the evidence provided above, the magnitude of potential impacts is considered to be small with respect to intertidal hard substrate habitat and negligible with respect to intertidal mud and subtidal habitats. Therefore, while the probability of occurrence is high, the overall exposure is assessed as low for intertidal hard substrate habitat and negligible with respect to intertidal mud and subtidal habitats. The sensitivity of species to direct habitat loss due to reclamation is considered to be high for all marine habitats and species (given the lack of recoverability following reclamation).

The importance of the intertidal hard substrate habitat present on the breakwater is considered to be low given that this habitat is artificial and formed of the tipped slag waste deposits, although it is recognised that it has a similar ecological function to protected 'estuarine rocky habitats' and also provides some functional value to feeding waterbirds. The importance of the intertidal mud habitat present in the vicinity of the eastern side of breakwater is considered to be moderate given that while this specific area of mudflat is of poor ecological value and provides a limited function for coastal birds, it is a qualifying feature of the Dee Estuary SAC, a supporting feature of the Dee Estuary SPA/Ramsar site and a NERC Habitat of Principle Importance. The subtidal channel habitat is of low

15 Based on the extents given in the Standard Data Form on the JNCC website (JNCC, 2022a)

16 Based on the extents given in the Standard Data Form on the JNCC website (JNCC, 2022b; JNCC, 2022c)

conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. On this basis, importance of this habitat is considered to be low.

Based on the standard impact assessment matrix, the impact of direct habitat loss as a result of the new quay wall and reclamation on intertidal habitats is assessed as **insignificant** with respect to intertidal mud and **insignificant to minor adverse** with respect to intertidal hard substrate. The impact of the habitat loss on the subtidal channel habitat is assessed as **insignificant**.

It should be noted that marine ecological enhancements are proposed (Project Methodology Chapter 3). These involve the scraping back of rubble from the toe of the rubble along the western side of the dock estate to expose mudflat habitat on the Mostyn Bank. This will allow silt to settle in the areas where the rubble is scraped back and will support natural mudflat restoration.

Direct loss of intertidal habitat as a result of capital dredging

General scientific context

The impact of direct habitat loss can involve building over marine habitats (such as reclamation) or the permanent physical removal of substratum and associated organisms from the seabed. Direct habitat loss can also occur due to deepening as a result of dredging causing a change from an intertidal to a subtidal environment.

Intertidal habitats are sensitive to physical loss at locations where new structures are introduced onto the seabed (i.e. within the development 'footprint' of these structures). The significance of such losses will vary on a site-by-site basis in response to differences in the extent and duration of the losses as well as the relative value of the habitats in question. The value of the habitats is, in turn, reflected by the species that are present and level of statutory and non-statutory protection afforded to them. As any effects are very much dependent upon site specific considerations, a generic scientific review is not appropriate in this case and the focus of the impact assessment is based on site-specific considerations.

Project impact assessment

Capital dredging will cause a direct loss of 1.34 ha of intertidal habitat which will be changed to subtidal habitat as a result of the deepening of the berth pocket required for the new quay wall.

The habitat in this area (which is known as 'Bug Bank') consists of low elevation and dynamic sandflat habitat. The project-specific intertidal benthic survey recorded a highly impoverished faunal assemblage characterised by very low numbers of mobile crustaceans (such as *Eurydice pulchra* and *Corophium volutator)*, errant polychaetes (such as *Nephtys* spp.) and gastropods (such as the bivalve *Kurtiella bidentata*) (Appendix 8.1 of the ES). These species are considered commonly occurring in the region and typical of tide swept sandflat habitat. The mobile sandflat habitat on Bug Bank is also considered highly disturbed as a result of tide swept nature of this area (causing a high degree of sediment mobility) and also due to ongoing maintenance dredging of Bug Bank. These factors prevent the establishment of a more species rich habitat in the area (Tillin, 2018). This habitat is, therefore, considered to be of limited functional value for species at higher trophic levels in terms of feeding resources (such as fish and coastal waterbirds).

The intertidal habitat loss as a result of the capital dredge represents approximately 0.008 % the Dee Estuary SAC and 0.013 % of the 'mudflats and sandflats not covered by seawater at low tide' feature of the Dee Estuary SAC[17]. This loss also represents 0.009 % of the Dee Estuary SPA/Ramsar site[18].

This habitat loss is, therefore, considered to be negligible in the context of the Dee Estuary SAC and SPA/Ramsar. Potential effects of this loss in intertidal on waterbirds is assessed in the 'Coastal waterbirds' sub section.

Based on the evidence provided above, the probability of habitat loss occurring is high and the magnitude of potential impacts is considered to be negligible. Exposure to change is, therefore, considered to be negligible. Therefore, while the sensitivity of species to direct habitat loss, is considered to be high for all benthic habitats and species within the footprint that is lost (given the lack of recoverability), vulnerability is assessed as none. The benthic habitats and associated species that overlap with the area of loss are of low ecological value, but intertidal sandbanks are a qualifying feature of the Dee Estuary SAC (and a supporting feature of the SPA/Ramsar site). On this basis, importance is considered to be moderate. The impact is, therefore, considered to be **Insignificant.**

Changes to subtidal habitats and species as result of the removal of seabed material during dredging

General scientific context

Dredging causes a direct physical removal of subtidal sediments, causing a modification to the existing subtidal habitat. The impacts to benthic fauna associated with the dredged material include changes to abundance and distribution through damage or mortality.

The speed of recovery of the temporarily disturbed areas is dependent on the scale and timing of the disturbance, the life histories of species and the stability and diversity of the benthic community present. For example, while the opportunistic bivalve *Abra* spp. is vulnerable to physical disturbance (due to its fragile shell), the species is considered to have a high recoverability due to a high fecundity and larval dispersal rate (Marine Ecology Surveys, 2008; De-Bastos, 2016a). Furthermore, a regularly disturbed sedimentary habitat with a low diversity benthic assemblage is likely to recover more quickly (i.e. return to its disturbed or 'environmentally-stressed' baseline condition) than a stable habitat with a pre-existing mature and diverse assemblage (Johnson *et al.,* 2017).

In general, where studies have been undertaken to understand the effects of physical disturbance, they have shown recolonisation of deposited sediments by benthic species to be quite rapid. Sites are initially colonised by short lived, fast growing, opportunistic species ('r-selected') that are tolerant of high levels of disturbance; infaunal species dominate, particularly polychaetes worms. In time, these are succeeded by longer lived, slower growing species with a lower tolerance for disturbance (Newell *et al.,* 1998; Tillin *et al.,* 2011). Rates of recovery reported in reviewed literature suggest that a recovery time of six to 24 months is characteristic of many mobile sands and estuarine muds where frequent disturbance of the deposits precludes the establishment of long-lived communities (Tillin *et al.*, 2019; De-Bastos, 2016b). In contrast, a community of sands and gravels may take two to three years to establish, depending on the proportion of sand and level of environmental disturbance by waves and currents (Newell *et al.,* 1998; Bolam, and Rees, 2003).

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17 Based on the extents provided in the Standard Data Form on the JNCC website (JNCC, 2022a)

18 Based on the extents provided in the Standard Data Form on the JNCC website (JNCC, 2022b; JNCC, 2022c)

Project impact assessment

A capital dredge will be required to create a new berth pocket alongside the new quay wall and to deepen the existing berth pocket along the existing quay wall. The total volume of capital dredge material from the berth pockets is approximately 500,000 m^3, including side slopes and overdredge allowance, over an area of approximately 40,000 m^2 (4 ha) (see Project Methodology Chapter 3).

The main navigation channel will need to be dredged to a maximum depth of – 4 m CD as is already consented (DML1542v2). The total volume of capital dredge material that needs to be removed from the main navigation channel is estimated to be up to 3 million m^3. The capital dredge areas are shown on Figure 3.1 in Chapter 3.

Due to the nature of the material to be dredged, the berth pockets are likely to be dredged by a cutter suction dredger and the main navigation channel is anticipated to be dredged by a trailer suction hopper dredger (TSHD).

The capital dredge will result in the loss of 1.34 ha of lower elevation intertidal habitat as a direct result of deepening the berth pockets (i.e. it will permanently change to subtidal habitat). This has already been assessed above. In addition, the dredging will cause changes to approximately 3.16 ha of subtidal habitat as a direct result of the physical removal of subtidal sediment. These habitat changes are assessed in this section.

Following the capital dredge, the dredge pockets will provide a similar habitat to that occurring under pre-dredge conditions which would then be expected to be recolonised by a similar assemblage to baseline conditions.

Recolonisation of the benthic habitat is expected to occur over a relatively short period of time based on an understanding of the benthic community present in the area and the life history strategies of the species. The project-specific subtidal survey (Section 8.6.2 and Appendix 8.1) recorded an impoverished benthic community characterised by low numbers of the polychaete *Nephtys* sp. (particularly *Nephtys hombergii),* oligochaete *Tubificoides benedii*, nematodes and juvenile blue mussel *Mytilus edulis*. These characterising species dominated the assemblage and contributed almost entirely to the total abundances of organisms recorded at most of the sites. Other species recorded included the bivalve *Limecola balthica* and polychaete *Eteone longa*. These species are typically fast growing and/or have rapid reproductive rates which allow populations to fully re-establish in typically less than 1 to 2 years and for some species within a few months (De-Bastos, 2016b; Tillin and Mainwaring, 2016; Tillin and Ashley, 2018). The benthic communities would, therefore, be expected to recolonise the dredge footprint relatively quickly. All the species recorded are also considered commonly occurring and not protected, with the faunal assemblage recorded also considered characteristic of subtidal habitats found more widely in this section of the Dee Estuary (GoBe Consultants Ltd., 2011; ERM, 2009).

Based on the evidence provided above in the scientific review and applying the project impact assessment methodology, the magnitude of the change to the subtidal habitats and associated benthic species is considered to be small. Therefore, while the probability of occurrence is high, the overall exposure is assessed as low for subtidal habitats. The sensitivity subtidal habitats to seabed disturbance within the dredge footprint is considered to be low given the high recoverability rates. Vulnerability is, therefore, assessed as low. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites although it is noted that subtidal habitats form a component of the ‘Estuaries’ feature of the SAC. Importance is, therefore, considered to be low. Overall, the potential effect is assessed as **insignificant** for subtidal habitats.

Changes to habitats and species as a result of sediment deposition during dredging and dredge disposal

General scientific context

Sediments suspended and dispersed dredging has the potential to resettle over the seabed. This potential blanketing or smothering of benthic species may cause stress, reduced rates of growth or reproduction and in the worst cases the effects may be fatal (Pineda *et al.,* 2017; Bolam *et al*., 2016).

Habitats within estuarine and coastal environments experience highly fluctuating conditions including the resuspension and deposition of sediments on a daily basis (through tidal action), lunar cycles (due to the differing influences of spring and neap tides) and on a seasonal basis (due to storm activity and conditions of extreme waves). Subtidal and intertidal habitats are, therefore, characterised by such perturbations and the biological communities of these environments are well adapted to survival under fluctuating conditions.

If the amount of sediment deposited is too great to allow species to survive burial, then recovery occurs via re-colonisation and/or migration to the new sediment surface (Bolam *et al.,* 2006a; 2006b). In general, the rate of recovery is dependent upon just how stable and diverse the assemblage was in the first place. A regularly disturbed sedimentary habitat with a low diversity benthic assemblage is likely to recover more quickly (i.e. return to its disturbed or 'environmentally-stressed' baseline condition) than a stable habitat with a pre-existing mature and diverse assemblage. A study by Bolam *et al.* (2004), for instance, concluded that the relatively rapid recovery observed at a location on the Crouch Estuary was due to the opportunistic nature of the invertebrate assemblages and the dispersive behaviour of the dominant species that were present before the material was deposited. Furthermore, in cases where the quantity and type of sediment deposited does not differ greatly from natural sedimentation, e.g. of similar particle size, the effects are likely to be relatively small as many of the species are capable of migrating up through the deposited sediments (Budd, 2004).

The Marine Evidence based Sensitivity Assessment (MarESA) approach (Tyler-Walters *et al.,* 2018) found that benthic communities in both sandy and muddy estuarine sediments are typically considered to be tolerant to the deposition of up to 5 cm of fine material in a single event with burrowing species considered able to relocate to preferred depths through this level of deposition. Deposition of greater depths of fine sediment could result in some mortality although evidence suggests that some characterising species are likely to be able to reposition. Bivalve and polychaete species have been reported to migrate through depositions of sediment greater than 30 cm (De-Bastos, 2016a; De-Bastos, 2016b; Ashley, 2016; Tillin, 2016). A previous review by the University of Hull also concluded that benthic invertebrates in sediments are able to adapt and readjust if sediment laid is placed as thin veneers over several days although they can also tolerate moderate amounts (20 cm) of material being deposited at one time (IECS, 2001).

Project impact assessment: Capital dredging

Sediment changes that are predicted to occur as a result of the capital dredging are considered in more detail in the physical processes assessment (Chapter 6). In summary, increased sedimentation above 10 mm is predicted within around 500 m, mainly across the proposed reclamation area, with sedimentation reducing to 1-2 mm off the end of the existing breakwater. Outside of these areas, the majority of deposition levels across the study area are less than 1 mm. Once on the bed, the deposited material returns to the background system to be put back into suspension on subsequent peak flood or ebb tides to be further dispersed.

The majority of habitat located in close proximity to the proposed dredge footprint on Salisbury Bank (adjacent to the Port of Mostyn) consists of tide-swept sandflat habitat which consists of a clean sand substratum with a relatively species poor, macrofaunal community comprising low numbers of mobile crustaceans (such as *Bathyporeia pilosa* and *Eurydice pulchra*) and polychaetes (such as *Nephtys* spp.). Mudflat habitat in the local area is characterised by typical mud dwelling species such as the bivalves (peppery furrow shell *Scrobicularia plana*, common cockle *Cerastoderma edule*, Baltic tellin *Limecola balthica*), polychaetes (such as *Hediste diversicolor)*, mud snail *Peringia ulvae,* mud shrimp *Corophium volutator,* and the oligochaete *Tubificoides* spp. (Section 8.6.2).

These burrowing infaunal species are considered tolerant to some sediment deposition. The predicted millimetric changes in deposition are, therefore, considered unlikely to cause smothering effects as described in the scientific review above. In addition, the species recorded in the benthic invertebrate surveys are fast growing and/or have rapid reproductive rates which allow populations to typically rapidly recolonise disturbed habitats, many within a few months following the disturbance events (Ashley and Budd, 2020; Ashley, 2016; Tillin, 2018).

It should also be noted that the subtidal channel habitats and adjacent intertidal habitats in the area of the proposed capital dredging are already subject to high levels of deposition naturally. This is as a result of high background suspended sediment concentrations and strong hydrodynamic conditions (due to tidal flows and the exposed nature of in the Dee Estuary) causing the resuspension and deposition of sediments on a daily basis and the regular movement of morphological features such as sand waves which are often dynamic in nature (ABPmer, 2017; ABPmer, 2021).

Deposition of sediment as a result of dredging will be highly localised and similar to background variability. Magnitude of change is, therefore, assessed as negligible. Probability of occurrence is high and, thus, the overall exposure to change is negligible. Based on the evidence provided above, sensitivity of intertidal and subtidal habitats within the vicinity of the proposed works to increased smothering is considered to be low given that these species are well adapted to survival under fluctuating sediment conditions and have high recoverability rates. Vulnerability is, therefore, assessed as none. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites, although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high. Taking all these considerations into account, the overall potential impact of deposition during dredging on benthic features is assessed as **insignificant**.

Project impact assessment: Dredge disposal

The capital dredge material that is proposed to be disposed of and/or reused is as follows:

- Up to 600,000 m^3 to be pumped directly ashore into the reclamation area to be reused as fill; and
- Up to 3 million m^3 to be transported and disposed of at the existing Mostyn Deep disposal site (IS102).

An assessment of the sediment changes that are predicted to occur as a result of the capital dredging is presented in more detail in the physical processes assessment (Chapter 6). In summary, peak sedimentation depths within the disposal site are predicted around 50-60 mm, reducing to around 4-6 mm within a distance of approximately 1 km from the disposal site.

The existing Mostyn Deep disposal site (IS102) is located in an area that is subject to regular natural physical disturbance (and associated scouring) as a result of very strong tidal flows. The current use of the disposal site will also cause some disturbance due to sediment deposition. The Port of Mostyn is currently able to deposit up to a maximum of 900,000 tonnes (approximately 600,000 m^3) of material per annum at Mostyn Deep (IS102) under its existing capital and maintenance dredge disposal licence for the main navigation channel (DML1542v2). Since the renewed maintenance dredge and disposal licence was granted in December 2019, the total disposal quantity has been approximately 100,000 m^3 and the annual average disposal quantity has been around 50,000 m^3, indicating some spare capacity. The regular disturbance caused by natural processes, and to less of an extent by the intermittent disposal activity, is reflected in a generally impoverished assemblage in the vicinity of the disposal site.

The benthic species recorded in the area of the disposal site include mobile infauna (such as errant polychaetes e.g. *Nephtys* spp. and mobile crustaceans) which are able to burrow through sediment. They are, therefore, considered tolerant to some sediment deposition. In addition, characterising species typically have opportunistic life history strategies, with short life histories (typically two years or less), rapid maturation and the production of large numbers of small propagules which makes them capable of rapid recoverability should mortality as a result of smothering occur (Ashley and Budd, 2020; De-Bastos 2016b; Tillin, 2018; Ashley, 2016; Tyler-Walters and Garrard, 2019). On this basis, any effects are considered to be temporary and short term.

In summary, deposition in the wider area surrounding the disposal ground is expected to be in the order of millimetres based on the physical processes assessment (Chapter 6 of the ES). Sedimentation of this scale is unlikely to result in significant smothering effects to most faunal species with recoverability expected to be high.

The magnitude of the change during disposal is considered to be negligible in the context of background variability. Probability of occurrence is high and the overall exposure is, therefore, negligible. Given that habitats and species within and around the disposal site are well adapted to disturbed conditions with high recoverability rates, sensitivity is considered to be low and thus vulnerability is considered to be none. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high. The overall potential impact of deposition on benthic features is assessed as **insignificant**.

Changes in water and sediment quality during capital dredging and dredge disposal

General scientific context

Elevated suspended sediment concentrations

Dredging activities result in the suspension of disturbed sediment (Newell *et al.,* 1998). Macrofauna living in estuarine systems which are subject to naturally high levels of SSCs are considered well adapted to living in highly turbid conditions. An increased level of suspended sediments may result in an increase in food availability and therefore growth and reproduction for surface deposit feeders (such as certain polychaetes) within estuarine environments that rely on a supply of nutrients at the sediment surface. However, food availability would only increase if the additional suspended sediment contained a significant proportion of organic matter and the population would only be enhanced if food was previously limiting (De-Bastos, 2016b).

Greater energetic costs for benthic species could occur as a result of higher particle loads due to elevated suspended sediments stimulating the secretion of mucus to protect branchial or feeding structures of filter feeding organisms (Perry, 2016). Suspended sediment concentrations have been found to have a negative linear relationship with sub-surface light attenuation. Light availability and water turbidity are principal factors in determining depth range at which kelp and other algae are recorded. In addition, certain mobile epistrate feeders (such as the amphipod *Bathyporeia* spp.) feed on diatoms within the sand grains and an increase in suspended solids that consequently reduced light penetration could alter food supply (Tillin *et al.*, 2019). However, longer-term changes in turbidity levels rather than temporary elevations are likely to be required to elicit any measurable changes in these species.

Elevated suspended sediment levels can also cause increased scouring and damage of epifaunal species due to the potentially abrasive action of the suspended sediment in flowing water.

Increased suspended sediments may favour the development of suspension feeders such as bivalves over other species. However, it should be noted that many benthic invertebrates can switch feeding modes depending on environmental conditions. The negative effects of suspended sediment may be particularly important during larval settlement in spring, with settling stages potentially being more sensitive to effects such as scour. However, this is generally thought to be of less concern where fauna are adapted to naturally high levels of suspended sediments (Boyd *et al.*, 2004).

Dissolved oxygen

The resuspension of sediments containing organic material can cause oxygen depletion within the water column and the subsequent settling of this organic rich sediment can deplete sediment oxygen levels, potentially affecting benthic species. Reductions in dissolved oxygen from suspended sediments as a result of dredging are generally considered to be minimal and short-lived. However, potential effects can be more pronounced if dredging causes the disturbance of high levels of oxygen-depleting substances and nutrients present in some very fine-grained sediment deposits and where a great portion originate form waste water (Cefas, 2012).

Oxygen depletion in severe situations can lead to hypoxia with most research on the effects of reductions in dissolved oxygen on benthic fauna during hypoxic conditions. This occurs when oxygen is consumed (e.g. by decomposing organic matter, respiration and oxidation of reduced chemical species) faster than it is replenished (e.g. via air-water oxygen transfer, photosynthesis, and mixing) (Larsen *et al.*, 2019). Coastal and estuarine waters can be particularly susceptible to low oxygen conditions as sediments are organic-rich and impose high sediment oxygen demands. Highly stratified estuaries, in which surface and bottom waters do not mix, are more prone to hypoxia (Larsen *et al*., 2019). Coastal areas are more likely to experience hypoxia during summer when high temperatures strengthen salinity stratification (Levin *et al*., 2009). Severe anoxic events can deplete the benthic invertebrate communities and cause a shift in community composition, through attrition of intolerant species and elevated dominance, as well as reductions in body size (Tweedley *et al*., 2015). In general, crustaceans and echinoderms are typically more sensitive to hypoxia, with lower oxygen thresholds, than annelids, molluscs and cnidarians (Levin *et al*., 2009).

Release of contaminants

Benthic habitats and species are sensitive to toxic contamination (where concentrations of contaminants exceed sensitivity thresholds). Toxic contamination during construction can occur as a result of the release of synthetic contaminants such as fuels and oils or through the resuspension of sediment as a result of the disturbance of the seabed, which can lead to the release and mobilisation of sediment-bound contaminants into the water column. These include both toxic contaminants, such as heavy metals, pesticides and hydrocarbons, and non-toxic contaminants, such as nutrients. In particular, there is a risk that any uncontrolled releases of materials or sediments into the water column could make contaminants temporarily available for uptake by marine organisms. Over the longer-term any such releases could also become stored in the surface sediments of benthic habitats for future benthic uptake.

Suspension-feeding organisms may be particularly vulnerable to pollutants in the water column due to their dependence on filtration (Tillin *et al*., 2019). High levels of chemical contaminants can potentially cause genetic, reproductive and morphological disorders in marine species. Contaminants may also have combined effects. Studies have suggested links between contamination with polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl (PCBs), amines and metals and a range of disorders (MacDonald and Ingersoll, 2010). Increased incidence of tumours, neoplasia, DNA damage, polyploidy, hypoploidy, hermaphoditism and reduced immune response have all been reported in marine invertebrates in areas of high levels of pollution (Hannam *et al.,* 2010; Catalano *et al.,* 2012; Hesselman *et al.,* 1988; Nacci and Jackim, 1989; Gardner *et al.,* 1993; Schaeffer and Herricks, 1993; Barsiene, 1994). Another highly researched pollutant is Tributyltin (TBT), which has toxic effects in a wide variety of biota, whereas inorganic tin is less toxic. TBT effects include lethal toxicity and effects on growth, reproduction, physiology, and behaviour. Several of the negative effects are due to interferences with the endocrine function, as occurs in the phenomenon imposex. Imposex is the superimposition of male organs onto females of gastropods, which are normally a dioecious species (Borja *et al.,* 2012).

Sub-lethal effects of chemical contamination on marine invertebrates can reduce the fitness of individual species. Lethal effects may allow a shift in community composition to one dominated by pollution-tolerant species such as oligochaete worms (Elliott *et al.,* 1998). A reduction in community species richness is associated with elevated levels of pollutants. Contamination with PAHs, for example, leads to high levels of mortality in amphipod and shrimp species, and decreased benthic diversity (Long *et al.,* 1995). Similar reductions in diversity are linked with heavy metal contamination (Dauvin, 2008). Polychaete worms are thought to be quite tolerant of heavy metal contamination, whereas crustaceans and bivalves are considered to be intolerant (Rayment, 2002).

Project impact assessment: Capital dredging

Elevated suspended sediment concentrations

The changes in SSC that are predicted to occur as a result of the capital dredge are considered in more detail in the physical processes assessment (Chapter 6). In summary, increased SSC as a result of the dredge activity is generally predicted to be limited in extent to the dredge site itself. Across the proposed berth and reclamation area, excess SSC values of up to 500-700 mg/l are predicted, quickly dispersing to less than 20 mg/l within a distance of around 300 m of the dredge site. Increased concentrations arising from the dredge operations are of lower magnitude and persist over a shorter distance (and time) than that from the disposal (assessed below).

Naturally very high SSC typically occur year-round in the Dee Estuary, particularly during the winter months when storm events disturb the seabed and on spring tides (Uncles *et al.,* 2013; Cefas, 2016). The estuarine benthic communities recorded on mudflats and the shallow mud in the region are considered tolerant to this highly turbid environment (De-Bastos, 2016b; Tillin, 2016; Ashley, 2016). The predicted SSCs are within the range that can frequently occur naturally and also as a result of ongoing dredge and disposal activity (Physical Processes Chapter 6).

In summary, the predicted increases in SSC due to the capital dredging will be localised and temporary based on the outcomes of the physical processes assessment (Chapter 6). Magnitude of change is assessed as negligible. Probability of occurrence is high and thus the overall exposure to change is negligible. Based on the evidence provided above, sensitivity of benthic habitats and species within the vicinity of the proposed development to increases in suspended sediments are considered to be low given that these receptors are well adapted to living in high suspended sediment conditions. Vulnerability is therefore assessed as none. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites, although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high. The overall effect of suspended sediments on benthic habitats and species is assessed as **insignificant**.

Dissolved oxygen

With respect to dissolved oxygen, increases in SSC will be brief and localised and there is not expected to be a significant reduction in dissolved oxygen as assessed in the Water and Sediment Quality assessment in Chapter 7 of this ES. The probability of a localised effect is, therefore, medium to high but the magnitude of change is considered to be negligible, leading to a negligible exposure to change. On this basis the impact is assessed as **insignificant.**

Release of contaminants

The potential to impact the marine environment as a result of any sediment-bound contaminants arises primarily when the sediment that is released into the water column disperses and deposits elsewhere. However, it should be noted that the majority of material disturbed during capital dredging works involving the cutter suction dredger will be sucked and discharged directly to the reclamation area to be reused as fill via a floating pipeline. The TSHD uses suction to raise loosened material from the bed through a pipe connected to a centrifugal pump. Suction alone may not be sufficient to remove the sand and therefore, the dredger draghead is often used to help loosen these sediments. Only a small proportion of the disturbed material during either method of dredging is raised into suspension and remains in the water column (i.e. through abrasion pressure from the cutter or draghead).

Sampling and subsequent chemical analysis has been undertaken in accordance with the agreed NRW sample plan. The results of this analysis are summarised in more detail in the Water and Sediment Quality Chapter 7. The contaminants in the sediments of the proposed dredge area are at low concentrations. Concentrations were mostly below Cefas Action Level 1 (AL1), with a few marginal exceedances. There were no exceedances of Action level 2 (AL2) in any sediment samples analysed.

Based on existing available information, the overall level of contamination in the proposed dredge area is considered to be low with only a small proportion of disturbed material expected to be raised into suspension. This material will be rapidly dispersed by strong tidal currents in the area. Significant elevations of contamination in the water column are, therefore, not anticipated. Based on these factors, the magnitude of change to subtidal habitat and species is considered to be negligible. Subsequently, exposure of benthic habitats and species to potential contaminants is also assessed as negligible. The sensitivity of subtidal habitats and species to contaminants is assessed as low to moderate because, although contaminants can cause toxicity in intertidal and subtidal communities, the concentrations of contaminants required to produce both lethal and sub-lethal effects are generally high (although responses vary considerably between species). Thus, marine habitats and species are not considered to be vulnerable to water quality changes associated with the scale of the proposed dredge. Vulnerability is, therefore, assessed as none. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites although it is noted that subtidal habitats form a component of the ‘Estuaries’ feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high. The overall potential impact of contamination on benthic habitats and species is assessed as **insignificant.**

Project impact assessment: Dredged disposal

Elevated suspended sediment concentrations

The hydrodynamic and sediment regime changes that are predicted to occur as a result of the dredge disposal is considered in more detail in the Physical Processes assessment (Chapter 6). Peak excess SSC levels resulting from the disposal activities are greatest (above 2,000 mg/l) at the point of release, reducing to around 600-800 mg/l within a distance of around 500 m from the disposal location. As the plume disperses, the peak excess SSC values reduce further, typically reaching 100-200 mg/l within a distance of around 1 km from the edges of the Mostyn Deep disposal site. Overall, the resultant plume typically extends up to 3.5 km from the disposal site, aligned with the dominant northwest / southeast tidal flow axis.

In practice, due to the high magnitude of (and wide envelope of variability in) background SSC levels, the predicted increase in concentrations resulting from the disposal activities is likely to become immeasurable (against background) within approximately 1-2 km of the disposal site. Furthermore, the effects of the proposed dredge and disposal operations are considered to be no different to those arising from the ongoing maintenance dredge/disposal activities that are presently carried out within the existing berths and approach channel. The measurable plume from each disposal operation is only likely to persist for a single tidal cycle (less than 6 hours from disposal). After this time, the dispersion under the peak flood or ebb tidal flows means concentrations will have reverted to background levels.

Naturally very high SSC typically occur year-round in the Dee Estuary, particularly during the winter months when storm events disturb the seabed and on spring tides (Uncles *et al.*, 2013; Cefas, 2016). The estuarine benthic communities recorded on mudflats and the shallow mud in the region are considered tolerant to this highly turbid environment (De-Bastos, 2016b; Tillin, 2016; Ashley, 2016). The predicted SSCs are within the range that can frequently occur naturally and also as a result of ongoing dredge and disposal activity (Physical Processes Chapter 6).

The disposal of sediment will temporarily increase SSC, however, due to the strong hydrodynamic conditions in the area, these temporary elevations in SSC are expected to dissipate rapidly to background concentrations. The magnitude of change is therefore assessed as negligible. Probability of occurrence is high and thus the overall exposure to change is negligible. Sensitivity of benthic features within the disposal ground and surrounding area to increases in suspended sediments are considered to be low given that these species are well adapted to survival in conditions with elevated SSCs. Vulnerability is, therefore, assessed as none. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites, although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high. The overall effect of suspended sediments on benthic habitats and species is assessed as **insignificant**.

Dissolved oxygen

With respect to dissolved oxygen, increases in SSC will be brief and localised and there is not expected to be a significant reduction in dissolved oxygen as assessed in the Water and Sediment Quality assessment in Chapter 8 of this ES. The probability of a localised effect is, therefore, medium to high but the magnitude of change is considered to be negligible, leading to a negligible exposure to change. On this basis the impact is assessed as **insignificant.**

Release of contaminants

The results of the sediment contamination sampling are summarised above and the Water and Sediment Quality chapter (Chapter 7). In summary, low levels of contamination were found in the samples and there is no reason to believe the sediment will be unsuitable for disposal in the marine environment.

During disposal, sediment will be rapidly dispersed in the water column. Therefore, the already low levels of contaminants in the dredged sediments will be dispersed further. The probability of changes in water quality occurring at the disposal site is considered to be low and the overall exposure to change is considered to be negligible. The sensitivity of subtidal habitats and species to contaminants is assessed as low to moderate because, although contaminants can cause toxicity in subtidal communities, the concentrations of contaminants required to produce both lethal and sub-lethal effects are generally high (although responses vary considerably between species). Thus, subtidal habitats and species are not considered to be vulnerable to water quality changes at the disposal site in the context of the disposal of the dredged arisings. Vulnerability is, therefore, assessed as none. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites, although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high. The overall effect of suspended sediments on benthic habitats and species is assessed as **insignificant**.

Underwater noise and vibration disturbance during construction

General scientific context

Marine invertebrates lack a gas-filled bladder and are thus unable to detect the pressure changes associated with sound waves (Carrol *et al*., 2017). However, all cephalopods as well as some bivalves, echinoderms, and crustaceans have a sac-like structure called a statocyst which includes a mineralised mass (statolith) and associated sensory hairs. Statocysts develop during the larval stage and may allow an organism to detect the particle motion associated with soundwaves in water to orient itself. In addition to statocysts, cephalopods have epidermal hair cells which help them to detect particle motion in their immediate vicinity, comparable to lateral lines in fish. Similarly, decapods have sensory setae on their body, including on their antennae which may be used to detect low-frequency vibrations. Whole body vibrations due to particle motion have been detected in cuttlefish and scallops, although species names and details of associated behavioural responses are not specified.

Scientific understanding of the potential effects of underwater noise on marine invertebrates is relatively underdeveloped (Hawkins *et al*., 2015). There is limited research to suggest that exposure to near-field low-frequency sound may cause anatomical damage (Carrol *et al*., 2017). Anecdotal evidence indicates there was pronounced statocyst and organ damage in seven stranded giant squid after nearby seismic surveys Guerra *et al*. Airgun exposure can cause damaged statocysts in rock lobsters up to a year later (Day *et al*., 2016). However, no such effects were detected in other studies (Christian *et al*., 2003). The disparate results between studies seem to be due to differences in sound exposure levels and duration, in some cases due to tank interference, although taxa-specific differences in physical vulnerability to acoustic stress cannot be discounted (Carrol *et al*., 2017).

There is also increasing evidence to suggest that benthic invertebrates behaviourally respond to particle motion (vibration) (Roberts *et al*., 2016). For example, blue mussels Mytilus edulis vary valve gape, oxygen demand and clearance rates (Spiga *et al*., 2016) and hermit crabs *Paganus bernhardus* shift their shell and at very high amplitudes, leave their shell, examine it and then return (Roberts *et al*., 2016). The vibration levels at which these responses were observed generally correspond to levels measured near anthropogenic operations such as pile driving and up to 300 m from explosives testing (blasting). A range of behavioural effects have also been recorded in decapod crustaceans, including a change in locomotion activity, reduction in antipredator behaviour and change in foraging habits (Tidau and Briffa, 2016). However, population level and mortality effects are considered unlikely.

Project impact assessment: Quayside works

Based on the evidence provided in the above scientific context review of the potential effects of underwater noise, population level and mortality effects in benthic invertebrates are considered unlikely. The proposed development will involve the installation of approximately 200 steel tubular piles, which are estimated to be a maximum of 2 m diameter in size. The overall piling operation is anticipated to take place over a period of approximately 12 months. The maximum impact piling scenario for the piles that need to be impact driven is for 2 tubular piles to be installed each day, involving approximately 240 minutes of impact piling per day (i.e. 17 % of impact piling).

Applying the project impact assessment methodology, the probability of a change in underwater noise and vibration occurring during piling is considered to be high. However, the piling activities will be temporary and relatively short term. Based on these factors, magnitude of the change in underwater noise and vibration due to piling is considered to be small and exposure to change is assessed as low. Population level and mortality effects in benthic invertebrates are considered unlikely and the piling may result in some short term and very localised behavioural responses in some individuals. The sensitivity of the benthic invertebrate species to piling is, therefore, considered to be low. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites, although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high. On this basis, the impact of piling noise and vibration on benthic invertebrates is assessed as **insignificant to minor adverse**.

Project impact assessment: Capital dredging and disposal

Based on the above review of the potential effects of underwater noise, population level and mortality effects in benthic invertebrates are considered unlikely. Furthermore, dredging is known to produce lower noise levels than piling or blasting, and, therefore, there is unlikely to be significant effects on benthic invertebrates.

Based on the evidence provided above in the scientific review and applying the project impact assessment methodology, the probability of a change in underwater noise and vibration occurring during dredging and disposal is considered to be high. However, dredging and the movement of vessels associated with disposal activities are known to produce lower noise levels than piling. Furthermore, the proposed capital dredge and disposal activities will be temporary, intermittent and only present for short periods in any one dredge location. Population level and mortality effects, and also behavioural responses, are considered unlikely. Based on these factors, the magnitude of the change in underwater noise and vibration due to dredging and disposal is considered to be negligible and the exposure to change is negligible. The sensitivity of benthic invertebrate species to dredging and disposal noise is considered to be negligible and, as described earlier, their overall importance is considered to range from low to high. On this basis, the impact of dredging and disposal noise and vibration on benthic invertebrates is assessed as **insignificant**.

Introduction and spread of non-native species

General scientific context

Non-native, or invasive, species are described as 'organisms introduced into places outside of their natural range of distribution, where they become established and disperse, generating a negative impact on the local ecosystem and species' (International Union for Conservation of Nature (IUCN, 2011). The ecological impacts of such 'biological invasions' are considered to be the second largest threat to biodiversity worldwide, after habitat loss and destruction. In the last few decades marine and freshwater systems have been impacted by invasive species, largely as a result of increased global shipping (Carlton and Geller, 1993).

The introduction and spread of non-native species can occur either accidentally or by intentional movement of species as a consequence of human activity (Ruiz and Carlton, 2003 cited in Pearce *et al.,* 2012). The main pathway for the potential introduction of non-native species is via fouling of vessels' hulls, transport of species in ballast or bilge water and the accidental imports from materials brought into the system during development activities. Pathways involving vessel movements (fouling of hulls and ballast water) have been identified as the highest potential risk routes for the introduction of non-native species (Carlton, 1992; Pearce *et al.,* 2012), particularly from different biogeographical regions, which agrees with the fact that areas with a high volume of shipping traffic are hotspots for non-native species in British waters (Pearce *et al.,* 2012).

The fouling of a vessel hull and other below-water surfaces can be reduced through the use of protective coatings. These coatings usually contain a toxic chemical (such as copper) or an irritant (such as pepper) that discourages organisms from attaching. Other coatings, such as those that are silicone-based, provide a surface that is more difficult to adhere to firmly, making cleaning of the hull less laborious. The type and concentration of coatings that can be applied to a boat hull is regulated and can vary between countries. Maintenance of hulls through regular cleaning will minimise the number of fouling organisms present. Hull cleaning can take place on land or in-water. In both cases, care needs to be taken to prevent the organisms and coating particles from being released into the water. By following best management practices, the impact of the cleaning procedure on the environment can be minimised.

Non-native invasive species also have the potential to be transported via ship ballast water. Seawater may be drawn into tanks when the ship is not carrying cargo, for stability, and expelled when it is no longer required. This provides a vector whereby organisms may be transported long distances. In 2004 the International Maritime Organisation (IMO) adopted the 'International Convention for the Control and Management of Ships' Ballast Water and Sediments', which introduced two performance standards seeking to limit the risk of non-native invasive species being imported (including distances for ballast water exchange and standards for ballast water treatment). The Convention came into force internationally in September 2017.

The UK is bound by international agreements such as the Convention on Biological Diversity, the United Nations Convention on the Law of the Sea, the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979), the Convention on the Conservation of European Wildlife and Natural Habitat (Berne Convention 1979) and the Habitats and Birds Directives. All of these include provisions requiring measures to prevent the introduction of, or control of, non-native species, especially those that threaten native or protected species (JNCC, 2004). Additionally, Section 14(1) of the Wildlife and Countryside Act (WCA) (1981) makes it illegal to release, or allow to escape into the wild, any animal which is not ordinarily resident in Great Britain and is not a regular visitor to Great Britain in a wild state, or is listed in Schedule 9 to the Act.

Project impact assessment

As discussed above, non-native species have the potential to be transported into the study area on ships' hulls during capital dredging and construction activity (such as any jack up barges used in piling). Non-native invasive species also have the potential to be transported via ship ballast water. Seawater may be drawn into the dredger tanks or hopper when the ship is not carrying cargo, for stability, and expelled when it is no longer required. This provides a vector whereby organisms may be transported long distances.

The vessels to be used for the construction of the proposed development will in the main originate from the UK and Europe. Vessels operating in the Dee Estuary are advised against discharging water ballast in order to avoid causing an impact on the marine environment and to minimise the risk of transferring non-native species in ship's ballast water and sediments. The ballast water management advice given to vessels by Port of Mostyn is in compliance with the IMO International Convention for the Control and Management of Ship's Ballast Water and Sediments, 2004. Vessels are required to maintain a ballast water management plan and a ballast water record book for inspection by the Harbour Authority and flag state. Further details are provided in the Commercial and Recreational Navigation Chapter 10. The Port of Mostyn also has a biosecurity plan which applies to any visiting vessel.

Within England and Wales, best practice guidance has been developed on how to manage marine biosecurity risks at sites and when undertaking activities through the preparation and implementation of biosecurity plans (Cook *et al.,* 2014). This guidance will be followed when developing biosecurity control measures to minimise the risk of the introduction and spread of non-native species during construction. These measures will be included within the Construction Environmental Management Plan (CEMP) (see Project Methodology Chapter 3). On this basis, the probability of the introduction and spread of non-native species from the construction phase is considered to be low. However, given that the magnitude of change is unknown, magnitude ranges from negligible to large depending upon the scale and nature of any non-native species introduction, thus the exposure ranges from negligible to low at worst. The sensitivity of all intertidal and subtidal receptors to non-native species introductions is expected to range from low to moderate. Vulnerability is, therefore, considered to be none to low. In addition, importance is considered to range from low to high depending on the conservation concern, rarity, structure/form and function of the habitat. The overall impact is, therefore, considered to be **insignificant to minor adverse.**

Fish and shellfish

This section assesses the potential for impacts on fish and shellfish receptors as a result of the proposed development during construction. The following impact pathways have been assessed:

- Direct loss or changes to fish and shellfish populations and habitat;
- Changes in water and sediment quality during capital dredging and dredge disposal; and
- Underwater noise and vibration disturbance during construction.

Direct loss or changes to fish and shellfish populations and habitat

General scientific context

Indirect effects (food chain)

Seabed sediment removal during dredging has the potential to directly impact demersal fish but, more importantly, could also impact upon the benthic communities that are prey for fish and shellfish, and consequently could alter the distribution and presence of fish species in the region. Fish can have different feeding strategies, for example, some demersal feeders such as cod can show a strong preference for crustacea (Pearce, 2008), whereas species such as plaice, dover sole, lemon sole and dab are benthic invertebrate feeders with a strong preference for polychaetes. Other species such as sandeel and whiting are invertebrate and piscivorous feeders. However, a change in dietary composition as a result of dredging may not be damaging to the fish population as the majority of species are likely to switch to alternate prey sources in the event of an impact on their preferred prey, providing sufficient biomass is available to support them (Pearce, 2008).

Indirect effects (habitat change)

Should the removal of seabed sediments during dredging lead to habitat loss, it could potentially impact on critical habitats including spawning, nursery and overwintering grounds that have an important ecological function. Fish species that spawn directly onto the seabed are more sensitive to the effects of seabed removal than those that spawn into the water column. For example, Herring use coarse sediments as spawning grounds. Herring along with sandeel species which live within the sediment are considered particularly sensitive to habitat change (Tillin *et al.,* 2011).

The loss or alteration of habitat may also affect shellfish species. Shellfish species generally show a preference for a particular habitat e.g. coarser, gravelly sediments appear to be preferred by brooding female brown crabs in which they partially bury and over-winter in a dormant state (Eaton *et al*., 2003). Research shows that under the path of the draghead there is a 30-70 % reduction in benthic species diversity, a 40-95 % reduction in the number of individuals and a similar reduction in biomass of benthic communities (Newell *et al*., 1998). Recovery of many benthic invertebrate populations including shellfish species will depend on new juvenile recruits settling at the location in the form of larvae rather than the migration of adults.

Direct effects (uptake)

Hydraulic entrainment, through the direct uptake of aquatic organisms by the suction field generated at the draghead or cutterhead during dredging operations has the potential to result in the by-catch of fish eggs, larvae and even mobile juveniles and adults (Wenger *et al*., 2017).

Limited research has been carried out regarding entrainment rates of fish in marine dredging. Lees *et al*. (1992) sampled the outwash from an aggregate dredger in the English Channel and recorded the species. In five x 10 minute samples, 22 fish were sampled and a further red gurnard was found from the surface of the hopper cargo. Most fish appeared physically undamaged and would have been washed back to sea, however the scope of the study did not include assessments of their subsequent survival rates. Demersal fish with poorer hearing sensitivity including flatfish and elasmobranchs are considered more likely to be entrained by the dredger drag head (Reine and Clarke, 1998; Stelzenmuller *et al*., 2010). Large and active demersal and pelagic juvenile and adult finfish are likely to avoid dredging areas during operations in response to noise levels and increased turbidity (Tillin *et al*., 2011).

In general, eggs, embryo and larval stages are considered more vulnerable to entrainment than adults. While the entrainment rates are likely to represent a small proportion of total larval production, fish entrained at the egg, embryo and larval stages will experience extremely high mortality rates although mortality rates will vary among fish species and development stages (Wenger *et al*., 2017).

Few infaunal benthic invertebrates (including shellfish species) are able to escape entrainment (Newell *et al*., 1998). Some individuals may survive entrainment and be returned to the sea in the outwash or during screening although heavily shelled shellfish species such as bivalves, snails and crabs are more likely to be retained within the hopper and therefore would be lost with the cargo (Tillin *et al.,* 2011).

Project impact assessment: Quayside works and capital dredge

There is the potential for impacts to fish as a result of habitat loss due to the footprint of the proposed development. Dredging by cutter suction dredger and TSHD has the potential to result in the direct uptake of fish and fish eggs by the action of the suction pump (entrainment). Capital dredging also has the potential to result in seabed disturbance and smothering of seabed habitats and species. These changes have the potential to impact on fish species through potential changes in prey resources and the quality of foraging, nursery and spawning habitats.

Potential prey items for flatfish and demersal fish such as the mud shrimp *Corophium volutator* and polychaete worms (Ashley and Budd, 2020) were recorded during the project specific intertidal and subtidal surveys (Appendix 8.1 of the ES). However, the sedimentary habitats in the dredge footprint and area of the reclamation were generally impoverished with low abundances of these prey items recorded. Furthermore, most fish species are opportunistic and generalist feeders, which means that they are generally not reliant on a single prey item. Fish are also mobile species and will easily be able to move away from the zone of influence and utilise other nearby areas for foraging. Furthermore, the area of habitat loss and change only represents a small proportion of the foraging ranges of many fish species (particularly the larger and more commercial species such as whiting, plaice and Dover sole).

During dredging, there is the potential for fish along with roe (eggs) of these species to be removed. The region is known to support whiting, sandeel, plaice and sole spawning grounds. However, the dredge footprint and nearby area is already subject to regular natural seabed disturbance due to strong tidal currents and also seabed disturbance as a result of existing vessel movements and ongoing maintenance dredging. The dredge footprint and nearby area is, therefore, likely to provide disturbed and sub-optimal spawning conditions with more optimal habitat present in the wider region. In addition, both the dredge footprint and reclamation area are considered negligible in the context of suitable nursery habitat in the region.

The nearest cockle beds to the Port of Mostyn is New Bed and Salisbury located approximately 400 m and 700 m away respectively (Image 8.1, Section 8.6.3). Commercially exploited mussel beds are located at West Kirby and Thurstaston which are over 5 km away (Section 8.6.3). There is, therefore, considered to be no direct overlap of the capital dredge footprint with commercial shellfish beds. In addition, deposition levels on intertidal habitats at these distances are expected to be within the range of natural variability (see sub-section above 'Changes to habitats and species as a result of sediment deposition during dredging and dredge disposal'). On this basis, potential effects due to habitat loss or change on commercially exploited shellfish beds are anticipated to be negligible.

Based on these factors, magnitude is considered to be small and probability medium. Consequently, the exposure of all fish and shellfish to direct habitat changes is considered to be negligible to low. The sensitivity of fish and shellfish to habitat change on the scale predicted is considered to be low, leading to a low vulnerability. Therefore, while the overall importance of certain fish and shellfish species is high (i.e. for fish species of conservation interest), the impact is assessed as **insignificant to minor adverse**.

Project impact assessment: Dredge disposal

The disposal of dredged material at the existing Mostyn Deep disposal site (IS102) will result in the deposition of sediments which has the potential to cause physical disturbance and smothering of seabed habitats.

As described above in sub-section 'Benthic Habitats and Species', the disposal ground is located in a highly dynamic area subject to regular natural physical disturbance (and associated scouring) as a result of very strong tidal flows and deposition due to regular existing maintenance dredge disposal activity. This is reflected in an impoverished benthic assemblage (characterised by a few opportunistic species in very low numbers). This area is, therefore, likely to provide limited prey resources for fish species. In addition, benthic infaunal species characterising the disposal site are considered likely to show some tolerance to sediment deposition and also rapid recoverability rates. On this basis, potential effects on prey resources for fish are expected to be of low magnitude and temporary.

Furthermore, fish are mobile species and will easily be able to move away from the zone of influence and return following the cessation of disposal activity. The highly disturbed nature of the seabed is also unlikely to provide suitable conditions as a spawning or nursery area for fish.

Based on these factors, magnitude is considered to be small and probability medium. Consequently, the exposure of all fish to direct habitat changes is considered to be negligible to low. The sensitivity of fish to habitat change on the scale predicted is considered to be low, leading to a low vulnerability. Therefore, while the overall importance of certain fish species is high (i.e. for fish species of conservation interest), the impact is assessed as **insignificant to minor adverse**.

Changes in water and sediment quality during capital dredging and dredge disposal

General scientific context

Elevated suspended sediment concentrations

Increased suspended sediments can lead to physiological effects in adult finfish resulting from the abrasion of sediment particles on gill tissues, causing reduced gill function and possible mortality (Wenger *et al.*, 2017; Kjelland *et al.,* 2015). Such effects on fish are considered to occur at suspended sediment levels of around 10,000 mg/l (Britwell, 2000). High SSC levels may impact spawning and nursery grounds through damage to eggs and planktonic larvae, as well as causing abrasion or clogging of the fragile gills of larval and juvenile fish, resulting in mortality or reduced growth rates.

Because turbidity often impairs visual acuity, activities and processes that require vision can be inhibited, leading to behavioural responses. For example, foraging in both planktivorous and piscivorous fish can be negatively affected by suspended sediments. Piscivores are especially sensitive to increasing turbidity because many are visual hunters that detect prey from a distance. An increase in suspended sediment reduces both light and contrast, decreasing encounter distances between predator and prey (Wenger *et al.*, 2017).

Elevated suspended sediments can also influence the movements and migrations of fish. For example, a range of salmonid species have been observed actively avoiding moving through areas with suspended sediment plumes (Wenger *et al.*, 2017; Kjelland *et al.,* 2015). However, such responses can cease if fish become acclimatised. Fish in high latitude coastal areas typically have to contend with variable turbidity and often poor visual conditions, resulting from fluctuations in ambient light levels, suspended sediments and in the light transmission properties of the water. For example, concentrations as high as 9,000 mg/l have been recorded in the path of salmon runs in the Usk Estuary (Alabaster, 1993). Similarly, lamprey and shad species have been known to successfully pass through estuaries with extremely high suspended sediments and, therefore, can be considered tolerant of turbid conditions (Scottish Government, 2010). The mobile nature of fish species generally allows avoidance of areas of adverse conditions which are unlikely to significantly affect a population provided such conditions are temporary.

A decrease in turbidity and hence increased light penetration may result in increased phytoplankton production and hence increased food availability for shellfish suspension feeders, including cockles *Cerastoderma edule*. Therefore, reduced turbidity may be beneficial. In areas of high suspended sediment, a decrease may result in improved condition and recruitment due to a reduction in the clogging of filtration apparatus of suspension feeders and an increase in the relative proportion of organic particulates. However, a decrease in suspended organic particles in some areas may reduce food availability for deposit feeders resulting in lower growth or reduced energy for reproduction. Lethal effects are considered unlikely given the occurrence of *Cerastoderma edule* and clams in estuaries where turbidity is frequently high from suspended organic and inorganic matte (Tillin and Tyler-Walters, 2016).

Evidence suggests that *Mytilus edulis* beds can tolerate a broad range of suspended solids and occur on sediments in sheltered coast (where turbulent water flow over the mussel beds could resuspend sediments locally) and in turbid bays and estuaries (Tillin *et al.*, 2022).

Organic enrichment and oxygen depletion

The resuspension of sediments containing organic material can cause oxygen depletion within the water column. The subsequent settling of this organic rich sediment can deplete the sediments of oxygen and affect shellfish and benthic prey items used by fish. The response of fish to low concentrations of dissolved oxygen is determined by a range of factors, including the duration of exposure, water temperature and the presence of other pollutants (Wenger *et al.*, 2017). The duration of any low dissolved oxygen event is a key factor in determining its effect. Most fish would survive an extremely low concentration of dissolved oxygen, such as 2 mg/l, for a few minutes, but a longer exposure would start to have sub-lethal and eventually lethal effects (ABP Research, 2000).

Release of contaminants

The potential release of contaminants during construction and dredging activities may result in those contaminants becoming available for uptake by any fish and/or shellfish in the water column or on surface sediments. There is an indirect risk to some finfish species as sediment-bound contaminants may temporarily bioaccumulate in the tissues of certain fish prey, such as polychaete worms and marine bivalves, and made available for uptake by feeding fish.

The influence of contaminated sediments is considered to have a greater impact on fish than elevated SSC with a range of evidence suggesting that direct exposure to contaminants negatively effects fish (Wenger *et al.*, 2017). Hydrophobic contaminants (such as legacy persistent organic pollutants including PCBs and organochlorine pesticides) as well as high-molecular weight polyaromatic and aliphatic hydrocarbons (such as PAHs), are closely associated with organic material in sediments. These contaminants have been linked to a range of potential reproductive impacts on adult fish (e.g. steroidogenesis, vitellogenesis, gamete production or spawning success) as well as lethal and non-lethal developmental (spinal and organ development, growth) impacts on embryos and larvae (Johnson *et al.,* 2014).

Demersal fish species, such as dab and flounder, which remain close to the seabed and feed mainly on benthic organisms, would experience a higher exposure to contaminated sediments than pelagic fish such as herring.

Project impact assessment: Capital dredge

The changes in SSC that are predicted to occur as a result of the capital dredge are considered in more detail in the physical processes assessment (Chapter 6) and summarised above in the sub-section ‘Benthic habitats and species’.

As noted in the preceding section, fish within the Dee Estuary are well adapted to living in an area with variable and typically very high suspended sediment loads. Fish feed on a range of food items and, therefore, their sensitivity to a temporary change in the availability of a particular food resource is considered to be low. Their high mobility enables them to move freely to avoid areas of adverse conditions and to use other food sources in the local area.

As highlighted above, salmonids and other migratory fish can be sensitive to elevated suspended sediment concentrations. However, Atlantic salmon and sea trout are both known to migrate through estuaries with high SSCs to get to spawning areas (including the Dee Estuary which is considered one of the estuaries in the UK with particularly high levels of SSCs) (Salmon and Trout Conservation, 2017; Wenger *et al*., 2017; Kjelland *et al*., 2015; Uncles *et al.,* 2013; Cefas, 2016). Other migratory species such as lamprey and shad species also pass through estuaries with high suspended sediments. Elevated SSCs due to dredging are considered to be of a magnitude that can occur naturally or as a result of ongoing maintenance dredging/disposal.

Sediment plumes resulting from dredging will be relatively localised (in the context of the entire width of the Dee Estuary) and are also considered to dissipate relatively rapidly and be immeasurable against background levels within a relatively short duration of time (less than a single tidal cycle) as described in more detail in the physical processes assessment (Chapter 6). Therefore, salmonids and other migratory fish would also be able to avoid the temporary sediment plumes. Based on these factors, there is considered limited potential for migrating fish to be adversely affected by the predicted changes in SSC.

Given that elevated SSCs due to dredging are considered to be in the range of variability that can occur naturally in the Dee Estuary (which has very high SSCs year-round, particularly during the winter months), as well as due to ongoing maintenance dredging/disposal, and that the plumes will be temporary in nature, sensitive life stages of fish occurring in the region such as larvae and juvenile fish are considered unlikely to be adversely affected by the dredging.

With respect to shellfish, cockles and mussels are considered well adapted to estuarine conditions where turbidity is very high, including in the Dee Estuary (Tillin and Tyler-Walters, 2016; Tillin *et al*., 2022) and sediment plumes are predicted to be temporary and immeasurable against background conditions at the distance of the nearest shellfish bed, the 'New Bed' cockle bed, which is located approximately 400 m away (Image 8.1).

Therefore, while the probability of a localised and temporary change is high, magnitude of change will be negligible and consequently exposure to change is assessed as negligible. Sensitivity of fish and shellfish is assessed as low to moderate and consequently vulnerability is assessed as none. Therefore, while the overall importance of certain fish and shellfish species is high (i.e. for fish species of conservation interest), the impact is assessed as **insignificant**.

With respect to dissolved oxygen, increases in SSC will be brief and localised and there is not expected to be a significant reduction in dissolved oxygen as assessed in the Water and Sediment Quality Chapter 7. The probability of a localised effect is, therefore, medium to high but the magnitude of change is considered to be negligible, leading to a negligible exposure to change. Whilst the sensitivity of fish and shellfish is considered to be low to moderate and certain species have a high nature conservation importance, the impact is assessed as **insignificant.**

With respect to sediment contamination, low levels of contamination were found in the sediment contamination samples as presented in the Water and Sediment Quality Chapter 7. Based on this sampling data, the overall level of contamination in the proposed dredge area is considered to be low, and the sediment plume would be expected to rapidly dissipate by the strong tidal currents in the area. Significant elevations in the concentrations of contaminants within the water column are, therefore, not anticipated. Based on these factors, the magnitude of change to fish and shellfish species is considered to be negligible. Subsequently, exposure of fish and shellfish species to potential contaminants is assessed as negligible. Given that the sensitivity of fish and shellfish is considered to be low to moderate and the overall importance is considered to range from low to high, depending on the ecological value and protected status of individual species, the impact is assessed as **insignificant.**

Project impact assessment: Dredge disposal

The changes in SSC that are predicted to occur as a result of the disposal activities are considered in more detail in the Physical Processes assessment (Chapter 6 of the ES) and summarised above in the sub-section 'Benthic habitats and species'.

The disposal of sediment will temporarily increase SSC, however, due to the strong hydrodynamic conditions in the area, these temporary elevations in SSC are expected to rapidly dissipate to background concentrations within a matter of hours and before the next disposal. As highlighted above, migratory species including Atlantic salmon are known to migrate through estuaries with high SSCs (including the Dee Estuary which is considered one of the estuaries in the UK with particularly high levels of SSCs) (Uncles *et al*., 2013; Cefas, 2016) and the predicted SSCs are within the range that can frequently occur naturally and also as a result of ongoing dredge and disposal activity. Sediment plumes resulting from disposal will also be relatively localised in the context of the entire width of the estuary. Therefore, salmonids and other migratory fish would also be able to avoid the temporary sediment plumes.

Based on these factors, magnitude of change is, therefore, assessed as negligible. Probability of occurrence is high and, thus, the overall exposure to change is negligible. Therefore, while the sensitivity of fish is low to moderate and certain species have a high nature conservation importance (e.g. migratory Atlantic salmon and lamprey) any impact is assessed as **insignificant**.

With respect to sediment contamination, the results of the sediment contamination sampling are summarised above, and in the Water and Sediment Quality Chapter 7. In summary, low levels of contamination were found in the samples and there is no reason to believe the sediment will be unsuitable for disposal in the marine environment.

Based on the results of the sediment sampling survey, the overall level of contamination in the proposed dredge area is considered to be low. During disposal, sediment will be rapidly dispersed in the water column. Therefore, the already low levels of contaminants in the dredged sediments will be dispersed further. The probability of changes in water quality occurring at the disposal site is considered to be low and the overall exposure to change is considered to be negligible. Therefore, while the sensitivity of fish is low to moderate and certain species have a high nature conservation importance, the impact is assessed as **insignificant**.

Underwater noise and vibration disturbance during construction

General scientific context

Elevated underwater noise and vibration levels during construction activities can potentially disturb fish by causing physiological damage and/or inducing adverse behavioural reactions. A detailed underwater noise assessment has been undertaken for the proposed development (Appendix 8.4) and is briefly summarised in this section.

For most piling activities, the main source of noise and vibration relates to where piles are hammered or vibrated into the ground. Percussive piling involves hammering the pile into the seabed resulting in an impact blow and high levels of noise. Vibro-piling produces lower levels of noise as piles are vibrated into the seabed.

The dredging process involves a variety of sound generating activities which can be broadly divided into sediment excavation, transport and placement of the dredged material at the disposal site (CEDA, 2011; WODA, 2013; Jones and Marten, 2016). For most dredging activities, the main source of sound relates to the vessel engine noise.

There is a wide diversity in hearing structures in fish which leads to different auditory capabilities across species (Webb *et al*., 2008). All fish can sense the particle motion[19] component of an acoustic field via the inner ear as a result of whole-body accelerations (Radford *et al*., 2012), and noise detection ('hearing') becomes more specialised with the addition of further hearing structures. Particle motion is especially important for locating sound sources through directional hearing (Popper *et al*., 2014; Hawkins *et al*., 2015; Nedelec *et al*., 2016). Although many fish are also likely to detect sound pressure[20], particle motion is considered equally or potentially more important (Hawkins and Popper, 2017).

From the few studies of hearing capabilities in fish that have been conducted, it is evident that there are potentially substantial differences in auditory capabilities from one fish species to another (Hawkins and Popper, 2017). Popper *et al.* (2014) proposed the following three categories of fish which are described below:

- Fish with a swim bladder or air cavities that aid hearing;
- Fish with a swim bladder that does not aid hearing; and
- Fish with no swim bladder.

The first category comprises fish that have special structures mechanically linking the swim bladder to the ear. Fish species in the study area that fall within this first category include herring (*Clupea harengus*) and twaite shad *Alosa fallax*.

The second category comprises fish with a swim bladder where the organ does not appear to play a role in hearing. Fish species in the study area that fall within this second category include Atlantic cod (*Gadus morhua*), Atlantic salmon (*Salmo salar*), European eel (*Anguilla anguilla*), European seabass (*Dicentrarchus labrax*), Atlantic mackerel (*Scomber scombrus*), smelt (*Osmerus eperlanus*) and whiting (*Merlangius merlangus*).

The third category comprises fish lacking swim bladders that are sensitive only to sound particle motion and show sensitivity to only a narrow band of frequencies (e.g. flatfishes, sharks, skates and rays). Fish species in the study area that fall within this third category include plaice (*Pleuronectes platessa*), sea lamprey (*Petronmyzon marinus*), sole (*Solea solea*) and thornback ray (*Raja clavata*).

Project impact assessment: Quayside works

The distances at which potential mortality/injury and behavioural effects in fish are predicted to occur as a result of the percussive piling and vibro-piling associated with the development are included in Appendix 8.4.

The predicted range WHICH at which the Popper *et al.* (2014) quantitative instantaneous peak Sound Pressure Level (SPL) thresholds for pile driving are reached indicates that there is a risk of mortality, potential mortal injury or recoverable injury within 151 m from the source of impact piling in fish with

[19] Particle motion is a back and forth motion of the medium in a particular direction; it is a vector quantity that can only be fully described by specifying both the magnitude and direction of the motion, as well as its magnitude, temporal, and frequency characteristics.

[20] Pressure fluctuations in the medium above and below the local hydrostatic pressure; it acts in all directions and is a scalar quantity that can be described in terms of its magnitude and its temporal and frequency characteristics.

a swim bladder (such as herring, Atlantic salmon and European eel) and within 70 m in fish with no swim bladder (such as lamprey and flatfish). For vibro-piling, there is a risk of mortality, potential mortal injury or recoverable injury within 3 m from the source in fish with a swim bladder and within 1 m in fish with no swim bladder.

The calculator developed by the United States National Marine Fisheries Service (NMFS) (NMFS, 2021) as a tool for assessing the potential effects to fish exposed to elevated levels of underwater sound produced during pile driving was used to calculate the range at which the cumulative Sound Exposure Levels (SEL) thresholds for pile driving (Popper *et al*., 2014) are reached. Based on the assumptions highlighted in Appendix 8.4, there is predicted to be a risk of mortality and potential mortal injury within 385 m from the source of impact piling in fish with a swim bladder involved in hearing (such as herring), within 262 m from the source in fish with a swim bladder not involved in hearing (such as European eel) and within 82 m in fish with no swim bladder (such as sole). The distance at which the received level of noise is within the limits of the recoverable injury threshold is within 644 m in fish with a swim bladder and 121 m in fish without a swim bladder. For vibro-piling, there is predicted to be a risk of mortality and potential mortal injury within 26 m from the source in fish with a swim bladder involved in hearing, within 18 m from the source in fish with a swim bladder not involved in hearing and within 6 m in fish with no swim bladder. The distance at which the received level of noise is within the limits of the recoverable injury threshold is within 43 m in fish with a swim bladder and 8 m in fish without a swim bladder.

Based on the existing bathymetry and physical constraints of the study area, in particular the areas of the estuary that are under water and exposed (dry) during MHWS and MLWS, the maximum predicted zones of potential mortality/injury and behavioural effects in fish have been refined and are illustrated on Figure 3 to Figure 6 in Appendix 8.4.

The Dee Estuary is around 7 km wide at the location of the proposed development at high water. Given the mobility of fish, any individuals that might be present within the relatively localised areas associated with potential mortality/injury during pile driving activities would be expected to move away and avoid harm. At low water, the large expanses of intertidal flats will limit the propagation of noise to the immediate deeper locations of the Port of Mostyn berths, harbour area and Salisbury channel. Fish are anticipated to be mainly using other channels and parts of the Dee Estuary which are less disturbed by existing vessels and maintenance dredging activities.

Behavioural reactions are anticipated to occur for percussive and vibro piling in under 50 % and 16 % respectively of the width of the Dee Estuary at high water and limited to within the Port of Mostyn berths, harbour area and Salisbury channel at low water given that the existing sandbanks will be exposed and will act as a barrier to the transmission of underwater sound pressure. Although there is considered to be some potential for the percussive piling activity to result in a partial temporary barrier to fish movements, a significant part of the estuary will still be available for fish to move upstream and downstream unimpeded. The scale of the behavioural response within this predicted zone of influence is partly dependent on the hearing sensitivity of the species. Fish with a swim bladder involved in hearing (e.g. herring and shad) may exhibit a moderate behavioural reaction within distance in which a behavioural response is predicted (e.g. a sudden change in swimming direction, speed or depth). Fish with a swim bladder that is not involved in hearing (e.g. Atlantic salmon and European eel) are likely to display a milder behavioural reaction. Fish without a swim bladder (e.g. lamprey and plaice) are anticipated to only show very subtle changes in behaviour in this zone.

The scale of the behavioural effect is also dependent on the size of fish (which affects maximum swimming speed). Smaller fish, juveniles and fish larvae swim at slower speeds and are likely to move passively with the prevailing current. Larger fish are more likely to actively swim and, therefore, may be able to move out of the behavioural effects zone in less time, although it is recognised that the movement of fish is very complex and not possible to define with a high degree of certainty.

The effects of piling noise on fish also need to be considered in terms of the duration of exposure. The overall piling operation is anticipated to take place over a period of approximately 12 months. However, piling will not take place continuously as there will be periods of downtime, pile positioning and set up. The assessment has been undertaken on the assumption that piling works will be undertaken 24/7 and seven days per week. The maximum impact piling scenario for the piles that need to be impact driven is for 2 tubular piles to be installed each day, involving approximately 240 minutes of impact piling and approximately 40 minutes of vibro piling per day. There will, therefore, be significant periods over a 24-hour period when fish will not be disturbed by any impact piling noise. The actual proportion of impact and vibro piling is estimated to be around 17 % and 3 %. In other words, any fish that remain within the predicted behavioural effects zone at the time of percussive piling will be exposed to this disturbance only 17 % of the time over the piling programme and only 3 % of the time for vibro piling.

It is also important to consider the noise from piling against existing background or ambient noise conditions. The area in which the construction will take place already experiences regular vessel operations and ongoing maintenance dredging, and, therefore, fish are likely to be habituated to a certain level of intermittent anthropogenic background noise.

Applying the standard impact assessment criteria, the probability of occurrence of underwater noise disturbance during piling is high. Given the uncertainty regarding the actual timing and programme for the piling and the fact that the duration of the piling will be approximately 12 months, the assessment has been undertaken on the basis that the works could take place at any time of year. There piling will, therefore, occur during the sensitive migratory periods of fish in the Dee Estuary, including the migratory periods of diadromous fish such as Atlantic salmon, European smelt, European eel, shads and lamprey. Migratory fish moving between the Dee Estuary and the sea could potentially pass near to the proposed marine works (with a risk of injury potentially occurring in close proximity to the piling activity). In addition, a behavioural response (e.g. displacement) or acoustic barrier could occur over approximately half of the Dee Estuary at high water, and much more localised to the Port of Mostyn area at low water. Magnitude and consequently exposure to change is, therefore, considered to be medium for these migratory species.

The sensitivity of Atlantic salmon, sea trout, European smelt, shads and European eel is considered to be moderate with the sensitivity of lamprey species low based on the Popper *et al*. (2014) fish noise exposure criteria. All diadromous fish species are considered to have a high importance due to their conservation value and protection. On this basis, whilst only temporary and short term in duration, the effect to Atlantic salmon, sea trout, European smelt, shads, European eel is considered to be **moderate adverse** and the effect to lamprey species **minor adverse**.

In terms of other fish occurring in the Dee Estuary, including resident and commercial fish species, the effect is considered to be **insignificant to minor adverse**. This is based on these other fish having a range of sensitivities from low to moderate and a low to medium importance in terms of nature conservation status.

Project impact assessment: Capital dredge and dredge disposal

The relative risk and distances at which potential mortality/injury and behavioural effects in fish are predicted to occur as a result of the dredging and vessel movements associated with the construction of the proposed development are included in Appendix 8.4.

The worst case source level (SL) generated by dredging and vessels is below the Popper *et al.* (2014) quantitative instantaneous peak SPL and cumulative SEL thresholds for pile driving, which indicates that there is no risk of mortality, potential mortal injury or recoverable injury in all categories of fish even at the very source of the dredger or vessel noise. This appears to correlate with the Popper *et al*. (2014) recommended qualitative guidelines for continuous noise sources which consider that the risk of mortality and potential mortal injury in all fish is low in the near, intermediate and far-field.

According to Popper *et al.* (2014), the risk of recoverable injury is also considered low for fish with no swim bladder and fish with a swim bladder that is not involved in hearing. There is a greater risk of recoverable injury in fish where the swim bladder is involved in hearing (e.g. herring) whereby a cumulative noise exposure threshold is recommended (170 dB rms for 48 h). The distance at which recoverable injury is predicted in these fish as a result of the dredging and vessel movements is 10 m.

Popper *et al*. (2014) advise that there is a moderate risk of temporary threshold shifts (TTS) occurring in the nearfield (i.e. tens of metres from the source) in fish with no swim bladder and fish with a swim bladder that is not involved in hearing and a low risk in the intermediate and far-field. There is a greater risk of TTS in fish where the swim bladder is involved in hearing (e.g. herring) whereby a cumulative noise exposure threshold is recommended (158 dB rms for 12 h). The distance at which TTS is predicted in these fish as a result of the dredging and vessel movements is 46 m.

Popper *et al.* (2014) guidelines suggest that there is considered to be a high risk of potential behavioural responses occurring in the nearfield (i.e. tens of metres from the source) for fish species with a swim bladder involved in hearing and a moderate risk in other fish species. At intermediate distances (i.e. hundreds of metres from the source), there is considered to be a moderate risk of potential behavioural responses in all fish and in the far-field (i.e. thousands of metres from the source) there is considered to be a low risk of a response in all fish.

Overall, there is considered to be a low risk of any injury in fish as a result of the underwater noise generated by dredging and vessel movements although recoverable injury could potentially occur in very close proximity to the dredger in fish where the swim bladder is involved in hearing (e.g. herring). The level of exposure will depend on the position of the fish with respect to the source, the propagation conditions, and the individual's behaviour over time. However, it is unlikely that a fish would remain in the vicinity of a dredger or vessel for extended periods. Behavioural responses are anticipated to be spatially negligible in scale and fish will be able to move away and avoid the source of the noise as required. Furthermore, the proposed capital dredging and vessel activities involved during construction will be temporary.

Based on the above considerations, the overall magnitude of the change in underwater noise due to dredging and possible disposal activities is considered to be negligible. Probability of occurrence is high and thus the overall exposure to change is negligible. While sensitivities of fish to underwater noise ranges from low to moderate depending on the Popper *et al.* (2014) category within which the fish species falls, vulnerability is assessed as none. The importance of fish ranges from high for fish of high nature conservation status to low for resident fish with no protected status and which are not of commercial value. Overall, therefore, the impact of underwater noise during dredging and disposal activities on fish is considered to be **insignificant.**

Marine mammals

This section assesses the potential for impacts on marine mammal receptors as a result of the proposed development during construction. The following impact pathways have been assessed:

- Underwater noise and vibration disturbance during construction.

Underwater noise and vibration disturbance during construction

General scientific context

Elevated underwater noise and vibration levels during construction activities can potentially disturb marine animals by causing physiological damage and/or inducing adverse behavioural reactions. A detailed underwater noise assessment has been undertaken for the proposed development (Appendix 8.4) and is briefly summarised in this section.

For most piling activities, the main source of noise and vibration relates to where piles are hammered or vibrated into the ground. Percussive piling involves hammering the pile into the seabed resulting in an impact blow and high levels of noise. Vibro-piling produces lower levels of noise as piles are vibrated into the seabed.

The dredging process involves a variety of sound generating activities which can be broadly divided into sediment excavation, transport and placement of the dredged material at the disposal site (CEDA, 2011; WODA, 2013; Jones and Marten, 2016). For most dredging activities, the main source of sound relates to the vessel engine noise.

Marine mammals are particularly sensitive to underwater noise at higher frequencies and generally have a wider range of hearing than other marine fauna, namely fish (i.e. their hearing ability spans a larger range of frequencies). The hearing sensitivity and frequency range of marine mammals varies between different species and is dependent on their physiology.

NOAA (2018) provides technical guidance for assessing the effects of underwater anthropogenic (human-made) sound on the hearing of marine mammal species. Specifically, the received levels, or acoustic thresholds, at which individual marine mammals are predicted to experience changes in their hearing sensitivity (either temporary or permanent) for acute, incidental exposure to impulsive and non-impulsive underwater anthropogenic sound sources are provided. These thresholds update and replace the previously proposed criteria in Southall *et al.* (2007) for preventing auditory/physiological injuries in marine mammals. Further recommendations have recently been published regarding marine mammal noise exposure by Southall *et al.* (2019) which complement the NOAA (2018) thresholds and also look at a wider range of marine mammal species.

The NOAA (2018) and Southall *et al.* (2019) thresholds are categorised according to marine mammal hearing groups. The key marine mammal species found in the study area comprise harbour porpoise, common seal and grey seal. According to NOAA (2018), harbour porpoise is categorised as a high-frequency (HF) cetacean and common and grey seals are categorised as phocid pinniped (PW) (earless seals or “true seals”).

There are no equivalent behavioural response criteria. Behavioural reactions to acoustic exposure are less predictable and difficult to quantify than effects of noise exposure on hearing or physiology as reactions are highly variable and context specific (Southall *et al.*, 2007).

Field studies have demonstrated behavioural responses of harbour porpoises to anthropogenic noise (Cefas, 2020). A number of studies have shown avoidance of pile driving activities during offshore wind farm construction (Brandt *et al.*, 2011; Carstensen *et al.*, 2006; Dähne *et al.*, 2013), with the range of measurable responses extending to at least 21 km in some cases (Tougaard *et al.*, 2009). Seismic surveys have also elicited avoidance behaviour in harbour porpoises, albeit short-term (Thompson *et al.*, 2013), and monitoring of echolocation activity suggests possible negative effects on foraging activity in the vicinity of seismic operations (Pirotta *et al.*, 2014). There is a scarcity of studies quantifying behavioural impacts from dredging (Thomsen *et al.*, 2011). An investigation by Diederichs *et al.* (2011) showed that harbour porpoises temporarily avoided an area of sand extraction off the Island of Sylt in Germany. Diederichs *et al.* (2011) found that, when the dredging vessel was closer than 600 m to the porpoise detector location, it took three times longer before a porpoise was again recorded than during times without sand extraction. However, after the ship left the area, the clicks made by harbour porpoise (for echolocation) resumed to the baseline rate.

Few studies have documented responses of seals to underwater noise in the field (Cefas, 2020). Tracking studies found reactions of the grey seals to pile driving during the construction of windfarms were diverse (Aarts *et al.*, 2017). These included altered surfacing or diving behaviour, and changes in swim direction including swimming away from the source, heading into shore or travelling perpendicular to the incoming sound, or coming to a halt. Also, in some cases no apparent changes in their diving behaviour or movement were observed. Of the different behavioural changes observed a decline in descent speed occurred most frequently, which suggests a transition from foraging (diving to the bottom) to more horizontal movement. These changes in behaviour were on average larger, and occurred more frequently, at smaller distances from the pile driving events, and such changes were statistically significantly different at least up to 36 km from the piling. In addition to changes in dive behaviour, also changes in movement were recorded. There was evidence that on average grey seals within 33 km were more likely to swim away from the pile driving. In some cases, seals exposed to pile-driving at close range, returned to the same area on subsequent trips. This suggests that some seals had an incentive to go to these areas, which was stronger than the deterring effect of the pile-driving.

A telemetry study found no overall significant displacement of common seal during construction of a wind farm in The Wash, south-east England (Russell *et al.*, 2016). However, during piling, seal usage (abundance) was significantly reduced up to 25 km from the piling activity; within 25 km of the centre of the wind farm, there was a 19 to 83 % (95 % confidence intervals) decrease in usage compared to during breaks in piling, equating to a mean estimated displacement of 440 individuals. This amounts to significant displacement starting from predicted received levels of between 166 and 178 d re 1 µPa (peak-peak). Displacement was limited to piling activity; within 2 hours of cessation of pile driving, seals were distributed as per the non-piling scenario.

Koschinski *et al.* (2003) conducted a playback experiment on harbour seals in which the recorded sound of an operational wind turbine was projected via a loudspeaker, resulting in modest displacement of seals from the source (median distance was 284 vs 239 m during control trials). Two further studies of ringed seals (*Phoca hispida*), which are closely related to both harbour and grey seals, have observed behaviour in response to anthropogenic noise: Harris *et al.*, (2001) reported animals swimming away and avoidance within ~150 m of a seismic survey, while Moulton *et al.*, (2003) found no discernible difference in seal densities in response to construction and drilling for an oil pipeline.

A number of field observations of harbour porpoise and pinnipeds to multiple pulse sounds have been made and are reviewed by Southall *et al.* (2007). The results of these studies are considered too variable and context-specific to allow single disturbance criteria for broad categories of taxa and of sounds to be developed. Another way to evaluate the responses of marine mammals and the likelihood of behavioural responses is by comparing the received sound level against species specific hearing threshold levels. Further information on the dB_{ht} metric and its limitations is provided in Appendix 8.4.

Project impact assessment: Quayside works

The distances at which permanent threshold shifts (PTS), TTS and behavioural effects in marine mammals that occur in the study area are predicted to occur during impact piling and vibro-piling for the proposed development are included in Appendix 8.4.

There is theoretically predicted to be a risk of instantaneous PTS and TTS in bottlenose dolphin within 8 m and 17 m respectively from the source of the percussive piling noise, and in harbour porpoise within 286 m and 619 m respectively. The risk of instantaneous PTS and TTS in seals is within 37 m and 79 m respectively. Based on the existing bathymetry and physical constraints of the study area, the predicted zones of instantaneous PTS and TTS in marine mammals have been refined and are illustrated on Figure 7 and Figure 8 in Appendix 8.4.

If the propagation of underwater noise from impact piling were unconstrained by any boundaries, the maximum theoretical distance at which the predicted cumulative SEL weighted levels of underwater noise during impact piling is within the limits of PTS and TTS in bottlenose dolphin is 514 m and 3.5 km respectively, and in harbour porpoise is 9.7 km and 67.0 km respectively. The maximum distance for PTS and TTS in seals is 5.0 km and 34.3 km respectively. The maximum theoretical distance at which the predicted cumulative SEL weighted levels of underwater noise during vibro piling is within the limits of PTS and TTS in bottlenose dolphin is 13 m and 171 m respectively, and in harbour porpoise is 138 m and 1.8 km respectively. The maximum distance for PTS and TTS in seals is 65 m and 855 m respectively. As noted earlier, the propagation of noise, however, will be significantly limited by the existing bathymetry and physical constraints of the study area.

Assuming a lower worst case swimming speed of 1.5 m/s for all marine mammal species (including both adults and juveniles), the maximum time that would take bottlenose dolphin to leave the cumulative SEL weighted PTS and TTS injury zones during impact piling is estimated to be around 6 and 39 minutes respectively. During vibro piling, this is estimated to be 9 seconds for PTS and 1.9 minutes for TTS. In harbour porpoise it is estimated to be 1.8 hours and 12.4 hours during impact piling for PTS and TTS respectively. During vibro piling, this is estimated to be 1.5 minutes for PTS and 20 minutes for TTS. The maximum time that would take seals to leave the PTS and TTS zones is estimated to be 55 minutes and 6.4 hours respectively during impact piling. For vibro piling, the maximum time that would take seals to leave the PTS and TTS zones is estimated to be 44 seconds and 9.5 minutes respectively. During impact piling, these durations equate to around 3 %, 50 % and 27 % of the time that would be required for a temporary injury to occur in bottlenose dolphin, harbour porpoise and seals respectively and, therefore, assuming marine mammals evade the injury effects zone, they are not considered to be at risk of any permanent or temporary injury during impact piling. During vibro piling, these durations equate to around 0.1 %, 1.4 % and 0.7 % of the time that would be required for a temporary injury to occur in bottlenose dolphin, harbour porpoise and seals respectively and are also not considered to be at risk of any permanent or temporary injury during vibro piling.

Any marine mammals present are likely to evade the area. Behavioural responses could include movement away from a sound source, aggressive behaviour related to noise exposure (e.g. tail/flipper slapping, fluke display, abrupt directed movement), visible startle response and brief cessation of reproductive behaviour (Southall *et al*., 2007). Mild to moderate behavioural responses of any individuals within these zones could include movement away from a sound source and/or visible startle response (Southall *et al*., 2007).

The effects of piling noise on marine mammals also need to be considered in terms of the duration of exposure. The overall piling operation is anticipated to take place over a period of approximately 12 months. However, piling will not take place continuously as there will be periods of downtime, pile positioning and set up. The assessment has been undertaken on the assumption that piling works will be undertaken 24/7 and seven days per week. The maximum impact piling scenario for the piles that need to be impact driven is for 2 tubular piles to be installed each day, involving approximately 240 minutes of impact piling per day and 40 minutes of vibro piling per day. There will, therefore, be significant periods over a 24-hour period when marine mammals will not be disturbed by any impact piling noise. The actual proportion of impact piling and vibro piling is estimated to be around 17 %

and 3 % respectively. In other words, any marine mammal that remain within the predicted behavioural effects zone at the time of percussive piling will be exposed to this disturbance only 17 % of the time over the piling programme and only 3 % of the time for vibro piling.

It is also important to consider the noise from piling against existing background or ambient noise conditions. The area in which the construction will take place already experiences regular vessel operations and ongoing maintenance dredging, and, therefore, marine mammals are likely to be habituated to a certain level of anthropogenic background noise.

Applying the standard impact assessment criteria in the assessment, the probability of occurrence of underwater noise disturbance during piling is high. The magnitude of the change is considered likely to be small to medium, taking account of the scale of change, relatively short term and temporary nature of the piling works and highly mobile nature of marine mammals. The sensitivity of marine mammal species to piling noise is considered to be moderate[21] and their importance is considered to be high for all marine mammal species given the level of protection that they are afforded. Therefore, the temporary underwater noise effect on marine mammals during piling is assessed as **minor to moderate adverse**.

Project impact assessment: Capital dredge and dredge disposal

The distances at which PTS, TTS and behavioural effects in marine mammals that occur in the study area are predicted to occur as a result of the dredging and vessel movements to and from the disposal sites associated with the proposed development are included in Appendix 8.4.

NOAA's user spreadsheet tool (NOAA, 2021) has been used to predict the range at which the weighted cumulative SEL acoustic thresholds (NOAA, 2018) for PTS and TTS are reached during the proposed dredging and disposal activity based on the assumptions highlighted in Appendix 8.4.

There is predicted to be no risk of PTS in any of the key marine mammal species found in the study area. The risk of TTS in bottlenose dolphin is limited to within 1 m from the dredging and vessel activity, and within 44 m in harbour porpoise and 12 m in seals.

Overall, there is not considered to be any risk of injury or significant disturbance to marine mammals from the proposed dredging and vessel activities that are proposed at the Port of Mostyn even if the dredging and vessel movements were to take place continuously 24/7.

The probability of a change in underwater noise occurring during dredging and dredge disposal is high. However, hearing damage is unlikely to occur and the main effect that could be expected in the vicinity of the dredge vessels would be short-term mild behavioural avoidance. Based on these factors, the magnitude of the change due to dredging noise is considered to be negligible and the sensitivity of marine mammals to dredging noise is considered to be low. Taking these factors into account, the overall exposure and vulnerability of marine mammals will be negligible and none respectively. Overall, therefore, the impacts of dredging noise on all marine mammals is considered to be **insignificant.**

[21] Moderate sensitivity was assigned on the basis that relatively localised injury effects (and behavioural responses over a wider area) are predicted from the anticipated level of underwater noise generated by the piling. However, the zones of potential injury and behavioural responses would be expected to be lower than for other activities such as the percussive piling of larger offshore tubular piles, seismic survey or blasting operations.

Coastal waterbirds

This section assesses the potential for impacts on coastal waterbird receptors as a result of the proposed development during construction. The following impact pathways have been assessed:

- Direct loss and change to intertidal feeding and roosting habitat; and
- Airborne noise and visual disturbance during construction.

Direct loss and change to intertidal feeding and roosting habitat

General scientific context

The quality of intertidal habitat as a feeding resource for waterbirds can be highly variable both spatially and temporally (Mander *et al.,* 2013). Higher energetic costs for waterbirds could occur in areas where habitat change has caused a reduction in prey distribution and density. This may affect local populations in the long-term through impacts on individual fitness (survival, body condition and fecundity) (Bowgen *et al.,* 2016).

Habitat loss can also result in increased densities of birds already using a site, increasing the potential for interference competition (Santos *et al*., 2005; Bowgen *et al*., 2016). Loss or severe degradation of intertidal habitat could displace birds and cause them to redistribute either locally or to neighbouring sites (Gunnarsson *et al*., 2005). This in turn might affect the birds at those sites through competition and density-dependent mortality. Redshank displaced following the construction of an amenity barrage at Cardiff Bay (South Wales), for example, experienced a poorer body condition and had a lower survival rate after they moved (Burton *et al.,* 2006). Lambeck (1991) found that Oystercatchers displaced following large-scale habitat loss in the Delta region of The Netherlands experienced significantly higher mortality than those originally ringed elsewhere in the Delta, presumably as a result of the increased densities in recipient areas.

Project impact assessment: Quayside works

The proposed quayside works will cause a direct loss of 2.84 ha of intertidal habitat of which 2.57 ha is intertidal mud habitat and 0.27 is intertidal hard substrate habitat. The potential effects of this loss on benthic habitats and species is assessed in the above sub-section ‘Benthic habitats and species’.

- The loss of intertidal mud represents approximately 0.016 % the Dee Estuary SAC and specifically 0.024 % of the ‘mudflats and sandflats not covered by seawater at low tide’ feature of the Dee Estuary SAC[22]. This loss also represents 0.018 % of the Dee Estuary SPA/Ramsar site [23].
-

The artificial hard habitat found around the eastern side of the breakwater supports a range of epifaunal prey items which are consumed by some wader species including barnacles, blue mussel *Mytilus edulis*, periwinkles *Littorina littorea* and shore crabs *Carcinus maenas* (Section 8.6.2 and Appendix 8.1). All these species are considered to be prey for Turnstones, with Redshank known to feed on periwinkles and Oystercatchers on blue mussels (Naylor *et al*., 2017). Ornithology data suggests that small flocks of Turnstone (up to approximately 20 birds) as well as very low numbers of Oystercatcher and Curlew (<10 birds) use the eastern side of the breakwater for feeding around low water with these numbers only representing a very small proportion of the overall Dee Estuary populations (Section 8.6.5).

22 Based on the extents given in the Standard Data Form on the JNCC website (JNCC, 2022a)

23 Based on the extents given in the Standard Data Form on the JNCC website (JNCC, 2022b; JNCC, 2022c)

The scale of habitat loss is considered unlikely to be of a magnitude that would cause changes to diet or prey consumption levels to an extent that individual survival rates or local population levels (either directly through mortality or due to birds dispersing to new feeding areas in other areas of the Dee Estuary) are affected. Nevertheless, the loss of this artificial hard substrate habitat still represents a loss of a habitat which is of some functional value for a range of species for feeding.

The mudflat habitat adjacent to the breakwater was found to support very low abundances of prey items for coastal waterbirds including the mud shrimp *Corophium volutator*, mud snail *Peringia ulvae*, polychaetes and clams (*Tellinoidea* spp. and Baltic tellin *Limecola balthica*). The number of prey species and abundance levels recorded in benthic samples were much smaller than recorded in ecologically richer mudflat habitats in the nearby local area such as the Mostyn Bank as summarised in Section 8.6.2 and Appendix 8.1. This would be expected given that the mudflat habitat on the Mostyn Bank is considered much more stable than the soft/fluid sandy mud observed in this area.

Bird data suggests that this mudflat is rarely used by waterbirds other than low numbers of gulls and more infrequently Oystercatchers or Redshank (several individuals). This would be expected given the limited prey resources available. In addition, due to its semi enclosed nature (around infrastructure associated with the ferry Ro-Ro terminal and old Airbus berthing facility), the area provides limited lines of sight for birds and is also likely to be subject to regular disturbance pressure from nearby quay side and vessel operations.

Overall, the probability of occurrence is considered to be high with magnitude of change considered to be small, leading to a low exposure to change. Local populations of waterbirds are considered to have a low sensitivity to the scale of habitat loss predicted. On this basis, vulnerability is considered to be low. Importance is high given the protection afforded to the bird species in the area of predicted loss. On this basis, the impact is assessed as **minor adverse**.

Project impact assessment: Capital dredging

The capital dredge will result in the loss of 1.34 ha of lower elevation intertidal habitat as a direct result of deepening the berth pockets (i.e. it will permanently change to subtidal habitat).

The intertidal habitat loss as a result of the capital dredge represents approximately 0.008 % the Dee Estuary SAC and 0.013 % of the 'mudflats and sandflats not covered by seawater at low tide' feature of the Dee Estuary SAC[24]. This loss also represents 0.009 % of the Dee Estuary SPA/Ramsar site[25].

This change will be highly localised and will not change the overall structure or functioning of the nearby mudflats within the Port of Mostyn area or more widely in the Dee Estuary. This habitat loss is, therefore, considered to be negligible in the context of similar suitable habitat in the Dee Estuary SPA/Ramsar site.

The habitat in this area (which is known as 'Bug Bank') consists of low elevation and dynamic sandflat habitat. The project-specific intertidal benthic survey recorded a highly impoverished faunal assemblage with very low abundances of prey items for coastal waterbirds recorded (such as polychaetes, the mudsnail *Peringia* spp. and mud shrimp *Corophium* spp. and bivalves Tellinoidea *spp.* No cockles (which is a key prey item for Oystercatchers) were recorded during the surveys (Section 8.6.2 and Appendix 8.1). In addition, Bug Bank is only exposed for a relatively short amount of time during low water periods with much of this bank only becoming exposed during spring tidal phases. On this basis, the loss is considered to only cause a highly localised and negligible change in the prey

24 Based on the extents provided in the Standard Data Form on the JNCC website (JNCC, 2022a)

25 Based on the extents provided in the Standard Data Form on the JNCC website (JNCC, 2022b; JNCC, 2022c)

resources available for birds feeding which will not be of a magnitude that will affect individual survival rates or local population levels (either directly through mortality or due to birds dispersing to new feeding areas in other areas of the Dee Estuary).

The area of loss is, therefore, considered to be of limited functional value to coastal waterbirds. This is reflected in the bird data which has only recorded limited use of this area by waterbirds compared with nearby areas. This includes loafing Herring Gulls (flocks of typically 15 to 100 birds), as well as very low numbers of Oystercatcher (<10 birds), which are primarily recorded loafing and more occasionally foraging. Low numbers of other species such as Black-headed Gulls, Great Black-backed Gulls and Cormorants consisting of a few individuals are also occasionally recorded on Bug Bank. Furthermore, Bug Bank typically only supports a very small proportion of the overall Dee Estuary populations of the species commonly recorded (for example approximately 0.02 % of Oystercatchers and 0.7 % of the Herring Gull population[26]).

Overall, the probability of occurrence is considered to be high with magnitude of change considered to be low, leading to a low exposure to change. Local populations of waterbirds are considered to have a low sensitivity to the scale of habitat loss predicted. On this basis, vulnerability is considered to be low. Importance is high given the protection afforded to the bird species in the area of predicted loss. On this basis, the impact is assessed as **minor adverse**.

Noise and visual disturbance

General scientific context

Disturbance can cause birds to cease feeding, which can decrease the total amount of time available for feeding, as well as disrupting other behaviour such as breeding (Coleman *et al.*, 2003; Martín *et al.*, 2014). Where disturbance causes birds to take flight, it can increase energy demands and may increase food consumption by decreasing the available habitat area (Goss-Custard, 2020; Linssen *et al.*, 2019; Stillman *et al.*, 2007). Repetitive disturbance events can result in possible long-term effects such as loss of weight, condition and a reduction in reproductive success, leading to population impacts (Durell *et al.*, 2005; Goss-Custard *et al.*, 2006; Belanger and Bedard, 1990). Birds typically show a dispersive response to disturbance with prolonged disturbance causing displacement (Goss-Custard, 2020; Dwyer, 2010; Navedo and Herrera, 2012).

Disturbance often occurs through a combination of visual and noise stimuli simultaneously, although some occurrences may be through separate visual or noise stimuli (Wright *et al.*, 2013). Birds will also vary their response to human activities depending on the type of the activity, the noise produced, the speed and randomness of approach, the distance to which the disturbance factor approaches and the frequency of disturbance (Burton *et al.*, 2002., Rees *et al.*, 2005; Liley *et al.*, 2011; Coleman *et al.*, 2003; Ruddock and Whitfield, 2007; Stillman *et al.*, 2012).

Disturbance responses associated with construction activity

Construction activity in the coastal zone may lead to disturbance which has the potential to cause a reduction in foraging activity as well as temporary displacement from a localised area around the works (Burton *et al.*, 2002).

26 When compared against Dee Estuary Low Tide data winter for 2021/22 data (BTO, 2022).

Overall, responses to construction noise and activity appear to initiate similar or less disturbance than that of human presence on the foreshore (e.g. recreation) (ERM, 1996; ABPmer, 2013; IECS, 1997; IECS, 2013). For example, while some localised disturbance was caused as a result of piling activity as part of the construction work for ABB Power Generation Ltd (Pyewipe, Grimsby), this was not considered to have a major effect on surrounding bird populations and was found to be no greater than the effect arising from third party disturbance, including walkers and stopped cyclists, which were unrelated to the ABB works (ERM, 1996). The greater effect of human presence as opposed to general construction works and machinery is also supported by IECS (1997), in that a person approaching feeding birds on the mudflat caused birds to fly when the person was approximately 300 m from the birds, whereas machinery could approach birds up to 50 m before the birds moved away.

Lower levels of disturbance for construction activities compared with other nearby human activity was also observed during bird monitoring as part of the marine licensing consent for a quay wall construction development at the Port of Southampton. The study evaluated the disturbance effects of the extension work on waterbird species using the mudflat habitat on Bury Marsh opposite the Port of Southampton (approximately 100 to 200 m away) during the overwinter period. No bird disturbance behaviour (such as startling, rapid flight or abruptly stopping foraging) was observed during periods of percussive piling activity. However, disturbance to waterbirds was observed on several occasions due to vessels and kayaks within 50 m of Bury Marsh (ABPmer, 2013).

Studies into the distances from activities that evoke a disturbance response suggest that for most coastal works and other foreshore activity, disturbance behaviour is not typically observed when activities occur more than 200 to 300 m away from a source with the reactions of many species occurring between 20 and 100 m (ABPmer, 2002; Ruddock and Whitfield, 2007; IECS, 2009a; Wilson, 2009; IECS, 2009b; Dwyer, 2010; IECS, 2013; Ross and Liley, 2014; Collop *et al.*, 2016; Goodship and Furness, 2019; Goodship and Furness, 2022; ABPmer, 2013). This is discussed in more detail below.

Construction techniques which are known to cause loud source noise levels (such as piling) have been the subject of a number of disturbance monitoring studies which have investigated the relationship between activity source levels and the disturbance responses elicited by birds (IECS, 2009a; Xodus, 2012; Wright *et al.*, 2013; ABPmer, 2002; IECS, 2013). Research suggests that irregular construction noise at levels typically above 70 dB can cause behavioural responses in some waterbird species with flight responses generally occurring above 80 dB (Table 8.20). However, responses of birds will be dependent on a range of site-specific factors including ambient (background) noise levels, time of year, levels of existing activity and the species assemblage. In addition, visual disturbance associated with construction activity will often create a disturbance effect before any associated noise starts to have an effect (IECS, 2013).

Table 8.20. Summary of noise disturbance studies

Study	Summary
IECS, 2009a; IECS, 2009b	A study of coastal construction noise effects on the Humber Estuary was undertaken based around the measurement of noise levels while simultaneously monitoring the behavioural response by birds during flood defence works at Saltend. The defence works involved the use of a double hydraulic pile on site. The study noted a moderate to high behavioural response to irregular piling noise above 70 dB and a moderate response to regular piling noise below 70 dB. A flight response was noted to occur during works generating noise at between 80-85 dB. Behavioural responses, notably the down-shore movements of wildfowl were noted above 70 dB. Noise levels between 55 dB and 84 dB were generally accepted by birds. Other impacts associated with construction included a high response to personnel and plant equipment on the mudflat and a moderate to high response to

Study	Summary
	personnel and plant equipment on the seaward toe and crest. Occasional movement of a crane jib and load resulted in a low to moderate response. Noises below 50 dB, long-term plant activities only on the crest and activity behind the flood bank elicited a low response.
Xodus, 2012	Monitoring of birds as part of the Grimsby River Terminal Project found that noise from construction (including piling) caused only 1 % of the disturbance events observed, with large disturbances mainly caused by the presence of raptors, aircraft and helicopters. The study concluded that percussive piling noise less than 66 dB LA_{max} F gave rise to no disturbance, whilst a mild behavioural response (such as heads up alert, short walk or swimming) was observed to occur in the range of 73 to 81 dB LA_{max} F. Percussive piling noise over 83 dB LA_{max} F was considered likely to evoke a flight response.
Wright *et al.*, 2013	The experimental study intentionally disturbed birds at a high tide roost site, on the south bank of the Humber estuary using an impulsive sound similar to that associated with noise from port and power generation construction such as percussive piling and recorded the behavioural responses. Lapwing appeared to be the species most sensitive to intentional disturbance, while Curlew was the most tolerant. The study recommended that impulsive noise limits should be restricted to < 69.9 dB at the site.
ABPmer, 2002	Disturbance monitoring of waterbirds in the vicinity of construction works (piling and dredging) at the ABP Teignmouth Quay Development concluded that sudden noise in the region of 80 dB appears to elicit a flight response in waders up to 250 m from the source, with levels of approximately 70 dB causing flight or anxiety behaviour in some species.

Birds generally appear to habituate to continual noises as long as there is no large amplitude 'startling' component (Hockin *et al.*, 1992). With specific respect to piling, it has been concluded that although piling has the potential to create most noise during construction; it often consists of rhythmic "bangs", which birds might become accustomed to depending on the distance that birds are away from the piling (ABP Research, 2001). For example, observations as part of the construction work for ABB Power Generation Ltd (Pyewipe) suggested that it was the initial sudden bang during piling activities, which caused some localised disturbance, and that subsequent bangs typically resulted in reduced disturbance, demonstrating habituation (ERM, 1996).

Species sensitivity and responses

The level of response to potential disturbance stimuli also varies considerably between species with some ducks (such as Shelduck) and larger waders such as Curlew, Grey Plover and godwits generally showing stronger responses to disturbance stimuli than smaller waders (such as Turnstone, Dunlin and Sanderling) and gulls (Goodship and Furness, 2022; Collop *et al.*, 2016; Calladine *et al.*, 2006; IECS, 2013; Goodship and Furness, 2019). A detailed review of the responses and sensitivity of key waterbird species to noise and visual disturbance is presented in Table 8.21. This includes data on flight initiation distance (FID) which is the distance at which a bird takes flight in response to a perceived danger and is used to help better understand the relative sensitivity of disturbance on different species.

Table 8.21. Summary of evidence of the sensitivity for different key species to noise and visual disturbance stimuli

Species	Sensitivity to noise and visual disturbance	
	Evidence on the sensitivity to disturbance stimuli	**Sensitivity level[1]**
Shelduck	Shelduck are generally a wary species and are considered particularly sensitive to visual disturbance. Typically, they approach construction works no closer than 300 m and can be affected by visual disturbance up to 500 m away from source (IECS, 2013). Noise disturbance has been reported from 72 dB upwards for Shelduck. However, the species is subject to a high degree of habituation and further exposure to sounds of the same or greater level can lead to no response to stimuli. No response has been recorded for noise levels as high as 88 dB but this is likely to be an extreme 'no response' level and caution should be exercised at receptor levels over 70 dB. Observation of disturbance responses from flood protection works has suggested that Shelduck react to noise in approximately 30 % of exposure events to sudden noise above 60 dB or any noise above 70 dB (IECS, 2013). Goodship and Furness (2022) assessed Shelduck as having a high sensitivity to human disturbance with the range in mean FID from the literature reviewed of 36 m to 250 m as a result of the presence of people on or near the foreshore although FIDs up to 700 m have been recorded. Goodship and Furness (2019) undertook a disturbance literature review and assessed Shelduck as one of the species considered most sensitive to disturbance stimuli with the range in mean FID from the literature reviewed of 148 m to 250 m as a result of the presence of people on or near the foreshore.	Moderate
Curlew	Research evidence indicates that Curlew are a cautious species that does not habituate to works rapidly and are also particularly intolerant of people, allowing approach to a range of typically 120-300 m before flushing (IECS, 2013; Lausen *et al.*,2005). Goodship and Furness (2022) assessed Curlew as having a high sensitivity to human disturbance with the with the range in mean FID from the literature reviewed of 38 m to 340 m as a result of the presence of people on or near the foreshore with motorised vessels having a mean FID of 140 m and motorised vehicles 188 m. Collop *et al., (*2016) recorded a minimum FID of 88 m and a maximum FID of 570 m (with a mean of 340 m) for this species through experimentally disturbing foraging birds (approaching a total of 39 times) as part of a research study. Goodship and Furness (2019) undertook a disturbance literature review and assessed Curlew as one of the species considered most	Moderate

Species	Sensitivity to noise and visual disturbance	
	Evidence on the sensitivity to disturbance stimuli	Sensitivity level[1]
	sensitive to disturbance stimuli with the range in mean FID from the literature reviewed of 38 m to 340 m as a result of the presence of people on or near the foreshore with motorised vessels having a mean FID of 140 m.	
Black-tailed Godwit	Data on the responses of Black-tailed Godwit to disturbance in the UK is limited although disturbance responses have been recorded within 100-250 m of construction activity (IECS, 2013). Goodship and Furness (2022) found evidence of FIDs between 20 and 150 m as a result of presence of people on or near the foreshore from the literature reviewed in the study.	Moderate
Bar-tailed Godwit	Bar-tailed Godwit can be a relatively disturbance tolerant species that habituates to works rapidly (allowing an approach range of as close as 40-100 m before flushing). However, despite this tolerance, Bar-tailed Godwits can abandon highly disturbed areas in favour of quieter areas to forage and roost. For example, direct observation of disturbance responses by the species to flood defence works found the species did not forage within 200 m of the activity, despite foraging being actively pursued beyond this range, suggesting that they had actively vacated the area close to the works. This is consistent with previous research findings (IECS. 2013). Collop *et al.*, (2016) recorded a minimum FID of 32 m and a maximum FID of 225 m (with a mean of 84 m) for this species through experimentally disturbing foraging birds (approaching a total of 92 times) as part of a research study. Goodship and Furness (2019) and Goodship and Furness (2022) undertook disturbance literature reviews and assessed Bar-tailed Godwit as being of moderate sensitivity to disturbance stimuli with the range in mean FID from the literature reviewed of 22 m to 219 m as a result of the presence of people on or near the foreshore.	Moderate
Oystercatcher	Oystercatchers are relatively tolerant of disturbance stimuli and will habituate rapidly to ongoing activity. In undisturbed areas they will often flush at great ranges but in more disturbed locations such as a typical estuary, this figure reduces to typically between approximately 25-200 m dependent upon the stimuli (with people causing the most extreme reaction) (IECS, 2013). Collop *et al.*, (2016) recorded a minimum FID of 30 m and a maximum FID of 228 m (with a mean of 97 m) for this species through experimentally disturbing foraging birds (approaching a total of 147 times) as part of a research study. Goodship and Furness (2019) and Goodship and Furness (2022) undertook disturbance literature reviews and assessed Oystercatcher as being of moderate sensitivity to disturbance stimuli with the range in mean FID from the literature reviewed of	Low to moderate

Species	Sensitivity to noise and visual disturbance	
	Evidence on the sensitivity to disturbance stimuli	Sensitivity level[1]
	26 m to 136 m as a result of the presence of people on or near the foreshore with motorised vessels having a mean FID of 74 m and motorised vehicles a mean FID of 106 m.	
Redshank	Redshank are considered a relatively tolerant species to visual stimuli (and will often approach much closer than 100 m before flushing (sometimes as close as 30-50 m)) but can be sensitive to noise stimuli, They are also considered to habituate to works rapidly (IECS, 2013). Collop *et al., (*2016) recorded a minimum FID of 28 m and a maximum FID of 187 m (with a mean of 80 m) for this species through experimentally disturbing foraging birds (approaching a total of 53 times) as part of a research study. Goodship and Furness (2022) assessed Redshank as having a moderate sensitivity to human disturbance with the range in mean FID from the literature reviewed of 4 to 150 m as a result of the presence of people on or near the foreshore. Goodship and Furness (2019) undertook a disturbance literature review and assessed Redshank as being relatively sensitive to disturbance stimuli with the range in mean FID from the literature reviewed of 24 m to 137 m as a result of the presence of people on or near the foreshore.	Low to moderate
Knot	Knot appear to be a species relatively tolerant to visual stimuli and are considered to habituate relatively rapidly to people although disturbance responses have been recorded within <75-100 m of visual stimuli. However, Knot are considered quite sensitive to noise stimuli, especially in conjunction with visual stimuli. Knot have been recorded foraging close to plant (<50 m) and to workers (>75 m), (IECS, 2013). Collop *et al., (*2016) recorded a minimum FID of 20 m and a maximum FID of 240 m (with a mean of 72 m) for this species through experimentally disturbing foraging birds (approaching a total of 78 times) as part of a research study. Goodship and Furness (2022) assessed Knot as having a moderate sensitivity to human disturbance with the range in mean FID from the literature reviewed of 21 to 74 m as a result of the presence of people on or near the foreshore with motorised vessels having a mean FID of 200 m.	Low to moderate
Dunlin	Dunlin appear to be a species relatively tolerant to visual stimuli and are considered to habituate to people with most responses occurring in <75-100 m of visual stimuli. Dunlin have been recorded foraging extremely closely to plant (<50 m) and >75 m from worker. When foraging, they can be initially disturbed by	Low

Species	Sensitivity to noise and visual disturbance Evidence on the sensitivity to disturbance stimuli	Sensitivity level[1]
	activity start-up, with a flight response, but will then forage back towards construction works, approaching to within 25 m on occasion, before sometimes flushing and moving away again, to repeat the process (IECS, 2013). Collop *et al., (*2016) recorded a minimum FID of 9 m and a maximum FID of 194 m (with a mean of 44 m) for this species through experimentally disturbing foraging birds (approaching a total of 117 times) as part of a research study (IECS, 2013). Goodship and Furness (2019) and Goodship and Furness (2022) undertook disturbance literature reviews with the evidence reviewed suggesting that Dunlin is less sensitive to disturbance than many other waders with the range in mean FID from the literature reviewed of 39 m to 163 m as a result of the presence of people on or near the foreshore.	
Turnstone	Turnstone are considered not very sensitive to noise stimuli and habituate rapidly, especially in conjunction with visual stimuli. They are tolerant of people/workers and plant, allowing approach as close as 30-50 m before flushing. Direct observation of disturbance effects from works found Turnstone responses to be consistent with the expected high tolerance, with birds allowing approach to works to within 10 m before reacting. This was in a highly disturbed area with much public use of the foreshore and of 127 potential disturbance events observed, only 19 caused reaction of which only 3 were caused by the works with trucks flushing Turnstones at between 15-100m. Walkers (and dog walkers in particular) caused the greatest reactions. There was no evidence of reactions to noise, which reached levels above 90 dB due to piling (IECS, 2013). Collop *et al., (*2016) recorded a minimum FID of 5 m and a maximum FID of 75 m (with a mean of 32 m) for this species through experimentally disturbing foraging birds (approaching a total of 40 times) as part of a research study. Goodship and Furness (2019) undertook a disturbance literature review with the evidence suggesting that Turnstone is less sensitive to disturbance than many other waders with the range in mean FID from the literature reviewed of 12.5 m to 39 m as a result of the presence of people on or near the foreshore.	Low

1. The assigned sensitivity levels have been based on available evidence with respect to responses to disturbance stimuli. For some species a range in sensitivity has been presented where evidence suggests large variations in intraspecific responses due to various factors which could influence sensitivity (such as the type of activity, site specific factors such as habituation, environmental conditions and site fidelity etc). Where information is limited a precautionary sensitivity level has been assigned.

The response to disturbance is also dependant on the previous experience of the bird to disturbance (i.e. level of habituation) as well as a range of other factors such as environmental conditions, their state at the time of the disturbance (e.g. hungry or satiated) and the quality of their alternative foraging sites (Gill *et al.*, 2001; Mullner *et al.*, 2004; IECS, 2009a; Collop *et al.* 2016).

It is also important to understand potential behavioural responses of disturbance in the context of energetic costs, mortality and population consequences as some disturbance has been shown to have limited adverse effects on waterbirds. For example, Goss-Custard *et al.* (2006) used an individual-based behavioural model to establish critical thresholds for the frequency with which wading birds can be disturbed before they die of starvation. The model was tested on Oystercatchers in the Baie de Somme, France, where birds were put to flight by disturbance up to 1.73 times/daylight hour. The modelling results showed that the birds could be disturbed up to 1.0 to 1.5 times/h before their fitness was reduced in winters with good feeding conditions (abundant cockles and mild weather) but only up to 0.2 to 0.5 times/h when feeding conditions were poor (scarce cockles and severe winter weather).

Collop *et al.* (2016) looked into the likely consequences of different frequencies of disturbance on various wading birds, using their data on mean flight time and mean total time lost. The authors found that a 5 % reduction in birds' daily available feeding time would be expected to result from responding to between 38 and 162 separate disturbance events (depending on species and tidal stage). The mean cost per individual flight response represented less than a tenth of a per cent of each species' daily energy requirements. The study concluded that the energetic costs of individual disturbance events, were low relative to daily requirements and unlikely to be frequent enough to seriously limit foraging time.

Review summary

Within the construction site, the level of disturbance stimuli is dependent on the type of activity being undertaken. In general, human presence on or near the foreshore (e.g. walking) is considered to cause greater disturbance than vehicles or watercraft and waterbirds are more easily disturbed by irregular movements than the regular and defined presence of machinery, vessels and other vehicles (IECS, 1997; ABPmer, 2013; McLeod, *et al.* 2013; Guay *et al.* 2014; Glover *et al.* 2015). High level responses to noise (such as dispersal away from marine works) are typically associated with sudden or irregular noise over 70-80 dB (at the receiver (i.e. bird) location not the noise source) (IECS, 2009a; Xodus, 2012; Wright *et al.*, 2013; ABPmer, 2002; IECS, 2013).

The specific responses that waterbirds will have to disturbance varies between species as well as between birds of the same species due to a range of factors including the level of habituation and environmental conditions (Gill *et al.*, 2001; Mullner *et al.*, 2004; IECS, 2009a; Collop *et al.* 2016).

Distances over 300 m have been recorded more occasionally for some sensitive species such as Curlew or Shelduck (IECS, 2013; Collop *et al.* 2016; Goodship and Furness, 2019; Goodship and Furness, 2022) and a 300 m radius is commonly applied to construction works based on a broadly worst-case FID range for sensitive waterbirds (Cutts, 2021). However, evidence from the detailed review above suggests, that waterbirds generally show a flight response to anthropogenic activities such as construction and a presence of people (such as workers) on or near the foreshore at distances <200-300 m (and more typically between 20 m and 100 m for certain species such as Turnstone or Dunlin) (ABPmer, 2002; Ruddock and Whitfield, 2007; IECS, 2009a; Wilson, 2009; IECS, 2009b; Dwyer, 2010; IECS, 2013; Ross and Liley, 2014; Goodship and Furness, 2022; Collop *et al.*, 2016; Goodship and Furness, 2019; ABPmer, 2013).

Project impact assessment

The proposed development will involve a range of activities, which will result in a temporary source of noise and visual disturbance to roosting and feeding waterbirds during construction. This includes the following:

- Piling: Noise stimuli caused by the percussive and vibro piling activity. Piling has the potential to create the highest noise-related disturbance levels during construction. Piling works are anticipated to be carried out 24/7 (although limited to up to 240 minutes of percussive piling and 40 minutes of vibro piling per 24-hour period) and the overall programme for the piling works is approximately 12 months;
- Jack-up barges: The potential presence of jack-up barges (for the piling rigs) used in construction will potentially cause both noise and visual disturbance;
- The use of the cutter suction dredger for the capital dredge of the berths and for pumping the dredged material as fill into the reclamation area; and
- The operation of plant machinery such as rollers/dozers or potentially dynamic/hammer impact compaction techniques.

The evidence reviewed above suggests that the response of waterbirds to disturbance stimuli is relatively limited at distances over 200 m, particularly in areas subject to already high levels of existing anthropogenic activity (as found in the Port of Mostyn area). High level responses to noise (such as dispersal away from marine works) are typically associated with sudden or irregular noise over 70 to 80 dB at the receptor (i.e. bird) (IECS, 2013).

Habitat directly adjacent to the proposed development on Salisbury Bank (located approximately 250 to 300 m away) consists of low elevation sandflat habitat (which is highly dynamic and impoverished with a low prey availability for waterbirds). This is reflected in its use by relatively low numbers of waterbirds. Therefore, given the low functionality of this area and the distance away from construction activity, disturbance responses would be expected to be limited in this area.

The nearest functionally important waterbird habitat to the construction activity is the artificial hard substrate ledge roost on the western side of the breakwater. As described in Section 8.6.5, the breakwater is considered an important roost for Oystercatcher and is also used by large numbers of Redshank in some years during September (an important month for the movement of passage birds), as well as by lower numbers of other species roosting such as Curlew. Construction activity on the breakwater itself is expected to be relatively limited with most of the works primarily being undertaken within or on the edge of the marine environment in the harbour (such as the piling and pumping of dredged material). Furthermore, the top of the breakwater (which is several metres above high water) will act as a natural screen to some extent to waterbirds on the Mostyn Bank and other habitats downstream of the Port of Mostyn during the lower phases of the tidal cycle. This will help limit visual disturbance stimuli associated with construction activity. However, it is anticipated that disturbance to some roosting birds on the artificial hard substrate ledge roost on the western section of breakwater could occur during construction particularly due to noise associated piling (which will be undertaken within approximately 100-150 m of the ledge roost).

Feeding habitat of the Mostyn Bank and mudflat habitat between the Mostyn Channel and Salisbury Channel (which is also used by feeding birds) are located over 200 m from piling activity. Therefore, some disturbance to birds in these areas is also considered possible although responses would be expected to be more limited.

Given that waterbirds present in the area are expected to be habituated to some extent to anthropogenic activities (due to existing port operations and also the nearby railway line which is located just above the Mostyn Bank foreshore), any disturbance responses are expected typically to involve infrequent, mild behavioural responses in a localised area in the vicinity of the breakwater and adjacent nearby mudflats for most species. The responses observed are likely to include increased vigilance to short flights with birds rapidly resettling and resuming feeding near their original location. More sensitive species could show localised avoidance and larger disturbance events (causing birds to flush and temporarily disperse from the vicinity of the proposed development). This may particularly be the case initially when birds are likely to be less habituated to the new activity. Rather than being displaced from the local area completely, though, birds would be expected to redistribute to nearby foreshore (such as on the Mostyn Bank) and continue to feed and roost in these alternative locations following dispersal.

It is recognised that during very cold periods, coastal waterbirds are more susceptible to disturbance due to higher energetic costs and greater feeding requirements for thermoregulation. Furthermore, very cold winter weather can cause mudflats and adjacent functionally linked terrestrial habitats used for feeding (such as agricultural land and wet grassland) to freeze. Cold conditions can also cause an influx of waterbirds from continental Europe which have flown to Britain to escape from even colder conditions in these areas. This can further increase competition for feeding resources in an area. The increased difficulty obtaining enough food and greater energy required for thermoregulation can in some situations cause reduced survival rates and appear to make birds seem more tolerant to disturbance as birds avoid using excess energy reserves (Goss-Custard, *et al*., 2006; JNCC, 2021, RSPB, 2010; Collop *et al*., 2016).

In summary, the probability of noise and visual disturbance stimuli occurring during construction is considered to be high. Frequent disturbance at a level which could cause dispersive responses and short-term and localised displacement of coastal waterbirds is anticipated with waterbirds considered particularly vulnerable to the effects of disturbance during very colds winter periods. Magnitude and consequently exposure to change is therefore considered to be medium for all commonly occurring waterbirds. The sensitivity of coastal waterbirds in the area is considered to range from low to moderate depending on the species. Importance is considered to be high for all species because of the protection afforded to coastal waterbirds. Therefore, the impact of temporary disturbance during construction has been assessed as **minor to moderate adverse**.

Otters

This section assesses the potential for impacts on otter receptors as a result of the proposed development during construction. The following impact pathways have been assessed:

- Direct loss or changes to otter populations and habitat; and
- Noise and visual disturbance during construction.

Direct loss or changes to otter populations and habitat

General scientific context

Otters are vulnerable to the loss or damage of their shelters and to the loss of habitat which, in turn, can leave them more exposed to disturbance effects. If shore development overlaps with otter habitat it may result in direct loss or damage of foraging habitat, holts and resting places (couches). When assessing the impacts of construction work, the sensitivities of otter to habitat damage are gauged by the presence or absence of otter activity (e.g. spraints) and by evidence of otter shelters.

Project impact assessment

There is the potential for impacts to otter as a result of foraging habitat loss due to the footprint of the proposed development. Capital dredging also has the potential to result in seabed disturbance and smothering of seabed habitats and species. These changes have the potential to impact on otter through potential changes in prey resources and the extent and quality of foraging habitat.

Otters feed mainly on fish (particularly eels and salmonids), waterbirds, amphibians and crustaceans. They are opportunistic and generalist feeders, which means that they are generally not reliant on a single prey item. They are also mobile species and will easily be able to move away from the zone of influence and utilise other nearby areas for foraging. Furthermore, the area of habitat loss and change will only represent a very small proportion of the foraging ranges and foraging habitat available of otters.

Overall, due to a lack of active holts and/or couches and the availability of alternative habitat and prey species for foraging and commuting otters, the magnitude of change is considered to be small and the probability of occurrence is low. Consequently, the exposure of otter to direct loss or changes to habitat is considered to be negligible. The sensitivity of otter to habitat change on the scale predicted is considered to be low, and therefore vulnerability is assessed as none. Therefore, while the overall importance of otter is high, the impact is assessed as **insignificant**.

Noise and visual disturbance during construction

General scientific context

Otter are sensitive to visual and noise disturbance. They are intolerant of areas subject to intense human activity, such as recreational areas. Noise and visual impacts associated with coastal engineering works may exclude otter from foraging habitat.

Otter move along established routes between open-water habitats, including freshwater sites near the coast, therefore they are sensitive to any activities that could cause a barrier to their established pathways.

Project impact assessment

Otters could be impacted as a result of disturbance due to noise, vibration (activities such as piling, lighting) and increased human activity which could deter animals from using the area of the estuary close to the proposed development during construction.

- Given the temporary and short term nature of the disturbance, the limited presence of otter in the vicinity of the proposed development and the availability of alternative habitat for foraging and commuting animals, the magnitude of change is considered to be medium and the probability of occurrence is low. Consequently, the exposure of otter to noise and visual disturbance is considered to be low/negligible. The sensitivity of otter to disturbance on the scale predicted is considered to be low to moderate, and therefore vulnerability is assessed as none to low. Therefore, while the overall importance of otter is high, the impact is assessed as **insignificant to minor adverse**.

8.7.2 Operational Phase

Based on an understanding of the nature and scale of the proposed development, together with the environmental baseline and stakeholder comments from the Scoping Opinion, the potential effects during the operational phase that are considered to be potentially relevant are reviewed in Table 8.22. This includes the rationale for scoping in or out individual pathways for further assessment.

Table 8.22. Potential effects during operation scoped in and out of further detailed assessment

Receptor	Impact Pathways/Potential Effects	Project activity	Included in assessment?	Justification
Benthic habitats and species	Changes to benthic habitats and species as result of seabed removal during dredging	Maintenance dredging	Yes	Maintenance dredging causes the direct physical removal of marine sediments from the dredge footprint, resulting in the modification of existing marine habitats. The impacts to benthic fauna associated with the dredged material include changes to abundance and distribution through damage, mortality or relocation to a disposal site. This impact pathway has, therefore, been scoped into the assessment.
	Changes to habitats and species as a result of sediment deposition	Maintenance dredging and disposal	Yes	Maintenance dredging and dredge disposal has the potential to result in localised physical disturbance and smothering of seabed habitats and species (where the sediment settles out of suspension back onto the seabed). This will require further assessment and has, therefore, been scoped in.
	Indirect changes to seabed habitats and species as a result of changes to hydrodynamic and sedimentary processes	Maintenance dredging and disposal	No	Maintenance dredging and disposal has the potential to result in changes to hydrodynamic and sedimentary processes (e.g. water levels, flow rates, changes to tidal prism, accretion and erosion patterns). The predicted physical processes impacts from future maintenance dredging will be similar to that which already arises from the ongoing maintenance dredging. The ecological monitoring work that has been undertaken over the last 15 years provides a good ecological description of the range of intertidal habitats across the local sub-system (i.e. around the Approach Channel). The work has not identified any effect or change that is attributable to the Approach Channel maintenance work and has, generally, shown that these habitats have been relatively stable and consistent year on year. However, these habitats do vary naturally as a function of the many physical and ecological forces which act on them (e.g. changing wave/storm environments, different seasonal conditions as well as differences in species movement, recruitment and colonisation success). Where changes have been observed they have been considered to be a function of natural variability and not an indication of change brought about by the Approach Channel dredging work (ABPmer, 2017; ABPmer, 2021). An assessment of the hydrodynamic and sediment regime changes that are predicted to occur as a result of the maintenance dredging are considered in more detail in the physical processes assessment (Chapter 6). Only changes in hydrodynamic and sedimentary processes that are of a negligible magnitude are predicted. These changes are considered unlikely to be discernible against natural processes on nearby habitats. This impact pathway has, therefore, been scoped out of the assessment.

Receptor	Impact Pathways/Potential Effects	Project activity	Included in assessment?	Justification
	Changes in water and sediment quality	Maintenance dredge and dredge disposal	Yes	Changes in water quality during maintenance dredging and dredge disposal could impact benthic habitats and species through an increase in SSC and the release of toxic contaminants bound in sediments. This will require further assessment and has, therefore, been scoped in.
	Underwater noise	Maintenance dredge and dredge disposal	No	The outcomes of the assessment of underwater noise disturbance from capital dredging activities during construction will be the same for maintenance dredging activities during operation. Underwater noise effects on benthic invertebrates were assessed as insignificant during capital dredging. The magnitude of potential impact is considered equivalent during maintenance dredging. The potential effect is, therefore, considered to be insignificant and has been scoped out of more detailed assessment.
	Underwater noise	Vessel operations	No	During the operational phase, there is the potential for noise disturbance to benthic invertebrate species as a result of vessel movements. The worst case source level associated with vessels during operation is the same as for dredging activity and, therefore, the predicted ranges of effect applicable to vessel and dredging operations are the same. The potential effect is, therefore, considered to be insignificant and has been scoped out of more detailed assessment.
	Non-native species transfer during vessel operations	Vessel operations	Yes	Non-native species have the potential to be transported into the local area on the hulls of vessels during operation. Non-native invasive species also have the potential to be transported via vessel ballast water. This impact pathway has, therefore, been scoped into the assessment.
Fish	Changes to fish populations and habitat	Maintenance dredge and dredge disposal	yes	Maintenance dredging has the potential to result in seabed disturbance and smothering of seabed habitats and species. These changes have the potential to impact on fish species through potential changes in prey resources and the quality of foraging, nursery and spawning habitats. This will require further assessment and has, therefore, been scoped in.
	Changes in water and sediment quality	Maintenance dredge and dredge disposal	Yes	Changes in water quality during maintenance dredging could impact fish species through an increase in SSC and the release of toxic contaminants bound in sediments. This will require further assessment and has, therefore, been scoped in.
	Underwater noise	Maintenance dredge and dredge disposal	No	The outcomes of the assessment of underwater noise disturbance from capital dredging activities during construction will be the same for maintenance dredging activities during operation. A worst case source level for all types of dredgers has been applied to the underwater noise assessment and, therefore, the predicted ranges of effect are applicable to both the maintenance and capital dredging activities. Underwater noise effects on fish were assessed as insignificant during capital dredging. The magnitude of potential impact is considered equivalent during maintenance dredging. The potential effect is, therefore, considered to be insignificant and has been scoped out of more detailed assessment.

Receptor	Impact Pathways/Potential Effects	Project activity	Included in assessment?	Justification
	Underwater noise	Vessel operations	No	During the operational phase, there is the potential for noise disturbance to fish species as a result of vessel movements. The worst case source level associated with vessels during operation is the same as for dredging activity and, therefore, the predicted ranges of effect applicable to vessel and dredging operations are the same. Overall, only mild behavioural responses in close proximity to the Ro-Ro vessels are anticipated with noise levels unlikely to be discernible above ambient levels in the wider Dee Estuary area. This impact pathway has, therefore, been scoped out of more detailed assessment.
Marine mammals	Underwater noise	Maintenance dredge and dredge disposal	No	The outcomes of the assessment of underwater noise disturbance from capital dredging activities during construction will be the same for maintenance dredging activities during operation. A worst case source level for all types of dredgers has been applied to the underwater noise assessment and, therefore, the predicted ranges of effect are applicable to both the maintenance and capital dredging activities. Underwater noise effects on marine mammals were assessed as insignificant during capital dredging with only short-term and mild behavioural response predicted. The magnitude of potential impact is considered equivalent during maintenance dredging. The potential effect is, therefore, considered to be insignificant and has been scoped out of more detailed assessment.
	Underwater noise	Vessel operations	No	During the operational phase there is the potential for noise disturbance to marine mammal species as a result of vessel movements. The worst case source level associated with vessels during operation is the same as for dredging activity and, therefore, the predicted ranges of effect applicable to vessel and dredging operations are the same. Overall, only mild behavioural responses in close proximity to the Ro-Ro vessels are anticipated with noise levels unlikely to be discernible above ambient levels in the wider Dee Estuary area. The potential effect is, therefore, considered to be insignificant and has been scoped out of more detailed assessment.
	Visual disturbance of hauled out seals	Vessel operations	No	The nearest haul out site to the proposed development and maintenance dredge areas is located on the West Hoyle sandbank near Hilbre Island (approximately 3 to 5 km away). No established seal haul out sites are known to occur nearer to the proposed development. Seals which are hauled out on land, either resting or breeding, are considered particularly sensitive to visual disturbance (Hoover-Miller *et al.*, 2013). The level of response of seals is dependent on a range of factors, such as the species at risk, age, weather conditions and the degree of habituation to the disturbance source. Hauled out seals have been recorded becoming alert to powered craft at distances of up to 800 m although seals generally only disperse into the water at distances <150 to 200 m (Wilson, 2014; Mathews, *et al.*, 2016; Henry and Hammill, 2001; Strong and Morris, 2010). For example, in a study focusing on a colony of grey seals on the South Devon coast, vessels approaching at distances between 5 m and 25 m resulted in over 64 %

Receptor	Impact Pathways/Potential Effects	Project activity	Included in assessment?	Justification
				of seals entering the water, but at distances of between 50 m and 100 m only 1 % entered the water (Curtin *et al*., 2009). Recent disturbance research has also found no large-scale redistribution of seals after disturbance with most seals returning to the same haul out site within a tidal cycle (Paterson *et al*., 2019). Based on this evidence, seals hauled out on the West Hoyle sandbank are out the zone of influence of any potential visual disturbance effects as a result of maintenance dredging and vessel operations. The potential for disturbance to hauled out seals has, therefore, been scoped out of further detailed assessment.
	Collision risk	Vessel operations	No	Vessels using the berths during operation will be typically approaching at slow speeds (2-4 knots) and maintenance dredging/dredge disposal will be mainly stationary or travelling at low speeds (2-6 knots), making the risk of collision very low. Although all types of vessels may collide with marine mammals, vessels traveling at a speeds over 10 knots are considered to have a much higher probability of causing lethal injury (Schoeman *et al*., 2020). Furthermore, the region is already characterised by a high level of shipping traffic. The additional operational vessel movements resulting from the proposed development will constitute an increase in vessel traffic in the area. The projected shipping movements will equate to an average increase to 11 movements per week during the construction of the AyM OWF between 2025 and 2026 and 25 movements per week during the construction of Morgan/Mona OWFs between 2027 and 2030 (Commercial and Recreational Navigation Chapter 10). These levels are lower than the approximately 32 vessel movements per week in the past at the Port of Mostyn when general cargo ships and a twice daily ferry service was in operation. In general, incidents of mortality or injury of marine mammals caused by vessels remain a relatively rare occurrence in UK waters (ABP Research 1999; CSIP, 2020). For example, out of 144 post mortem examinations carried out on cetaceans in 2018, only two (1.4 %) were attributed to boat collision with the biggest causes of mortality including starvation and by-catch, although some incidents are likely to remain unreported (CSIP, 2020). In addition, marine mammals frequently foraging within the region will routinely need to avoid collision with vessels and are, therefore, considered adapted to living in an environment with high levels of vessel activity. This impact pathway has, therefore, been scoped out of further detailed assessment.
Coastal waterbirds	Disturbance of waterbirds during operation	Berth operations	Yes	During operation, there is the potential for airborne noise and visual disturbance to affect coastal waterbirds. This impact pathway has, therefore, been scoped into the assessment.

Benthic habitats and species

This section assesses the potential for impacts on benthic habitats and species receptors as a result of the proposed development during operation. The following impact pathways have been assessed:

- Changes to benthic habitats and species as result of seabed removal during maintenance dredging;
- Changes to habitats and species as a result of sediment deposition during maintenance dredging and dredge disposal;
- Changes in water and sediment quality during maintenance dredging and dredge disposal; and
- Introduction and spread of non-native species during operation.

Changes to benthic habitats and species as result of seabed removal during maintenance dredging

General scientific context

Scientific evidence on this potential impact pathway has already been provided in Section 8.7.1 and is, therefore, not repeated here.

Project impact assessment

Once the constructed quay is operational, a maintenance dredging and disposal programme for the new and existing berths will be put in place. The marine works will also comprise the continued ongoing maintenance dredging of the navigation channel to a depth of -4 m CD. The maintenance dredge area is shown as the red line application boundary on Figure 3.3 in the Project Methodology Chapter 3.

The maintenance dredge area comprises a polygon that shows where maintenance dredging of the navigation channel may take place in response to the natural movement of the Salisbury and Mostyn channels. In reality, any dredging that is required will be limited to one main channel that is dominant at any given time and will not take place across the entire area of the polygon. This will maintain the volume of dredging that is required to a minimum.

The total volume of maintenance dredge material that is permitted to be dredged is up to 900,000 tonnes (approximately 600,000 m^3) per annum under the existing dredge marine licence (DML1542v2) and an additional 99,990 tonnes (approximately 66,660 m^3) per annum under the existing dredge marine licence (DML2001). The total volume of maintenance dredge material that needs to be removed from the new berth, harbour and navigation channel is estimated to be up to 600,000 m^3per annum which remains within the cap set in the existing marine licences.

A range of dredging methods, including TSHD, plough and water injection dredging (WID) techniques are likely to be used for the maintenance dredge activities as per the existing licences.

Maintenance dredging causes the direct physical removal of marine sediments from the dredge footprint, resulting in the modification of existing marine habitats. The impacts to benthic fauna associated with the dredged material include changes to abundance and distribution through damage, mortality or relocation to the disposal site (impacts at the proposed disposal sites are assessed in detail below).

Following maintenance dredging, sediment in the dredged areas would be expected to start to recolonise relatively rapidly by a similar assemblage to baseline conditions. The project-specific subtidal survey (Section 8.6.2 and Appendix 8.1 of the ES) recorded an impoverished benthic community characterised by low numbers of the polychaete *Nephtys* sp. (particularly *Nephtys hombergii),* oligochaete *Tubificoides benedii,* nematodes and juvenile blue mussel Mytilus edulis. These characterising species dominated the assemblage and contributed almost entirely to the total abundances of organisms recorded at most of the sites. Other species recorded included the bivalve *Limecola balthica* and polychaete *Eteone longa*. These species are typically fast growing and/or have rapid reproductive rates which allow populations to fully re-establish in typically less than 1-2 years and for some species within a few months (De-Bastos, 2016b; Tillin and Mainwaring, 2016; Tillin and Ashley, 2018).

Maintenance dredging, however, will cause an ongoing source of seabed disturbance, albeit in the localised areas that require regular dredging. Benthic data suggests that the shallow sandy channel habitats in the Dee Estuary are generally relatively impoverished which is likely to reflect the existing high levels of natural physical disturbance in the area due to strong near bed tidal currents and sediment transport (Section 8.6.2). All the species recorded are also considered commonly occurring and not protected, with the faunal assemblage recorded also considered characteristic of subtidal habitats found more widely in this section of the Dee Estuary (GoBe Consultants Ltd., 2011; ERM, 2009).

Based on the evidence provided above and applying the project impact assessment methodology, the magnitude of the change to the subtidal habitats and associated benthic species is considered to be small and although the probability of occurrence is high, the overall exposure is assessed as low. The sensitivity of subtidal habitats to seabed disturbance within the dredge footprint is considered to be low given the high recoverability rates. Vulnerability is, therefore, assessed as low. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Importance is, therefore, considered to be low for subtidal habitats. Overall, the potential effect is assessed as **insignificant to minor**.

Direct changes to benthic habitats and species as a result of deposition during maintenance dredging and dredge disposal

General scientific context

Scientific evidence on this potential impact pathway has already been provided in Section 8.7.1 and is, therefore, not repeated here.

Project impact assessment: Maintenance dredging

Sediment changes that are predicted to occur as a result of the maintenance dredging are considered in more detail in the physical processes assessment (Chapter 6). In summary, as a result of a less intensive dredge programme (and an overall lower predicted dredge volume), future maintenance dredging will result in smaller changes in sedimentation within the dredge plumes compared to the capital dredge. Furthermore, the predicted impacts from future maintenance dredging will be similar to that which already arises from the ongoing maintenance of the existing Port and channel areas.

The majority of habitat located in close proximity to the proposed maintenance dredge footprint on Salisbury Bank (adjacent to the Port of Mostyn) consists of tide-swept sandflat habitat which consists of a clean sand substratum with a relatively species poor, macrofaunal community which low numbers of mobile crustaceans (such as *Bathyporeia pilosa* and *Eurydice pulchra*) and polychaetes (such as *Nephtys* spp.). Stable mudflat and sandy mud habitats in the local area are characterised by typical mud dwelling species such as the bivalves (peppery furrow shell *Scrobicularia plana*, common cockle *Cerastoderma edule*, Baltic tellin *Limecola balthica*), polychaetes (such as *Hediste diversicolor)*, mud snail *Peringia ulvae,* mud shrimp *Corophium volutator,* and the oligochaete *Tubificoides* spp. (Section 8.6.2).

These burrowing infaunal species are considered tolerant to some sediment deposition. The predicted millimetric changes in deposition are, therefore, considered unlikely to cause smothering effects as described above. In addition, the species recorded in the benthic invertebrate surveys are fast growing and/or have rapid reproductive rates which allow populations to typically rapidly recolonise disturbed habitats, many within a few months following the disturbance events (Ashley and Budd, 2020; Ashley, 2016, Tillin, 2018).

It should also be noted that the subtidal channel habitats and adjacent intertidal habitats in the area of the proposed maintenance dredging are already subject to high levels of deposition naturally. This is as result of high background suspended sediment concentrations and strong hydrodynamic conditions (due to tidal flows and the exposed nature of in the Dee Estuary) causing the resuspension and deposition of sediments on a daily basis and the regular movement of morphological features such as sand waves which are often dynamic in nature (ABPmer, 2021; ABPmer, 2017).

Deposition of sediment as a result of dredging will be similar to background variability. Magnitude of change is, therefore, assessed as negligible. Probability of occurrence is high and thus the overall exposure to change is negligible. Based on the evidence provided above, sensitivity of intertidal and subtidal habitats within the vicinity of the proposed works to increased smothering are considered to be low given that these species are well adapted to survival under fluctuating sediment conditions and have high recoverability rates. Vulnerability is therefore assessed as none. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high. Taking all these factors into consideration, the overall potential impact of deposition on benthic features is assessed as **insignificant**.

Project impact assessment: Dredge disposal

The maintenance dredge material comprises predominately fine to medium sand (60-70 %) with smaller variable proportions of silt (30-40 %). The material that is removed is proposed to be disposed of and/or reused as is currently permitted under the existing maintenance dredge and disposal marine licences, specifically:

- Up to 900,000 tonnes (approximately 600,000 m^3) per annum to be transported and disposed of at the existing Mostyn Deep disposal site (IS102); and
- Up to 99,990 tonnes (approximately 66,660 m^3) per annum to be pumped through a floating pipeline directly into the existing Mostyn Breakwater disposal site (IS103).

- In addition, up to 150,000 tonnes (approximately 75,000 m^3) per annum to be pumped ashore into a prepared site at the Port of Mostyn to be beneficially used in other local construction projects.

An assessment of the sediment changes that are predicted to occur as a result of the disposal of maintenance dredge arisings is presented in more detail in the physical processes assessment (Chapter 6 of the ES). In summary, as a result of a less intensive dredge programme (and an overall lower predicted dredge volume), future maintenance dredging will result in smaller changes in sedimentation within the disposal site(s)) compared to the capital dredge. Furthermore, the predicted impacts from future maintenance dredging will be similar to that which already arises from the ongoing maintenance of the existing Port and channel areas.

The maintenance dredge and disposal volumes will remain within the cap set in the existing marine licences (DML1542v2 and DML2001). In addition, the same dredging and disposal methods as is currently permitted will also continue be used. Furthermore, the character of the maintenance dredge material is not expected to change (comprising predominantly recently deposited fine to medium sand with smaller variable proportions of silt). On this basis, it is considered that the likely impacts on marine receptors as a result of maintenance dredge disposal will be comparable to the existing maintenance dredge regime.

The Mostyn Deep disposal site (IS102) and Mostyn Breakwater disposal site (IS103) are located in areas subject to regular natural physical disturbance (and associated scouring) as a result of very strong tidal flows. These disposal sites have been characterised for the disposal of maintenance dredge arisings and the current permitted levels under the existing marine licences are not proposed to change as noted above. Since the renewed maintenance dredge and disposal licence was granted in December 2019, the total disposal quantity at the Mostyn Deep disposal site (IS102) has been approximately 100,000 m^3 and the annual average disposal quantity has been around 50,000 m^3, indicating some spare capacity. No material has been disposed of at the Mostyn Breakwater disposal site (IS103) since the licence was granted in October 2020, indicating some spare capacity. The regular disturbance caused by existing natural processes, and to less of an extent by the intermittent disposal activity, is reflected in a generally impoverished assemblage in the vicinity of the disposal site.

The benthic species recorded in the area of the disposal sites include mobile infauna (such as errant polychaetes e.g. *Nephtys* spp. and mobile crustaceans) which are able to burrow through sediment. They are, therefore, considered tolerant to some sediment deposition. In addition, characterising species typically have opportunistic life history strategies, with short life histories (typically two years or less), rapid maturation and the production of large numbers of small propagules which makes them capable of rapid recoverability should mortality as a result of smothering occur (Ashley and Budd, 2020; De-Bastos 2016b; Tillin, 2018; Ashley, 2016; Tyler-Walters and Garrard, 2019). On this basis, any effects are considered to be temporary and short term.

In summary, deposition in the wider area surrounding the disposal sites is expected to be in the order of millimetres based on the physical processes assessment (Chapter 6 of the ES). Sedimentation of this scale is unlikely to result in significant smothering effects to most faunal species with recoverability expected to be high.

The magnitude of the change during disposal is considered to be negligible in the context of background variability. Probability of occurrence is high and the overall exposure is, therefore, negligible. Given that habitats and species within and around the disposal site are well adapted to disturbed conditions with high recoverability rates, sensitivity is considered to be low and thus vulnerability is considered to be none. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high. The overall potential impact of deposition on benthic features is assessed as **insignificant**.

Changes in water and sediment quality during maintenance dredging and dredge disposal

General scientific context

Scientific evidence on this potential impact pathway has already been provided in Section 8.7.1 and, is therefore, not repeated here.

Project impact assessment: Maintenance dredging

Elevated suspended sediment concentrations

The changes in SSC that are predicted to occur as a result of maintenance dredging are considered in more detail in the physical processes assessment (Chapter 6). In summary, as a result of a less intensive dredge programme (and an overall lower predicted dredge volume), future maintenance dredging will result in smaller changes in SSC within the dredge plumes compared to the capital dredge. Furthermore, the predicted impacts from future maintenance dredging will be similar to that which already arises from the ongoing maintenance of the existing Port and channel areas

Naturally very high SSC typically occur year-round in the Dee Estuary, particularly during the winter months when storm events disturb the seabed and on spring tides (Uncles *et al.*, 2013; Cefas, 2016). The estuarine benthic communities recorded on mudflats and the shallow mud in the region are considered tolerant to this highly turbid environment (De-Bastos, 2016b; Tillin, 2016; Ashley, 2016). The predicted SSCs are within the range that can frequently occur naturally and also as a result of ongoing dredge and disposal activity (Physical Processes Chapter 6).

In summary, the predicted increases in SSC due to the maintenance dredging will be localised and temporary based on the outcomes of the physical processes assessment (Chapter 6). Magnitude of change is assessed as negligible. Probability of occurrence is high and thus the overall exposure to change is negligible. Based on the evidence provided above, sensitivity of benthic habitats and species within the vicinity of the proposed development to increases in suspended sediments are considered to be low given that these receptors are well adapted to living in high suspended sediment conditions. Vulnerability is therefore assessed as none. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites, although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high. The overall effect of suspended sediments on benthic habitats and species is assessed as **insignificant**.

Dissolved oxygen

With respect to dissolved oxygen, increases in SSC will be brief and localised and there is not expected to be a significant reduction in dissolved oxygen as assessed in the Water and Sediment Quality assessment in Chapter 7 of this ES. The probability of a localised effect is, therefore, medium to high but the magnitude of change is considered to be negligible, leading to a negligible exposure to change. On this basis the impact is assessed as **insignificant.**

Release of contaminants

The potential to impact the marine environment as a result of any sediment-bound contaminants arises primarily when the sediment that is released into the water column disperses and deposits elsewhere.

Sampling and subsequent chemical analysis has been undertaken in accordance with the agreed NRW sample plan. The results of this analysis are summarised in more detail in the Water and Sediment Quality Chapter 7. The contaminants in the sediments of the proposed dredge area are at low concentrations. Concentrations were mostly below Cefas Action Level 1 (AL1), with a few marginal exceedances. There were no exceedances of Action level 2 (AL2) in any sediment samples analysed. The material that will accumulate during operation and be removed during maintenance dredging is anticipated to be similar to the surficial sediment samples that have been recently sampled. Furthermore, sedimentation away from the dredge location is predicted to be relatively localised (see Physical Processes Chapter 6). It is, therefore, unlikely that sediment quality will decline elsewhere, as a result of the redistribution of material during maintenance dredging. In addition, maintenance dredging as part of the MEPE Project will be undertaken as part of the Port's regular sediment sampling and testing to ensure the material remains suitable for disposal at sea as is the case with the existing maintenance dredge and disposal licences.

Based on existing available information, the overall level of contamination in the proposed dredge area is considered to be low with only a small proportion of disturbed material expected to be raised into suspension. This material will be rapidly dispersed by strong tidal currents in the area. Significant elevations of contamination in the water column are, therefore, not anticipated. Based on these factors, the magnitude of change to subtidal habitat and species is considered to be negligible. Subsequently, exposure of benthic habitats and species to potential contaminants is also assessed as negligible. The sensitivity of subtidal habitats and species to contaminants is assessed as low to moderate because, although contaminants can cause toxicity in intertidal and subtidal communities, the concentrations of contaminants required to produce both lethal and sub-lethal effects are generally high (although responses vary considerably between species). Thus, marine habitats and species are not considered to be vulnerable to water quality changes associated with the scale of the proposed dredge. Vulnerability is, therefore, assessed as none. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high. The overall potential impact of contamination on benthic habitats and species is assessed as **insignificant.**

Project impact assessment: Dredge disposal

Elevated suspended sediment concentrations

The hydrodynamic and sediment regime changes that are predicted to occur as a result of the dredge disposal is considered in more detail in the physical processes assessment (Chapter 6). In summary, as a result of a less intensive dredge programme (and an overall lower predicted dredge volume), future maintenance dredging will result in smaller changes in SSC at the disposal site(s) compared to the capital dredge. Furthermore, the predicted impacts from future maintenance dredging will be similar to that which already arises from the ongoing maintenance of the existing Port and channel areas.

Naturally very high SSCs typically occur year-round in the Dee Estuary, particularly during the winter months when storm events disturb the seabed and on spring tides. The estuarine benthic communities recorded on mudflats and the shallow mud in the region are considered tolerant to this highly turbid environment (De-Bastos, 2016b; Tillin, 2016; Ashley, 2016). The predicted SSCs are within the range that can frequently occur naturally and also as a result of ongoing dredge and disposal activity (Chapter 6).

The disposal of sediment will temporarily increase SSC, however, due to the strong hydrodynamic conditions in the area, these temporary elevations in SSC are expected to rapidly dissipate to background concentrations. Magnitude of change is therefore assessed as negligible. Probability of occurrence is high and thus the overall exposure to change is negligible. Sensitivity of benthic features within the disposal ground and surrounding area to increases in suspended sediments are considered to be low given that these species are well adapted to survival in conditions with elevated SSCs. Vulnerability is, therefore, assessed as none. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites, although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high. The overall effect of suspended sediments on benthic habitats and species is assessed as **insignificant**.

Release of contaminants

The results of the sediment contamination sampling are summarised above and the Water and Sediment Quality chapter (Chapter 7 of the ES). In summary, low levels of contamination were found in the samples and there is no reason to believe the sediment will be unsuitable for disposal in the marine environment.

During disposal, sediment will be rapidly dispersed in the water column. Therefore, the already low levels of contaminants in the dredged sediments will be dispersed further. The probability of changes in water quality occurring at the disposal site is considered to be low and the overall exposure to change is considered to be negligible. The sensitivity of subtidal habitats and species to contaminants is assessed as low to moderate because, although contaminants can cause toxicity in subtidal communities, the concentrations of contaminants required to produce both lethal and sub-lethal effects are generally high (although responses vary considerably between species). Thus, subtidal habitats and species are not considered to be vulnerable to water quality changes at the disposal site in the context of the disposal of the dredged arisings. Vulnerability is, therefore, assessed as none. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high. The overall potential impact of deposition on benthic features is assessed as **insignificant.**

Introduction and spread of non-native species during operation

General scientific context

Scientific evidence on this potential impact pathway has already been provided in Section 8.7.1 and is, therefore, not repeated here.

Project impact assessment

Non-native species have the potential to be transported into the local area on vessels' hulls or via ballast water discharges once the proposed development is being used by vessels (i.e. is operational). However, the majority of vessels using the jetty will be undertaking relatively local movements between the Port of Mostyn and offshore windfarms in Liverpool Bay, and in the Irish and Celtic Seas, rather than more distant travel (which are considered more likely to spread non-native species more widely or increase the likelihood of introducing new species into the Dee Estuary).

On this basis and in view of existing legislation and best practice procedures, the probability of the introduction and spread of non-native species from the operational phase is considered to be low. However, given that the magnitude of change is unknown, magnitude ranges from negligible to large depending upon the scale and nature of any non-native species introduction, thus the exposure ranges from negligible to low at worst. The sensitivity of all intertidal and subtidal receptors to non-native species introductions is expected to range from low to moderate. Vulnerability is, therefore, considered to be low. Subtidal species in the area are considered to be commonly occurring and of low conservation concern with the habitats not characteristic of any of the qualifying features of overlapping designated sites although it is noted that subtidal habitats form a component of the 'Estuaries' feature of the SAC. Intertidal habitats in the study area are considered to be of low to high importance with variations taking into account not only their designated status (such as if they are a qualifying/sub-feature of the Dee Estuary SAC, supporting habitat of the Dee Estuary SPA or a NERC Habitat of Principle Importance) but also how representative they are of the physical form and ecological structure and function of the qualifying feature and/or the ecological value and functional importance they provide in terms of benthic prey resources for intertidal birds. Importance is, therefore, considered to range from low to high (for intertidal habitats). The overall potential impact of deposition on benthic features is assessed as **insignificant.**

Fish and shellfish

This section assesses the potential for impacts on fish and shellfish receptors as a result of the proposed development during operation. The following impact pathways have been assessed:

- Changes to fish populations and fish habitat during maintenance dredging and dredge disposal; and
- Changes in water and sediment quality during maintenance dredging and dredge disposal.

Changes to fish and shellfish populations and fish habitat during maintenance dredging and dredge disposal

General scientific context

Scientific evidence on this potential impact pathway has already been provided in Section 8.7.1 and is, therefore, not repeated here.

Project impact assessment; Maintenance dredging

Dredging by TSHD has the potential to result in the direct uptake of fish and fish eggs by the action of the suction pump (entrainment). Maintenance dredging also has the potential to result in seabed disturbance and smothering of seabed habitats and species. These changes have the potential to impact on fish species through potential changes in prey resources and the quality of foraging, nursery and spawning habitats.

Potential prey items for flatfish and demersal fish such as the mud shrimp *Corophium volutator* and polychaete worms occur in the area of the maintenance dredge footprint (Ashley and Budd, 2020). However, most fish species are opportunistic and generalist feeders, which means that they are generally not reliant on a single prey item. Fish are also mobile species and will easily be able to move away from the zone of influence and utilise other nearby areas for foraging. Furthermore, the area of habitat loss and change will only represent a small proportion of the foraging ranges of many fish species (particularly the larger and more commercial species such as whiting, plaice and Dover sole).

During dredging, there is the potential for fish along with roe (eggs) of these species to be removed. The region is known to support whiting, sandeel, plaice and sole spawning grounds. However, the dredge footprint and nearby area is already subject to regular natural seabed disturbance due to strong tidal currents and also seabed disturbance as a result of existing vessel movements and ongoing maintenance dredging. The dredge footprint and nearby area is, therefore, likely to provide disturbed and sub-optimal spawning conditions with more optimal habitat present in the wider region. In addition, both the dredge footprint and reclamation area are considered negligible in the context of suitable nursery habitat in the region.

The cockle bed known as 'New Bed' overlaps the maintenance dredge area and there are a number of other cockle beds all located nearby, including Mostyn New and Salisbury (Image 8.1, Section 8.6.3). As noted above, the maintenance dredge area comprises a large area to ensure it takes account of the natural movement of the Salisbury and Mostyn channels. Dredging will not take place across the whole area and will be limited to one main channel that is dominant at any given time. The cockle beds are located on intertidal habitat and, therefore, will not directly overlap with the maintenance dredge activities which will take place on subtidal habitat. In addition, deposition levels during maintenance dredging on nearby intertidal habitats are expected to be within the range of natural variability as described above for 'Benthic habitats and species'. On this basis, potential effects due to habitat loss or change on commercially exploited shellfish beds are anticipated to be negligible.

Based on these factors, magnitude is considered to be small and probability medium. Consequently, the exposure of all fish and shellfish to direct habitat changes is considered to be negligible to low. The sensitivity of fish and shellfish to habitat change on the scale predicted is considered to be low, leading to a low vulnerability. Therefore, while the overall importance of certain fish and shellfish species is high (i.e. for fish species of conservation interest), the impact is assessed as **insignificant to minor adverse**.

Project impact assessment: Dredge disposal

The disposal of dredged material at the marine disposal sites will result in the deposition of sediments which has the potential to cause physical disturbance and smothering of seabed habitats.

The disposal sites are located in highly dynamic areas subject to regular natural physical disturbance (and associated scouring) as a result of very strong tidal flows, and to less of an extent any deposition due to regular existing maintenance dredge and disposal activity. This is reflected in an impoverished benthic assemblage at both disposal sites (characterised by a few opportunistic species in very low numbers). This area is, therefore, likely to provide limited prey resources for fish species. In addition, as described above in the 'Benthic habitats and species' sub-section, benthic infaunal species characterising the disposal site are considered likely to show some tolerance to sediment deposition and also rapid recoverability rates. On this basis, potential effects on prey resources for fish are expected to be of low magnitude and temporary. Furthermore, fish are mobile species and will easily be able to move away from the zone of influence and return following the cessation of disposal activity. The highly disturbed nature of the seabed is also unlikely to provide suitable conditions as a spawning or nursery area for fish.

Based on these factors, magnitude is considered to be small and probability medium. Consequently, the exposure of all fish to direct habitat changes is considered to be negligible to low. The sensitivity of fish to habitat change on the scale predicted is considered to be low, leading to a low vulnerability. Therefore, while the overall importance of certain fish species is high (i.e. for fish species of conservation interest), the impact is assessed as **insignificant to minor adverse**.

Changes in water and sediment quality during maintenance dredging and dredge disposal

General scientific context

Scientific evidence on this potential impact pathway has already been provided in Section 8.7.1 and is, therefore, not repeated here.

Project impact assessment: Maintenance dredging

The changes in SSC that are predicted to occur as a result of maintenance dredging are considered in more detail in the physical processes assessment (Chapter 6) and summarised above in the sub-section 'Benthic habitats and species'.

As noted in Section 8.7.1, fish within the Dee Estuary are well adapted to living in an area with variable and typically very high suspended sediment loads. Fish feed on a range of food items and, therefore, their sensitivity to a temporary change in the availability of a particular food resource is considered to be low. Their high mobility enables them to move freely to avoid areas of adverse conditions and to use other food sources in the local area.

As highlighted Section 8.7.1, salmonids and other migratory fish can be sensitive to elevated suspended sediment concentrations. However, Atlantic salmon and sea trout are both known to migrate through estuaries with high SSCs to get to spawning areas (including the Dee Estuary which is considered one of the estuaries in the UK with particularly high levels of SSCs). Other migratory species such as lamprey and shad species also pass through estuaries with high suspended sediments. Elevated SSCs due to dredging are considered to be of a magnitude that can occur naturally or as a result of ongoing maintenance dredging/disposal.

Sediment plumes resulting from dredging will be relatively localised (in the context of the entire width of the Dee Estuary) and are also considered to dissipate relatively rapidly and be immeasurable against background levels within a relatively short duration of time (less than a single tidal cycle) as described in more detail in the physical processes assessment (Chapter 6). Therefore, salmonids and other migratory fish would also be able to avoid the temporary sediment plumes. Based on these factors, there is considered limited potential for migrating fish to be adversely affected by the predicted changes in SSC.

Given that elevated SSCs due to dredging are considered to be in the range of variability that can occur naturally in the Dee Estuary (which has very high SSCs year-round, particularly during the winter months), as well as due to ongoing maintenance dredging/disposal, and that the plumes will be temporary in nature, sensitive life stages of fish occurring in the region such as larvae and juvenile fish are considered unlikely to be adversely affected by the dredging.

With respect to shellfish, cockles and mussels are considered well adapted to estuarine conditions where turbidity is very high, including in the Dee Estuary (Tillin and Tyler-Walters, 2016; Tillin *et al.*, 2022) and sediment plumes are predicted to be temporary and immeasurable against background conditions way from a localised area around the dredging activity.

Therefore, while the probability of a localised and temporary change is high, magnitude of change will be negligible and consequently exposure to change is assessed as negligible. Sensitivity of fish and shellfish is assessed as low to moderate and consequently vulnerability is assessed as none. Therefore, while the overall importance of certain fish and shellfish species is high (i.e. for fish species of conservation interest), the impact is assessed as **insignificant**.

With respect to dissolved oxygen, increases in SSC will be brief and localised and there is not expected to be a significant reduction in dissolved oxygen as assessed in the Water and Sediment Quality Chapter 7. The probability of a localised effect is, therefore, medium to high but the magnitude of change is considered to be negligible, leading to a negligible exposure to change. Whilst the sensitivity of fish and shellfish is considered to be low to moderate and certain species have a high nature conservation importance, the impact is assessed as **insignificant.**

With respect to sediment contamination, low levels of contamination were found in the sediment contamination samples as presented in the Water and Sediment Quality Chapter 7. Based on this sampling data, the overall level of contamination in the proposed dredge area is considered to be low, and the sediment plume would be expected to rapidly dissipate by the strong tidal currents in the area. Significant elevations in the concentrations of contaminants within the water column are, therefore, not anticipated. Based on these factors, the magnitude of change to fish and shellfish species is considered to be negligible. Subsequently, exposure of fish and shellfish species to potential contaminants is assessed as negligible. Given that the sensitivity of fish and shellfish is considered to be low to moderate and the overall importance is considered to range from low to high, depending on the ecological value and protected status of individual species, the impact is assessed as **insignificant.**

Project impact assessment: Dredge disposal

The changes in SSC that are predicted to occur as a result of the disposal activities are considered in more detail in the Physical Processes assessment (Chapter 6 of the ES) and summarised above in the sub-section 'Benthic habitats and species'.

The disposal of sediment will temporarily increase SSC, however, due to the strong hydrodynamic conditions in the area, these temporary elevations in SSC are expected to rapidly dissipate to background concentrations within a matter of hours and before the next disposal. As highlighted above, migratory species including Atlantic salmon are known to migrate through estuaries with high SSCs (including the Dee Estuary which is considered one of the estuaries in the UK with particularly high levels of SSCs) and the predicted SSCs are within the range that can frequently occur naturally and also as a result of ongoing dredge and disposal activity. Sediment plumes resulting from disposal will also be relatively localised in the context of the entire width of the estuary. Therefore, salmonids and other migratory fish would also be able to avoid the temporary sediment plumes.

Based on these factors, magnitude of change is, therefore, assessed as negligible. Probability of occurrence is high and thus the overall exposure to change is negligible. Therefore, while the sensitivity of fish is low to moderate and certain species have a high nature conservation importance (e.g. migratory Atlantic salmon and lamprey) any impact is assessed as **insignificant**.

With respect to sediment contamination, the results of the sediment contamination sampling are summarised above, and in the Water and Sediment Quality Chapter 7. In summary, generally low levels of contamination were found in the samples and there is no reason to believe the sediment will be unsuitable for disposal in the marine environment.

Based on the results of the sediment sampling survey, the overall level of contamination in the proposed dredge area is considered to be low. During disposal, sediment will be rapidly dispersed in the water column. Therefore, the already low levels of contaminants in the dredged sediments will be dispersed further. The probability of changes in water quality occurring at the disposal site is considered to be low and the overall exposure to change is considered to be negligible. Therefore, while the sensitivity of fish is low to moderate and certain species have a high nature conservation importance, any impact will be **insignificant**.

Coastal waterbirds

This section assesses the potential for impacts on coastal waterbird receptors as a result of the proposed development during operation. The following impact pathway has been assessed:

- Disturbance of waterbirds during operation.

Disturbance of waterbirds during operation

General scientific context

The operational phase of ports and other coastal developments provides a source of potential disturbance in the coastal environment. Waterbird monitoring work in the vicinity of port locations has generally recorded limited evidence of birds on nearby intertidal habitat being disturbed through regular land side port operations with birds often becoming habituated (such as the movement of vehicles, cranes and cargo containers) (ABPmer; 2015; ABPmer, 2013). For example, Cutts (2021) reported that most species of waterbird assemblages utilising estuarine habitats adjacent scale infrastructure (such as e.g. power stations, jetties, bridges, port facilities etc) appear to tolerant and will both roost and forage within less than 50 m of infrastructure. Waterbirds have also been recorded regularly feeding under large industrial jetties as well as roosting on jetties and harbour walls.

Disturbance events have also been recorded as part of the ornithology monitoring in the Port of Immingham area (Humber Estuary) from winter 2005/06 to winter 2021/22. This includes any potential disturbance due to operational activities on various jetties near intertidal mudflats. During the surveys the vast majority of the disturbance observed was caused due to either raptors (such as peregrine and sparrowhawk), recreational activities (angling or dog walking) or maintenance work on the seawall.

Disturbance was also recorded on several occasions as a result of construction or maintenance work on several of the jetties. However, no disturbance was recorded as a result of vessel movements or operational activity at or near the berths or jetties.

In general, human presence on the foreshore (e.g. walking) is considered to cause greater disturbance than vehicles or watercraft (McLeod *et al.,* 2013; Guay *et al.,* 2014; IECS, 2009a). Most disturbance events from powered vessels have been recorded within 100 m of the receptor with vessels approaching at faster speeds eliciting higher disturbance. Predictability and randomness is factor of vessel traffic which can cause variation in waterbird response. Literature suggests that vessels consistently using defined routes (such as ferries or cargo ships) elicit less of a disturbance response than recreational craft which are more unpredictable in terms of speed and course and thus their disturbance potential for birds may be enhanced (Rodgers and Schwikert, 2002; Burger, 1998; Schwemmer *et al*., 2011).

Vessel movements and human presence around pontoons and jetties has the potential to cause a regular and often sustained source of visual and noise disturbance stimuli to birds on nearby foreshore habitat. However, empirical studies to try and quantify both short term disturbance and more permanent displacement effects due to vessel movements and human activity around port and other operational jetties and pontoons are generally limited due to a lack of long-term monitoring studies.

Monitoring of potential disturbance due to the movements of vessels berthing at pontoons associated with offshore windfarm Operation and Maintenance (O&M) facilities in several port locations (including at the Port of Mostyn) near to mudflats used by waterbirds recorded evidence of some mild and localised disturbance and avoidance although events were generally infrequent with larger disturbance events (causing bird to fly out of the area) only occurring more rarely. Consistent evidence of changes (reductions) in waterbird abundance in the local area which could be linked to the operational activities was not recorded (ABPmer, 2015; ABPmer, 2021).

Project impact assessment

As described in Section 8.7.1, the breakwater (which is higher in elevation than the proposed development) will act as a natural screen for waterbirds on the Mostyn Bank and other habitats downstream of the Port of Mostyn. On this basis, operational activity along the quay (such as workers/personnel during vessel mooring and disembarkation) as well as vessel movements during berthing will not be visible to feeding and roosting birds in these areas. In addition, habitat directly adjacent to the proposed development on Salisbury Bank (located approximately 250 to 300 m away) consists of low elevation sandflat habitat (which is highly dynamic and impoverished with a low prey availability for waterbirds). This is reflected in its use by relatively low numbers of waterbirds. Therefore, given the low functionality of this area and the distance away from the proposed development, disturbance responses would be expected to be limited. Furthermore, the Port of Mostyn is already used by large numbers of vessels as described in the Commercial and Recreational Navigation Chapter 10. This includes vessels operating from existing Operations and Maintenance (O & M) Bases and include Service Operation Vessels (SOVs) and Crew Transfer Vessels (CTVs). These vessels transit to and from the Port of Mostyn on a daily basis, year-round. There will, therefore, be no significant changes to the visual or noise stimuli generated by the windfarm supporting activities. Observations suggest generally limited disturbance to bird on nearby mudflats as they transit to and from the Port of Mostyn (ABPmer, 2015).

It is understood from the Port that the proposed development will not result in a significant increase in operational activity on the breakwater above the existing levels which have occurred over the last twenty years with operational activity focused near to the berths. On this basis waterbirds would be expected to be habituated to this existing level of activity.

Over this period, birds have continued to use the roost. On this basis while some infrequent and mild disturbance responses (consisting of birds flushing and rapidly resettling nearby or on returning after a short time to the same roost) is possible, longer term displacement of roosting or feeding from Mostyn Bank is unlikely.

Based on the information provided above, disturbance to waterbirds is expected to remain at very low levels with limited change from the baseline conditions whether from noise or visual stimuli. Magnitude and consequently exposure to change is, therefore, likely to be low. The sensitivity of coastal waterbirds in the area is considered to range from low to moderate depending on the species. Importance is high because of the protection afforded to coastal waterbirds. Therefore, the impact of disturbance during operation has been assessed as **minor adverse**.

Potential risks to human health

All marine ecology effects arising from the construction and operation of the project are confined to the marine water environment or restricted to ecological receptors. These effects, with the possible exception of sediment contamination and noise disturbance do not directly impact on human health. Sediment contamination sampling through the depth of the proposed dredge has been undertaken to the agreed NRW sample plan. The results showed that the sediment is suitable for marine disposal (Water and Sediment Quality Chapter 7). The levels of contamination are, therefore, not expected to have a significant human or ecological effect. 'Airborne noise and vibration' has been scoped out of the EIA as no significant noise disturbance effects on human receptors are anticipated (see Impact Assessment Approach Chapter 5).

Potential impacts on climate and vulnerability of proposed development to climate change

The bathymetric and hydrodynamic changes resulting from the proposed development are very small in a regional context (Physical Processes Chapter 6). The magnitude of these changes are insufficient to cause morphological change that would significantly affect tidal propagation, saline intrusion or wave activity. As a result, the works will have no impact on the predicted ongoing effects of climate change in the marine environment. Equally the effects of climate change in the future would make an insignificant change to the marine ecology effects that have been assessed as a result of the project.

Risks of major accidents and/or disasters

The nature and scale of the impacts on marine ecology receptors that will result from the MEPE Project are not anticipated to cause any risk of a major accident and/or disaster occurring.

8.8 Mitigation and residual impacts

8.8.1 Secondary mitigation

Secondary mitigation measures (as defined in the Impact Assessment Approach Chapter 5) will alter the risk of exposure and, hence, will require significance to be re-assessed and thus the residual impact (i.e. with mitigation) identified. Secondary mitigation measures are described below and will be further developed if required through ongoing consultation with statutory authorities as part of the marine licence application review period.

Underwater noise and vibration on fish and marine mammals as a result of construction

In order to reduce the level of impact associated with underwater noise and vibration on fish and marine mammals during construction (which was assessed as **minor to moderate adverse**), the following mitigation measures will be implemented during piling:

- **Soft start:** The gradual increase of piling power, incrementally, until full operational power is achieved will be used as part of the piling methodology. This will give fish and marine mammals the opportunity to move away from the area before the onset of full impact strikes. The duration of the soft start is proposed to be 20 minutes in line with the JNCC piling protocol (JNCC, 2010);
- **Vibro piling:** Vibro piling is proposed to be used where possible (which produces lower peak source noise levels than percussive piling). However, in order to drive the piles to the required design level in certain circumstances percussive piling is likely to be required given the underlying geology and depth of piling that is required to ensure the required structural integrity and stability of the new quay wall;
- **Marine Mammal Observer:** In addition, in order to further reduce the significance of the impact to marine mammals the JNCC "Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals during piling" (JNCC, 2010) will be followed during percussive piling. The key procedures highlighted in this document include the following:
  - Establishment of a 'mitigation zone' of a pre-defined radius (e.g. 500 m) from the piling locations, prior to any percussive piling. Within this mitigation zone, observations of marine mammals will be undertaken by a trained member of the construction team using marine mammal identification resources;
  - 30 minutes prior to the commencement of percussive piling, a search should be undertaken by the Marine Mammal Observer to determine that no marine mammals are within the mitigation zone. Percussive piling activity should not be commenced if marine mammals are detected within the mitigation zone or until 20 minutes after the last visual detection;
  - During percussive piling, the Marine Mammal Observer should observe the mitigation zone to determine that no marine mammals are within this area. Construction workers will be alerted if marine mammals are identified, and piling will cease whilst any marine mammals are within the mitigation zone. Piling can recommence when the marine mammal exits the mitigation zone and there is no further detection after an agreed period of time (suggested to be 20 minutes); and
  - If there is a pause in percussive piling operations for any reason over an agreed period of time, then another search (and soft-start procedures for piling) should be repeated before activity recommences. If, however, the mitigation zone has been observed while piling has ceased and no marine mammals have entered the zone, piling activity can recommence immediately.

Taking into account the mitigation measures described above, the residual effects for underwater noise and vibration during construction on fish and marine mammals are assessed as **minor adverse** and not significant.

Disturbance to coastal waterbirds during construction

In order to reduce the level of impact associated with noise and visual disturbance during construction (which was assessed as **minor to moderate adverse**), the following mitigation measures will be implemented during construction:

- **Soft starts:** Using soft starts (as outlined above) will allow birds to become more tolerant to piling noise by allowing a more gradual increase in noise levels which will reduce the potential for birds to become startled;
- **Cold weather construction restriction:** Coastal waterbirds are considered particularly vulnerable to bird disturbance during periods of extreme winter weather. On this basis, it is proposed that a temporary cessation of piling and any activities taking place along the new quay wall is implemented following seven consecutive days of freezing (zero or sub-zero temperature) weather conditions. The restriction should not be lifted until after 24 hours of above freezing temperatures and also that Metrological Office weather forecasts indicate that freezing conditions will not return for the next five days. Similar measures have been implemented for other port developments and also as part of the JNCC scheme to reduce disturbance to waterfowl due to shooting activity during severe winter weather;
- **Acoustic barrier/visual screening:** In order to reduce potential visual and/or noise disturbance stimuli to waterbirds on the Mostyn Bank or breakwater roost, an acoustic barrier/visual screen will be installed along the breakwater prior to the commencement of construction so that movements of construction workers or vehicles will not be as visible and the levels of noise will be attenuated. Screens (such as fences and other barriers) are a widely used measure to help reduce potential disturbance to coastal waterbirds (Ikuta and Blumstein, 2003; Liley and Tyldesley, 2013; Hockin *et al*., 1992) and have been successfully applied as mitigation to reduce disturbance at a number of port locations including the Port of Mostyn (GoBe Consultants Ltd, 2011, ABPmer, 2014; MMO, 2018). These screens should be opaque or made out of material that distorts outlines of anthropogenic activity; and
- **Noise suppression system:** It is proposed that a noise suppression system (consisting of a pile shroud or sleeve with noise insulating properties) is used during percussive piling activities of the tube piles for the new quay wall to reduce noise levels on the Mostyn Bank or breakwater roost.

Taking into account the mitigation measures described above, the residual effects for noise and visual disturbance during construction on coastal waterbirds are assessed as **minor adverse** and not significant.

Disturbance to coastal waterbirds (operation)

The potential effects of disturbance during operation have been assessed as **minor adverse**. However, on a precautionary basis, it is proposed that the screens which are proposed to be installed during the construction phase remain in place initially during the operational phase also. The use of screens is considered likely to be most effective initially during operation when birds are less likely to be as habituated to any sources of new operational noise and visual disturbance stimuli. Over time, as the birds would be expected to become habituated to operations, a phased removal of the screens is proposed after 2 years.

8.8.2 Tertiary mitigation

Tertiary mitigation measures will be undertaken to manage commonly occurring environmental effects. Although these are not likely to alter the assessment conclusions, they are considered to be standard good practice. In terms of nature conservation and marine ecology receptors, these are as follows:

- **Even disposal deposition:** Targeting disposal loads in the central/deeper areas of the Mostyn Deep disposal site (IS102) to reduce depth reductions. This will minimise the initial reduction in water depth and any environmental changes at this disposal site;

- **Following biosecurity management procedures:** Biosecurity control measures during construction will be included within the CEMP. The Port of Mostyn will continue to manage biosecurity risk of ongoing port operations in accordance with existing procedures to minimise the risk of introduction and/or spread of non-native species where possible; and
- **Adhering to environmental management best practice:** The potential risk from accidents and spillages/leaks during construction will be avoided or minimised by ensuring that the construction methods, proposed design and the contractual arrangements follow pollution prevention legislation and environmental management best practice (see Project Methodology Chapter 3).

8.9 Summary of impacts

This section reports the assessment of potential impacts on nature conservation and marine ecology as a result of the proposed development. With the adoption of appropriate mitigation, it is considered that significant impacts on for nature conservation and marine ecology can be avoided and/or minimised. A summary of the impact pathways that have been assessed and the identified residual impacts following the application of mitigation measures is presented in Table 8.23.

Table 8.23. Summary of potential impact, mitigation measures and residual impacts for nature conservation and marine ecology

Receptor	Impact pathway	Impact significance	Mitigation/compensation measures	Residual Impact	Confidence
Construction phase					
Benthic habitats and species	Direct loss of intertidal and subtidal habitats and species as a result of the new quay wall	Insignificant (intertidal mud) Insignificant to minor adverse (intertidal hard substrate) Insignificant (subtidal habitat)		Insignificant (intertidal mud) Insignificant to minor adverse (intertidal hard substrate) Insignificant (subtidal habitat)	High
	Direct loss of intertidal habitat as a result of capital dredging	Insignificant	N/A	Insignificant	High
	Changes to subtidal habitats and species as result of the removal of seabed material during dredging	Insignificant	N/A	Insignificant	High
	Changes to habitats and species as a result of sediment deposition during dredging and dredge disposal	Insignificant	N/A	Insignificant	Medium
	Changes in water and sediment quality during capital dredging and dredge disposal	Insignificant	N/A	Insignificant	Medium
	Underwater noise and vibration disturbance during construction	Insignificant to minor adverse (piling) Insignificant (dredging and disposal)	N/A	Insignificant	Medium
	The potential introduction and spread of non-native species	Insignificant to minor adverse	Include biosecurity control measures within the CEMP in accordance with guidance.	Insignificant to minor adverse	Medium
Fish and shellfish	Direct loss or changes to fish and shellfish populations and habitat	insignificant to minor adverse	N/A	Insignificant to minor adverse	Medium
	Changes in water and sediment quality during capital dredging and dredge disposal	Insignificant	N/A	Insignificant	Medium

Receptor	Impact pathway	Impact significance	Mitigation/compensation measures	Residual Impact	Confidence
	Underwater noise and vibration disturbance during construction	Minor to moderate adverse (migratory fish during piling) Insignificant to minor adverse (other fish species during piling) Insignificant (dredging and disposal)	Apply soft start procedures during piling. Use vibro piling where possible.	Minor adverse (migratory fish during piling) Insignificant to minor adverse (other fish species during piling) Insignificant (dredging and disposal)	Medium
Marine mammals	Underwater noise and vibration disturbance during construction	Minor to moderate adverse (piling) Insignificant (dredging and disposal)	Apply soft start procedures during piling. Use vibro piling where possible. Marine Mammal Observer will follow JNCC protocol to minimise the risk of injury to marine mammals during percussive piling.	Minor adverse (piling) Insignificant (dredging and disposal)	Medium
Coastal waterbirds	Direct loss and change to intertidal feeding and roosting habitat	Minor adverse	N/A	Minor adverse	Medium
	Airborne noise and visual disturbance during construction	Minor to moderate adverse	Soft starts. Cold weather construction restriction. Screening. Noise suppression system.	Minor adverse	Medium
Otters	Direct loss or changes to otter populations and habitat	Insignificant	N/A	Insignificant	Medium
	Noise and visual disturbance during construction	Insignificant to minor adverse	N/A	Insignificant to minor adverse	Medium
Operational Phase					
Benthic habitats and species	Changes to benthic habitats and species as result of seabed removal during maintenance dredging	Insignificant to minor adverse	N/A	Insignificant to minor adverse	Medium
	Changes to benthic habitats and species as a result of deposition during maintenance dredging and dredge disposal	Insignificant	N/A	Insignificant	Medium

Receptor	Impact pathway	Impact significance	Mitigation/compensation measures	Residual Impact	Confidence
	Changes in water and sediment quality during maintenance dredging and dredge disposal	Insignificant	N/A	Insignificant	Medium
	The potential introduction and spread of non-native species during vessel operations	Insignificant	N/A	Insignificant	Medium
Fish and shellfish	Changes to fish populations and fish habitat during maintenance dredging and dredge disposal	Insignificant to minor adverse	N/A	Insignificant to minor adverse	Medium
	Changes in water and sediment quality during maintenance dredging and dredge disposal	Insignificant	N/A	Insignificant	Medium
Coastal waterbirds	Disturbance of waterbirds during operation	Minor adverse	Screening.	Minor adverse	Medium

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8.11 Abbreviations/Acronyms

AA	Appropriate Assessment
ABP	Associated British Ports
AEOI	Adverse Effect On the Integrity
ALSF	Aggregates Levy Sustainability Fund
ANSI	American National Standards Institute
ASA	Advertising Standards Authority
BAP	Biodiversity Action Plan
BEIS	Department for Business, Energy & Industrial Strategy
BTO	British Trust for Ornithology
CCW	Countryside Council for Wales
CD	Chart Datum
CEDA	Central Dredging Association
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CEMP	Construction Environment Management Plan
CHEEM	Cutts & Hemingway Estuarine Ecology and Management Ltd
CIEEM	Chartered Institute of Ecology and Environmental Management
CIS	Celtic and Irish Seas
COWRIE	Collaborative Offshore Wind Research into the Environment
cSAC	Candidate Special Area of Conservation
CSIP	Cetacean Strandings Investigation Programme
dB	Decibel
DECC	Department for Energy and Climate Change
DFO	Department of Fisheries and Oceans
DfT	Department for Transport
DNA	Deoxyribonucleic acid
DOER	Dredging Operations and Environmental Research
EC	European Commission
ECIA	Ecological Impact Assessment
EEC	Environment European Commission
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIRPHOT	Wales' grey seal photo-identification database
EMS	European Marine Site
ENV	Environment
ERM	Environmental Resources Management
ES	Environmental Statement
EU	European Union
FID	Flight Initiation Distance
FLDP	Flintshire Local Development Plan
FOCI	Features of Conservation Interest
GB	Great Britain
HF	High Frequency
HM	His Majesty's
HMSO	His Majesty's Stationary Office
HRA	Habitats Regulations Assessment
HTL	Hold the Line
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Sea
IECS	Institute of Estuarine and Coastal Studies

IEMA	Institute of Environmental Management and Assessment
IFCA	Inshore Fisheries Conservation Authority
IMO	International Maritime Organisation
INCA	Industry Nature Conservation Association
INNS	Invasive Non-Native Species
INT	Intertidal
INTERREG	European Territorial Cooperation
IUCN	International Union for Conservation of Nature
JCP	Joint Cetacean Protocol
JNCC	Joint Nature Conservation Committee
LSE	Likely Significant Effect
MAGIC	Multi-Agency Geographic Information for the Countryside
MCAA	The Marine and Coastal Access Act 2009
MCZ	Marine Conservation Zone
MEP	Mostyn Energy Park Development
MEPE	Mostyn Energy Park Extension
MEPF	Marine Environment Protection Fund
MHWS	Mean High Water Springs
MLA	Marine Licence Application
MLWS	Mean Low Water Springs
MMMU	Marine Mammal Management Unit
MMO	Marine Management Organisation
MoP	Mean of Peak
MPA	Marine Protected Out
MPS	Marine Policy Statement
MSC	Marine Mammal Management Unit
MU	Management Unit
NBN	National Biodiversity Network
NE	North East
NERC	Natural Environment and Rural Communities
NIFPP	Nseleni Independent Floating Power Plant
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPSfP	National Policy Statement for Ports
NPWS	National Parks and Wildlife Service
NRW	Natural Resources Wales
NT	National Threshold
NVC	National Vegetation Classification
NW	North West
NWIFCA	North West Inshore Fisheries Conservation Authority
OESEA	Offshore Energy Strategic Environmental Assessment
OGL	Open Government Licence
OPR	Office of Protected Resources
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
OWF	Offshore Wind Farm
PAH	Polycyclic Aromatic Hydrocarbons
PAM	Passive Acoustic Monitoring
PLC	Public Limited Company
PSA	Particle Size Analysis
pSPA	Potential Special Protection Areas
PTS	Permanent Threshold Shifts
PW	Phocid Pinniped

Ramsar	Wetlands of international importance, designated under The Convention on Wetlands (Ramsar, Iran, 1971)
RIS	Ramsar Information Sheet
Ro-Ro	Roll On-Roll Off
RSPB	Royal Society for the Protection of Birds
RWE	Rheinisch-Westfälisches Elektrizitätswerk
SAC	Special Area Conservation
SCANS	Small Cetaceans in European Atlantic Waters and the North Sea
SCOS	Special Committee on Seals
SE	South East
SEA	Strategic Environmental Assessment
SEL	Sound Exposure Levels
SL	Source Level
SMRU	Sea Mammal Research Unit
SPA	Special Protection Area
SPL	Sound Pressure Level
SSC	Suspended Sediment Concentrations
SSSI	Sites of Special Scientific Interest
STST	Selective Tidal Stream Transport
SUB	Subtidal
TBT	Tributyltin
TE	Technical Experts
TERRC	Teeside Environmental Reclamation and Recycling Centre
TOC	Total Organic Carbon
TraC	Transitional and Coastal Waters
TSHD	Trailing Suction Hopper Dredger
TSS	Traffic Separation Scheme
TTS	Temporary Threshold Shifts
UK	United Kingdom
UKBAP	United Kingdom Biodiversity Action Plan
WCA	Wildlife and Countryside Act 1981
WFD	Water Framework Directive
WID	Water Injection Dredging
WNMP	Welsh National Marine Plan
WODA	World Organisation of Dredging Association

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

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