Immingham Green Energy Terminal

Environmental Impact Assessment

Preliminary Environmental Information Report

Volume II – Main Report

Chapter 9: Nature Conservation (Marine Ecology)

Associated British Ports

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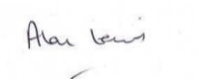
Signed		Date	20/12/2022
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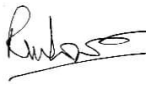
Signed		Date	20/12/2022
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9 Nature Conservation (Marine Ecology)

9.1 Introduction

9.1.1 This chapter presents the preliminary findings of the assessment of the likely effects of the Project on Marine Ecology. This chapter sets out the assessment methodology used, the datasets used to inform the assessment, an outline of baseline conditions, and sets out the likely significant effects the Project will have on marine ecology receptors.

9.1.2 There may be interrelationships related to the potential effects on Marine Ecology and other disciplines. Therefore, also refer to the following chapters:

a. **Chapter 6: Air Quality**;

b. **Chapter 10: Ornithology**;

c. **Chapter 16: Physical Processes**; and

d. **Chapter 17: Marine Water and Sediment Quality**.

9.1.3 Relevant aspects of the nature conservation and marine ecology assessment presented in this chapter will inform the Water Framework Directive (WFD) Assessment and also the Habitats Regulations Assessment (HRA) which will be prepared and included in the Environmental Statement (ES).

9.1.4 This chapter is also supported by the following figures and appendices:

a. **Figure 9.1:** Project specific subtidal benthic sampling stations (PEI Report, Volume III);

b. **Figure 9.2:** Internationally and nationally designated conservation sites (PEI Report, Volume III);

c. **Figure 9.3:** Spawning and nursery grounds of commercial fish species (PEI Report, Volume III);

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g. **Figure 9.7:** Harbour porpoise sightings in the Humber Estuary since 2000 (Source: Ref 9-30) (PEI Report, Volume III);

h. **Appendix 9.A:** Benthic Survey Report (PEI Report, Volume IV);

i. **Appendix 9.B:** Underwater Noise Assessment (PEI Report, Volume IV); and

j. **Appendix 9.C**: Habitats Regulations Assessment Stage 1 Screening (PEI Report, Volume IV).

9.2 Approach to Assessment

Scope and Methods

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

a. Nature conservation designations and protected species;

b. Benthic habitats and species;

c. Fish; and

d. Marine mammals.

9.2.2 There are no classified commercial shellfish (bivalve) beds in the Humber Estuary (Ref 9-1) and the areas around the Project and possible disposal sites do not support other commercial shellfisheries (such as crab/lobsters using creels or the collection of whelks). On this basis, commercial shellfisheries have, therefore, been scoped out of the assessment. Relevant fauna which are considered shellfish species (such as cockles or clams), however, are considered within the benthic habitats and species assessment.

9.2.3 Phytoplankton has also been scoped out of the assessment as while phytoplankton can be sensitive to changes in water quality, the predicted magnitude of potential changes in suspended sediments and contamination levels in the water column (as summarised in **Chapter 16 and 17** respectively) are not considered to be at a level which would cause lethal or sub-lethal effects in plankton. On this basis, phytoplankton has, been scoped out of the assessment.

9.2.4 A scoping exercise was undertaken in August 2022 to establish the form and nature of the Marine Ecology assessment, and the approach and methods to be followed.

9.2.5 The Scoping Report (**Appendix 1.A** of PEI Report Volume IV) records the findings of the scoping exercise and details the technical guidance, standards, best practice and criteria being applied in the assessment to identify and evaluate the likely significant effects of the Project on Marine Ecology.

9.2.6 Following receipt of the Scoping Opinion (**Appendix 1.B** of the PEI Report Volume IV) as to the information to be provided in the ES, the requirements set out in **Table 9.1** have been identified by the Planning Inspectorate as those to be taken account of as part of the ongoing Marine Ecology assessment.

Table 9.1: Scoping opinion responses on Nature Conservation (Marine Ecology)

Consultee	Summary of Response	How comments have been addressed in this chapter
Environment Agency	Paragraph 8.2 makes no mention of pelagic ecology, in particular phytoplankton communities – these should be considered (even if they are scoped out) as there is a pathway for impact on this ecological element for example, as a result of sediment resuspension, contaminant release, changes to hydromorphology (these are highlighted in the physical processes and water quality sections). Neither is there any explicit mention of saltmarsh baseline data (although saltmarshes are discussed in the 'current baseline' sections). The Environment Agency holds saltmarsh data for the Humber Transitional waterbodies. We recommend the Applicant search on the Environment Agency's Ecology and Fish data explorer to see if additional data are available at https://environment.data.gov.uk/ecology/explorer/ We are satisfied with the survey rationale outlined in section 8.3.	Scoping opinion noted. Phytoplankton has also been scoped out of the assessment as while phytoplankton can be sensitive to changes in water quality, the predicted magnitude of potential changes in suspended sediments and contamination levels in the water column (as summarised in **Chapter 16**: **Physical Processes** and **Chapter 17: Marine Water and Sediment Quality** respectively) are not considered to be at a level which would cause lethal or sub-lethal effects in plankton. On this basis, phytoplankton has, been scoped out of the assessment. Further baseline saltmarsh data has been provided in the PEI Report.
Planning Inspectorate	The Scoping Report states that there are no classified commercial shellfish (bivalve) beds in the Humber Estuary and the areas around the Proposed Development and dredged sediment disposal sites do not support other commercial shellfisheries (such as crab/ lobsters using creels or the collection of whelks) and therefore seeks to scope out impacts on commercial shellfisheries. The Inspectorate agrees	Scoping opinion noted.

Consultee	Summary of Response	How comments have been addressed in this chapter
	that this matter can be scoped out of the assessment on this basis.	
	The Scoping Report states that the amount of sediment that settles out of suspension back onto the seabed as result of piling is expected to be negligible and benthic habitats and species are not expected to be sensitive to this level of change. The Inspectorate agrees that this impact pathway is not likely to have a significant effect and can be scoped out.	Scoping opinion noted.
	The Scoping Report states that the pile structures have the potential to result in changes to hydrodynamic and sedimentary processes but such effects are anticipated to be negligible and highly localised (which would be confirmed by the physical processes assessment) and marine habitats and species are not expected to be sensitive to this level of change. The Inspectorate does not agree that this matter should be scoped out of the assessment as there is insufficient evidence that changes to hydrodynamic and sedimentary processes would not have any adverse significant effects	Scoping opinion noted. The preliminary assessment has confirmed that the effects of changes to hydrodynamic and sedimentary processes are highly localised (see **Chapter 16**: Physical Processes) This pathway is considered in **Section 9.5**.
	The Scoping Report states that 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 piling is considered unlikely to produce adverse effects in any marine species. The Inspectorate	Scoping opinion noted.

Consultee	Summary of Response	How comments have been addressed in this chapter
	agrees that this impact pathway is not likely to have significant adverse effects on marine species.	
	The Scoping Report proposes to scope impacts on fish from the capital dredge and disposal on the basis that the scale of the predicted changes are unlikely to cause anything more than negligible changes to fish habitats (feeding, spawning and nursery areas). The Inspectorate does not agree that this matter should be scoped out as changes in water and sediment quality during capital dredging and dredge disposal have been scoped into the assessment and there is insufficient evidence in the Scoping Report to demonstrate that changes to hydrodynamic and sedimentary processes would not have any adverse significant effects on fish habitats.	Scoping opinion noted. This pathway is considered in **Section 9.5**.
	The Scoping Report proposes to scope out an assessment of impacts on marine mammals as a result of changes to marine mammal foraging habitat and prey resources on the basis that the footprint of the Project only covers a highly localised area that constitutes a negligible fraction of the known ranges of local marine mammal populations. Given the limited scale of the area affected, the Inspectorate agrees that this matter can be scoped out of the assessment.	Scoping opinion noted.
	The Scoping Report proposes to scope out the potential for disturbance to hauled out seals on the basis of the distance between breeding populations and haul out sites to the proposed works (i.e. the	Scoping opinion noted.

Consultee	Summary of Response	How comments have been addressed in this chapter
	closest haul out site is observed to be on the north bank of the Humber Estuary, 3-4km from the dredge disposal sites and 4km from the DCO boundary). Given the large distances involved, the Inspectorate agrees that this matter should be scoped out of the assessment.	
	Impacts from vessels involved in construction and dredging activity are proposed to be scoped out on the basis that they would mainly be stationary or travelling at low speeds, making the risk of collision low. The Inspectorate agrees that this matter can be scoped out of the assessment on the basis that the collision risk is low and is not likely to have any adverse significant effects on marine mammals.	Scoping opinion noted.
	The Scoping Report proposes to scope out water quality impacts arguing that (1) the changes in suspended sediment levels would be localised, temporary and unlikely to result in adverse effects on marine mammals; (2) they are adapted to highly turbid conditions, and (3) contamination levels would be unlikely to produce lethal effects in these highly mobile species. In the absence of further data regarding sediment contamination levels and the potential water quality effect of the capital dredge, the Inspectorate is unable to scope this matter out of the assessment.	Scoping opinion noted. A more detailed rationale for scoping out water quality effects on marine mammals has been provided in **Table 9.11**.
	The Scoping Report proposes to scope out the potential for visual disturbance to hauled out seals because of the distance between breeding	Scoping opinion noted.

Consultee	Summary of Response	How comments have been addressed in this chapter
	populations and haul out sites to the proposed works. The Inspectorate agrees that this matter can be scoped out of the assessment on this basis.	
	The Scoping Report proposes to scope out this matter owing to the existing heavy shipping traffic and anticipated slow speeds of operational vessels (including maintenance dredging/ dredge disposal). The Inspectorate agrees that this matter can be scoped out of the assessment on the basis that the collision risk is low and is not likely to have any adverse significant effects on marine mammals.	Scoping opinion noted.
	In addition to the Humber Estuary European sites, the Proposed Development may also impact on the Greater Wash SPA and this should be considered within the ES.	Noted. The SPA is included in **Chapter 9: Terrestrial Ecology** and **Chapter 10: Ornithology** of the PEI Report.
	In addition to the assessment of the direct loss of intertidal and subtidal habitats and species as a result of the piles, the ES should also assess the potential for direct changes to benthic habitats and species underneath the raised pier structures, to determine their effect on the ecological function of the mudflats beneath.	Scoping opinion noted. Direct changes to benthic habitats and species underneath the raised pier structures has been scoped in and assessed in the operational phase (as the built infrastructure has the potential to result in this pathway).
	The impact of sediment resuspension and hydro-morphological changes on pelagic ecology receptors such as phytoplankton should be considered in the assessment of effects, unless otherwise robustly justified and agreed with relevant consultation bodies.	Phytoplankton has also been scoped out of the assessment as while phytoplankton can be sensitive to changes in water quality, the predicted magnitude of potential changes in suspended sediments and contamination levels in the water column (as summarised in **Chapter 16: Physical Processes** and **Chapter 17: Marine Water and**

Consultee	Summary of Response	How comments have been addressed in this chapter
		Sediment Quality respectively) are not considered to be at a level which would cause lethal or sub-lethal effects in plankton.
Natural England	The development site is within or may impact on the following European/internationally designated nature conservation site(s): •Humber Estuary Special Area of Conservation (SAC); •Humber Estuary Special Protection Area (SPA); •Humber Estuary Ramsar site. •Greater Wash Special Protection Area (SPA) Natural England broadly agrees with this section of the Scoping Report which detail the potential impact pathways on the designated sites during both construction and operation phases of the proposed development.	Scoping opinion noted.
	In addition, in the benthic habitats and species sections [with reference to Paragraph 8.4.4 (a) of the Scoping Report], we advise that direct changes to benthic habitats and species underneath the raised pier structures should also be assessed, to determine if it could affect the ecological function of the mudflats beneath. Natural England do not concur with the conclusion [with reference to Paragraph 8.4.4 (b) of the Scoping Report that Indirect changes to seabed habitats and species as a result of changes to hydrodynamic and sedimentary processes due to the capital dredge and disposal should be scoped out for fish] when 'Changes in water and sediment quality during capital dredging and dredge disposal' have been	Direct changes to benthic habitats and species underneath the raised pier structures has been scoped in and assessed in the operational phase (as the built infrastructure has the potential to cause effects for this pathway). A preliminary assessment of effects for this pathway is provided in **Section 9.5**. The predicted changes in hydrodynamic and sedimentary processes are very small. Based on preliminary modelling results (see **Chapter 16**; **Physical Processes**) and an understanding of the baseline conditions for fish it is very unlikely there would be any potential for effects on fish habitats (feeding, spawning and nursery areas) (see **Table 9.11**).

Consultee	Summary of Response	How comments have been addressed in this chapter
	scoped in. We would seek further clarification on this.	
	Impacts that maintenance dredging will have refer to notified feature having no sensitivity due 'to the scale of changes in SSC anticipated during capital dredging' [with reference to Paragraph 8.4.6 (a) (iii)]. These are two very different impacts therefore Natural England advise further consideration is given to the impacts of maintenance dredging will have on water quality.	The potential for impacts on water quality to affect marine mammals during capital dredging and disposal have been considered (see **Table 9.11**). The predicted changes in water quality during the capital dredge and disposal are negligible. Given that the maintenance dredging will be on a much smaller scale than capital dredging there are no anticipated effects.
	Natural England welcome the commitment to determine mitigation measure through the statutory consultation process.	Noted.

9.2.7 Having regard to the information presented within the Scoping Report (**Appendix 1.A** of PEI Report, Volume IV), the Planning Inspectorate's Scoping Opinion (**Appendix 1.B** of PEI Report, Volume IV) has also confirmed the Applicant's view that significant effects on: commercial shellfisheries; sediment deposition impacts of piling to benthic habitats and species; water quality effects due to piling on marine species, impacts to marine mammals as a result of changes to foraging habitat and prey resource; disturbance to hauled out seals; collision risk to marine mammals from vessels involved in construction and dredging are unlikely. Accordingly, these matters will remain scoped out of consideration in the ES.

9.3 Assessment Method

9.3.1 To facilitate the impact assessment process and ensure consistency in the terminology of significance, a standard assessment methodology will be applied to determine the significance of effects within the ES (see **Chapter 5: EIA Approach**). This methodology has been developed from a range of sources, including relevant Environmental Impact Assessment (EIA) Regulations, the EIA Directive (2014/52/EU), statutory and non-statutory guidance, consultations and ABPmer's previous (extensive) EIA project experience. The assessment also follows the principles of relevant guidance, including Institute of Environmental Management and Assessment (IEMA) guidelines, and the latest Chartered Institute of Ecology and Environmental Management (CIEEM) guidelines for ecological impact assessment in the UK and Ireland (which combine advice for terrestrial, freshwater and coastal environments) (Ref 9-2). The methodology adopted is considered to be 'best practice'.

9.4 Legislation, Policy and Guidance

9.4.1 **Table 9.2** presents the legislation, policy and guidance relevant to the Marine Ecology assessment and details how their requirements will be met.

Table 9.2: Relevant legislation, policy and guidance regarding Marine Ecology

Legislation / Policy / Guidance	Consideration within the PEI Report
Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora ('The Habitats Directive') (Ref 9-3)	
The Habitats Directive (92/43/EEC) is intended to help maintain biodiversity throughout the EU Member States by defining a common framework for the conservation of wild plants, animals and habitats of community interest. It established a network of Special Areas of Conservation (SAC) designated by Member States to conserve habitats and species (listed in Annexes I and II).	The Humber Estuary SAC and features are described in **Section 9.4**. A preliminary consideration of impacts on SAC habitats and species is provided in **Section 9.5.** A Habitats Regulations Screening report has been produced and is provided in **Appendix 9.C** (PEI Report, Volume IV).

Legislation / Policy / Guidance	Consideration within the PEI Report
Council Directive 2009/147/EC on the conservation of wild birds ('The Birds Directive') (Ref 9-4)	
Directive 2009/147/EC on the conservation of wild birds is known as the 'Birds Directive'. It creates a comprehensive scheme of protection for all wild bird species. The Directive recognises that habitat loss and degradation are the most serious threats to the conservation of wild birds. It, therefore, places great emphasis on the protection of habitats for endangered as well as migratory species (listed in Annex I), especially through the establishment of a coherent network of Special Protection Areas (SPAs) comprising all the most suitable territories for these species.	The Humber Estuary SPA and qualifying features are described in **Chapter 10: Ornithology**. A preliminary consideration of impacts on coastal waterbirds which are features of these sites are outlined in **Section 10.5**. A Habitats Regulations Screening report has been produced and is provided in **Appendix 9.C** (PEI Report Volume IV)**.**
The Water Framework Directive 2000/60/EEC (Ref 9-5)	
The Water Framework Directive (2000/60/EEC) (WFD) establishes a framework for the management and protection of Europe's water resources. The overall objectives of the WFD 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.	The Project (and associated disposal sites) is located within the Humber Lower water body (ID: GB530402609201) (further described in **Chapter 17: Marine Water and Sediment Quality**. A WFD compliance assessment will be prepared to support the DCO application which includes consideration of several key biological receptors, specifically habitats, fish, protected areas and invasive non-native species (INNS). The WFD compliance assessment will draw on information provided both in this chapter and other chapters within the ES.
Conservation of Habitats and Species Regulations 2017 as amended ('The Habitats Regulations') (Ref 9-6)	
The Habitats Directive and Birds Directive are transposed into UK law through the Conservation of Habitats and Species Regulations 2017 as amended, known as the "Habitats Regulations"[1]. 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	**Section 9.4** identifies protected habitats and species. A preliminary consideration of impacts on these receptors is provided in **Section 9.5**. A Habitats Regulations Screening report has been produced and is provided in **Appendix 9.C** (PEI Report Volume III)**.** This report will inform the consultation process and will aid the Competent Authority[2] in determining whether the Project has the potential for a likely significant effect (LSE) on the interest features and/or

1 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 2021).

2 The Secretary of State is the Competent Authority for the HRA under the UK Habitats Regulations.

Legislation / Policy / Guidance	Consideration within the PEI Report
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.	supporting habitat of a European/Ramsar site either alone or in-combination with other plans, projects and activities and, if so, will inform the requirement to undertake an Appropriate Assessment (AA) of the implications of the proposals in light of the site's conservation objectives.
The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (Ref 9-7)	
The Water Framework Directive (2000/60/EEC) is transposed into UK law through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 as amended, known as the Water Framework Regulations[3].	The Project (and associated disposal sites) is located within the Humber Lower water body (ID: GB530402609201) (further described in **Chapter 17: Marine Water and Sediment Quality**. A WFD compliance assessment will be prepared to support the DCO application which includes consideration of several key biological receptors, specifically habitats, fish, protected areas and invasive non-native species (INNS). The WFD compliance assessment will draw on information provided both in this chapter and other chapters within the ES.
Marine and Coastal Access Act 2009 (MCAA) (Ref 9-8)	
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 established the Marine Management Organisation (MMO) as the organisation responsible for marine planning and licensing. The Project will require a Marine Licence for the elements of the works below Mean High Water Springs including dredging, disposal and placing or removing objects on or from the seabed. For NSIPs the Development Consent Order (DCO) where granted may include provision deeming a marine licence to have been issued under Part 4 of the Marine and Coastal Access Act 2009. The MMO is responsible for enforcing, post-consent monitoring, varying, suspending, and revoking any deemed marine licence(s) as part of the DCO.	Information relevant to the marine licensing process is provided in the PEI Report including characterisation of the baseline for key marine ecology receptors (nature conservation sites, protected habitats and species, fish and marine mammals) (**Section 9.3**) and a preliminary assessment of impacts (**Section 9.5**). With respect to Marine Conservation Zones (MCZ), the Holderness Inshore MCZ is the nearest MCZ to the Project (located approximately 20 km away). This is considered to be beyond the zone of potential effects of the Project and as a consequence, a MCZ Assessment is not considered to be required.

[3] 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.

Legislation / Policy / Guidance	Consideration within the PEI Report
The Planning Act 2008 (PA2008) (Ref 9-9)	
Whilst the MCAA regulates marine licensing for works at sea, section 149A of the Planning Act 2008 enables an applicant for a DCO to include within the Order a Marine Licence which is deemed to be granted under the provisions of the MCAA.	Information relevant to the marine licensing process is provided in the PEI Report including characterisation of the baseline for key marine ecology receptors (nature conservation sites, protected habitats and species, fish and marine mammals) (**Section 9.4**) and a preliminary assessment of impacts (**Section 9.5**).
The Wildlife and Countryside Act 1981 (WCA) (Ref 9-10)	
The WCA is the principal mechanism for the legislative protection of wildlife in Great Britain. The WCA is the means by which the Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention), the Convention on the Conservation of Migratory Species of Wild Animals (Bonn 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 WCA applies to the terrestrial environment and inshore waters (0 to 12 nautical miles) and concerns the protection of wild animals and the designation of protected areas, including SSSIs.	**Section 9.4** identifies habitats and species which are protected under the WCA. A preliminary consideration of impacts on these receptors is provided in **Section 9.5**.
The Countryside and Rights of Way Act 2000 (CroW Act) (Ref 9-11)	
The CroW applies to England and Wales only. Part III of the CroW Act deals specifically with wildlife protection and nature conservation. The CroW Act places a duty on the Government 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 Act 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.	**Section 9.4** identifies habitats and species for which SSSIs have been designated. A preliminary consideration of impacts on these receptors is provided in **Section 9.5**.
Natural Environment and Rural Communities Act 2006 (NERC Act) (Ref 9-12)	

Legislation / Policy / Guidance	Consideration within the PEI Report
The NERC Act came into force in October 2006. In addition to establishing Natural England (NE) as the body responsible for conserving, enhancing, and managing England's natural environment, the Act also made amendments to both the Wildlife and Countryside Act 1981 and the CroW Act 2000. For example, it extended the CroW Act's biodiversity duty to public bodies and statutory undertakers, and altered enforcement powers in connection with wildlife prosecution. In addition to this, the NERC Act contains a number of additional measures designed to help streamline delivery and simplify the legislative framework, such as changes to the remit and constitution of the Joint Nature Conservation Committee (JNCC), reconstitution of the Inland Waterways Amenity Advisory Council, and improving the governance arrangements for the National Parks. Section 41 of the NERC Act requires the SoS to publish a list of habitats and species which are of principal importance for the conservation of biodiversity in England. The list has been drawn up in consultation with NE, as required by the NERC Act.	**Section 9.4** identifies habitats and species for which are protected under the NERC Act (priority species and habitats of principal importance). A preliminary consideration of impacts on these receptors is provided in **Section 9.5**.
The Eels (England and Wales) Regulations (2009) (Ref 9-13)	
The Eels (England and Wales) Regulations 2009 implement Council Regulation (EC) No 1100/2007 of the Council of the European Union, establishing measures for the recovery of the stock of European eel. This includes the requirement to notify the Environment Agency of the construction, alteration or maintenance of any structure likely to affect the passage of eels and where any such structure exists, the requirement to construct and operate an eel pass to allow the free passage of eels.	**Section 9.4** provides background information on European eel in the vicinity of the Project and outlines their ecology and distribution. A preliminary consideration of impacts on European eel is provided in **Section 9.5.**
National Policy Statement for Ports (Ref 9-14)	
The National Policy Statement for Ports (NPSfP) provides the framework for decisions on proposals for new harbour facility developments that constitute an NSIP. 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, preserve, protect and where possible improve marine and terrestrial biodiversity, be adapted to the impacts of climate change and	A preliminary consideration of impacts on species and habitats including those which are features of internationally, nationally and locally designated sites of ecological importance are presented in **Section 9.5.** Where appropriate, mitigation has been included and this is outlined in **Section 9.3**.

Legislation / Policy / Guidance	Consideration within the PEI Report
provide high standards of protection for the natural environment. As highlighted in paragraphs 5.1.4 and 5.1.5 of the NPSfP, where the development is subject to EIA, the applicant should ensure that the PEI Report clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. As highlighted in paragraphs 5.1.8 and 5.1.9 of the NPSfP, developments should aim to avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives. They should also ensure that appropriate weight is attached to designated sites of international, national and local importance.	
UK Marine Policy Statement (Ref 9-15)	
The UK Marine Policy Statement (MPS) is the framework for preparing marine plans and taking decisions affecting the marine environment. 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. Paragraphs 3.1.7 and 3.1.8 of the MPS are relevant to the ecology assessment of the Project which, amongst other things, state that: “Marine plan authorities and decision makers should take account of how developments will impact on the aim to halt biodiversity loss and the legal obligations relating to all MPAs, their conservation objectives, and their management arrangements…” Marine plan authorities and decision-makers should take account of the regime for MPAs and comply with obligations imposed in respect of them. This includes the obligation to ensure that the exercise of certain functions contribute to, or at least do not hinder, the achievement of the objectives of an MCZ. This would also include the obligations in relevant legislation relating to SSSIs and sites designated under the Birds and Habitats Directives.	A preliminary consideration of impacts on species and habitats including those which are features of MPAs are presented in **Section 9.5**.

Legislation / Policy / Guidance	Consideration within the PEI Report
East Inshore and East Offshore Marine Plans (Ref 9-16)	
The East Inshore and East Offshore Marine Plans, which are collectively referred to as 'the East Marine Plans', were formally adopted on 2 April 2014. There are five policies within the East Marine Plans specifically related to nature conservation and marine ecology.	Provides general guidance. See considerations of specific policies below.
Policy ECO1 - Cumulative impacts affecting the ecosystem of the East marine plans and adjacent areas (marine, terrestrial) should be addressed in decision-making and plan implementation:	Information on the cumulative and in-combination effects assessment for the Project are included in **Chapter 25: Cumulative and In-Combination Effects** of this PEI Report.
Policy BIO1 - Appropriate weight should be attached to biodiversity, reflecting the need to protect biodiversity as a whole, taking account of the best available evidence on those habitats and species that are protected or of conservation concern in the East Marine Plans and adjacent areas (marine, terrestrial).	A preliminary consideration of impacts to habitats and species that are protected or of conservation concern is presented in **Section 9.5**.
Policy BIO2 - Where appropriate, proposals for development should incorporate features that enhance biodiversity and geological interests.	A preliminary consideration of design, mitigation and enhancement measures is outlined in **Section 9.3**.
Policy MPA1 - Any impacts on the overall MPA network must be taken into account in strategic level measures and assessments, with due regard given to any current agreed advice on an ecologically coherent network:	A preliminary consideration of impacts habitats and species that are features of MPAs is presented in **Section 9.5**. A Habitats Regulations Screening report has been produced and is provided in **Appendix 9.C** (PEI Report, Volume IV). MCZs are considered in **Section 9.5**.
Policy FISH2 - Proposals should demonstrate, in order of preference: a) that they will not have an adverse impact upon spawning and nursery areas and any associated habitat, b) how, if there are adverse impacts upon the spawning and nursery areas and any associated habitat, they will minimise them, c) how, if the adverse impacts cannot be minimised they will be mitigated, and d) the case for proceeding with their proposals if it is not possible to minimise or mitigate the adverse impacts	**Section 9.4** provides background information on fish spawning and nursery areas in the vicinity of the Project. A preliminary consideration of impacts on fish is provided in **Section 9.5**.
North East Lincolnshire Local Plan 2013 to 2032 (Ref 9-17)	
The North East Lincolnshire Local Plan was adopted in 2018 and covers the period 2013 to 2032. Policy 7 of the plan highlights that for operational port areas "proposals for port related use will be supported and, where appropriate,	A preliminary consideration of impacts on species and habitats and designated sites are presented in **Section 9.5**. A Habitats Regulations Screening report has been produced and is provided in **Appendix 9.C** (PEI Report, Volume IV).

Legislation / Policy / Guidance	Consideration within the PEI Report
approved by the Council if the submitted scheme accords with the development plan as a whole and subject to the ability to satisfy the requirements of the Habitats Regulations." In addition, Policy 41 of the plan states that: "*The Council will have regard to biodiversity and geodiversity when considering development proposals, seeking specifically to:* *A. establish and secure appropriate management of long-term mitigation areas within the Estuary Employment Zone, managed specifically to protect the integrity of the internationally important biodiversity sites (see Policy 9 'Habitat Mitigation - South Humber Bank');* *B. designate Local Wildlife Sites (LWSs) and Local Geological Sites (LGSs) in recognition of particular wildlife and geological value;* *C. protect manage and enhance international, national and local sites of biological and geological conservation importance, having regard to the hierarchy of designated sites, and the need for appropriate buffer zones;* *D. localize the loss of biodiversity features, or where loss is unavoidable and justified ensure appropriate mitigation and compensation measures are provided;* *E. create opportunities to retain, protect, restore and enhance features of biodiversity value, including priority habitats and species; and,* *F. take opportunities to retain, protect and restore the connectivity between components of the Borough's ecological network.* Any development which would, either individually or cumulatively, result in significant harm to biodiversity which cannot be avoided, adequately mitigated or as a last resort compensated for, will be refused".	

Stakeholder Engagement

9.4.2 A range of stakeholders have been engaged as part of the scoping process to obtain their views on the Project and the scope of the Marine Ecology assessment, the results of which are presented within the Scoping Opinion (**Appendix 1.B** of the PEI Report, Volume IV). A meeting was held with Natural England on 23rd November 2022 to provide an overview of the Project and to discuss the impact pathways relevant to marine ecology receptors.

Limitations and Assumptions

9.4.3 The information presented in this preliminary assessment reflects that obtained and evaluated at the time of reporting and is based on an emerging design for the Project and the maximum likely extents of land required for its construction and operation.

9.4.4 The findings of this preliminary assessment may be subject to change as the design of the Project is developed and refined further through the assessment and consultation processes, and as further research and investigative surveys are completed to fully understand its potential effects. This assessment is informed by the assessment of changes to physical processes which is based on preliminary outputs from hydrodynamic modelling. Further model runs will be carried out and a calibration report produced to inform the ES.

9.4.5 This assessment has been undertaken based on the following assumptions:

a. The scheme design and project methodology, as detailed in **Chapter 2: The Project** and **Chapter 3: Need and Alternatives**;

b. The underwater noise assessment assumes that more than one piling rig with impact hammers will be used concurrently with up to four tubular piles to be installed each day using up to four piling rigs as a worst case;

c. The underwater noise assessment assumes that the dredging and vessel activity will take place continuously (24/7) during construction and as such, provides a precautionary assessment;

d. During operation, periodic maintenance dredging will be required; and

e. The underwater noise assessment assumes that marine mammals will evade the noise source.

9.4.6 Whilst these are assumptions, the assessment within this PEI Report has been undertaken considering the anticipated worst-case scenario in respect of marine ecology receptors at the dredge, piling and disposal locations.

Study Area

9.4.7 The study area for this assessment is the area over which potential direct and indirect effects of the Project are predicted to occur during the construction and operational periods. The direct effects on nature conservation and marine ecology receptors are those that occur within the footprint of the Project, such as the direct disturbance to benthic habitats and associated species as a result of construction. Indirect effects are those that may arise outside this footprint, such as the potential noise and visual disturbance effects on waterbirds during construction.

9.4.8 The study area for the nature conservation and marine ecology topic is focused on the Port of Immingham and proposed disposal sites with data for the wider Humber Estuary region presented where relevant to provide contextual information and to ensure the area of potential effects (e.g., noise disturbance) are fully considered.

9.5 Baseline Conditions

Current Baseline

Data and information sources

9.5.1 Current baseline conditions have been determined by a desk-based review of available information. A project-specific subtidal benthic survey has also been undertaken to characterise seabed habitats and species within and near to the proposed dredge footprint.

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

Nature conservation sites

a. Natura 2000 standard data forms or information sheets for each designation: Information on the species and habitats listed in the original citations (Ref 9-39; Ref 9-40; Ref 9-41; Ref 9-42);

b. Multi-Agency Geographic Information for the Countryside (MAGIC) Interactive Map (Ref 9-19): Information on the boundaries of designated sites; and

c. Natural England Conservation Advice for Marine Protected Areas: Humber Estuary Special Area of Conservation (SAC) (Ref 9-20) and Humber Estuary Special Protection Area (SPA) (Ref 9-21).

Benthic habitats and species

a. Recent Port of Immingham Benthic Surveys between the Immingham Oil Terminal and Eastern Jetty. This included ten intertidal stations sampled in September 2021 using a 0.01 m² hand-held core and ten subtidal stations that were sampled in September 2021 using a 0.1 m² Day Grab. In addition, six stations were sampled at dredge disposal sites HU060 and HU056 in September 2021 using a 0.1 m² Day Grab (four within each of the disposal sites and two nearby to each of the disposal sites);

b. Able Marine Energy Park Benthic Surveys: The results of intertidal benthic surveys (undertaken in 2015 and 2016) using a 0.01 m² core sample and a subtidal survey in 2016 using a 0.1 m² Day Grab in the North Killingholme area (Ref 9-22);

c. Humber Estuary SAC Intertidal Sediment Survey: Ecological survey work undertaken in 2014 to monitor and assess the intertidal mudflat and sandflat communities of the Humber Estuary (Ref 9-45);

d. Immingham Outer Harbour (IOH) Benthic Surveys: Intertidal sampling at 14 stations (using a Day Grab (0.06 m²) or Van Veen Grab (0.03 m²) and subtidal sampling at 17 stations in the Port of Immingham area in 2009 (Ref 9-23);

e. South Humber Channel Marine Studies: Benthic sampling in the intertidal (using a 0.01 m² core from 36 stations) and subtidal (0.1 m² Hamon grab

from 30 stations) between the Humber Sea Terminal and Immingham Port undertaken in 2010 (Ref 9-24);

f. HU056 Disposal Site Monitoring: Benthic invertebrate samples collected at five sites within the disposal sites and at six locations nearby (triplicate samples at all locations) in 2017 (Ref 9-25); and

g. Clay Huts Disposal Site Benthic Monitoring: Benthic invertebrate samples collected from four stations in 2008 from within and near to the Clay Huts disposal sites (Ref 9-23).

Fish

a. South Humber Channel Marine Studies: Fish surveys in the intertidal (four double-ended fyke nets) and subtidal (eight beam trawls) between the Humber Sea Terminal and Port of Immingham undertaken in 2010 (Ref 9-24). These sites are located approximately 3 to 4km from the Project;

b. Review of fish population data in the Humber Estuary: A review of available data to describe the fish populations in the Humber Estuary (Ref 9-58);

c. The Humber Regional Environmental Characterisation (REC): Fish ecology information provided in the Marine Aggregate Levy Sustainability Fund (Ref 9-26);

d. Environment Agency TraC Fish Monitoring: The results of the most recently available WFD fish monitoring for the nearest sites to the Project (seine netting/bream trawls at Foulholme Sands and otter trawls at Burcom). The Foulholme Sands surveys were undertaken twice a year in the spring and autumn with the Burcom surveys annually in the early winter. These sites are located approximately 3-5 km from the Project with data available up to 2017 for Foulholme Sands and 2019 for Burcom (Ref 9-27);

e. 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) (Ref 9-28); and

f. Fish Atlas of the Celtic Sea, North Sea, and Baltic Sea: The study provides an overview of information collected from internationally coordinated and national surveys and presents data and information on the recent distribution and biology of demersal and small pelagic fish in these ecoregions (Ref 9-29).

Marine mammals

a. Donna Nook Seal Counts: The latest pup counts available from the Lincolnshire Wildlife Trust for winter 2021/22 and 2020/21;

b. Sea Watch Foundation Review of Marine Mammals in the Humber Estuary Region: Information on cetacean status and distribution in the area derived from survey data and the national sightings database maintained by the Sea

Watch Foundation with sightings data from 2000 onwards analysed (Ref 9-30);

c. Records of marine mammal sightings from the Lincolnshire Environmental Records Centre (Ref 9-31) and National Biodiversity Network (Ref 9-32);

d. Distribution maps of cetacean and seabird populations in the North-East Atlantic: Distribution maps of cetaceans and seabirds based on survey data in the North-East Atlantic between 1980 and 2018 collated and standardised (Ref 9-33);

e. 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 Humber Estuary region) estimated using data from animal-borne telemetry tags by the Sea Mammal Research Unit (SMRU) (Ref 9-34);

f. Donna Nook Telemetry Data; The results of the tagging of 11 grey seals from the Donna Nook colony to understand the movements of grey seals in the region (Ref 9-35);

g. Special Committee on Seals (SCOS) Annual Report: Information on the status of seals around the UK coast is reported annually by the SMRU advised SCOS (Ref 9-36);

h. The 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 (Ref 9-37); and

i. Small Cetaceans in European Atlantic Waters and the North Sea (SCANS) III Data: 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) (Ref 9-38).

9.5.3 Site specific surveys -that have been undertaken to underpin the assessments include:

a. **Subtidal benthic sampling:** Eight subtidal stations were sampled in July 2022 (using a 0.1 m² Day Grab) within and near to the Project footprint. The location of the survey stations is shown in **Figure 9.1** (PEI Report, Volume III). All the samples collected were analysed for macrofaunal analysis (faunal composition, abundance and biomass), Particle Size Analysis (PSA) and Total Organic Carbon (TOC). The methods and results of these surveys are included in **Appendix 9.A** (PEI Report, Volume IV) and summarised in **Section 9.6** of this chapter.

Nature conservation sites and protected species

Designated sites

9.5.4 The Project falls within the boundaries of the Humber Estuary SAC, SPA and Ramsar site (collectively forming the Humber EMS; **Figure 9.1** (PEI Report, Volume III)). For the Humber Estuary SAC, the primary reason for designation is the presence of two broad scale habitats, 1130 Estuaries and 1140 Mudflats and sandflats not covered by seawater at low tide (Ref 9-39). These broad scale habitats support other more specific habitats which are qualifying features but not a primary reason for designation. These are:

a. 1110 Sandbanks which are slightly covered by sea water all the time;

b. 1150 Coastal lagoons (identified as a priority feature);

c. 1310 *Salicornia* and other annuals colonizing mud and sand;

d. 1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae);

e. 2110 Embryonic shifting dunes;

f. 2120 Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes');

g. 2130 Fixed coastal dunes with herbaceous vegetation ('grey dunes') (identified as a priority feature); and

h. 2160 Dunes with *Hippopha rhamnoides*.

9.5.5 Alongside the habitats for which the SAC is designated, there are also three mobile species listed on Annex II of the EU Habitats Directive (92/43/EEC) (the Natural Habitats and Wild Fauna and Flora Directive) included in the designation (Ref 9-39), namely:

a. 1095 Sea lamprey (*Petromyzon marinus)*;

b. 1099 River lamprey (*Lampetra fluviatilis)*; and

c. 1364 Grey seal (*Halichoerus grypus*).

9.5.6 Qualifying features of the Humber Estuary SPA and Humber Estuary Ramsar site are shown in **Table 9.3** and **Table 9.4** respectively.

Table 9.3: Qualifying features of the Humber Estuary SPA (Ref 9-40)

Internationally Important Populations	
Internationally Important Populations of Regularly Occurring Annex 1 Species	
Breeding Species Population	
Bittern *Botaurus stellaris*	2 calling males (10.5 % of the GB population)
Marsh Harrier *Circus aeruginosus*	10 breeding females (6.3 % of the GB population)
Avocet *Recurvirostra avosetta*	64 pairs (8.6 % of the GB population)

Internationally Important Populations	
Little Tern *Sternula albifrons*	51 pairs (2.1 % of the GB population)
Wintering Species Population	
Bittern	4 (4.0 % of the GB population)
Hen harrier *Circus cyaneus*	8 (1.1 % of the GB population)
Bar-tailed Godwit *Limosa lapponica*	2,752 (4.4 % of the GB population)
Golden Plover *Pluvialis apricaria*	30,709 (12.3 % of the GB population)
Avocet *Recurvirostra avosetta*	54 (1.7 % of the GB population)
On passage Species population	
Ruff *Calidris pugnax*	128 (1.4 % of the GB population)
Internationally Important Populations of Regularly Occurring Migratory Species	
Wintering Species Population	
Teal† *Anas crecca*	2,322 (<1 % of the population)
Wigeon† *Mareca penelope*	5,044 (<1 % of the population)
Mallard† *Anas platyrhynchos*	2,456 (<1 % of the population)
Turnstone† *Arenaria interpres*	629 (<1 % of the population)
Common Pochard† *Aythya ferina*	719 (<1 % of the population)
Greater Scaup† *Aythya marila*	127 (<1 % of the population)
Brent Goose† *Branta bernicla*	2,098 (<1 % of the population)
Goldeneye† *Bucephala clangula*	467 (<1 % of the population)
Sanderling† *Calidris alba*	486 (<1 % of the population)
Dunlin *Calidris alpina*	22,222 (1.7 % of the Northern Siberia/Europe/Western Africa population)
Red Knot *Calidris canutus*	28,165 (6.3 % of the North-eastern Canada/Greenland/Iceland/North-western Europe population)
Ringed Plover† *Charadrius hiaticula*	403 (<1 % of the population)
Oystercatcher† *Haematopus ostralegus*	3503 (<1 % of the population)

Internationally Important Populations	
Black-tailed Godwit *Limosa*	1,113 (3.2 % of the Icelandic Breeding population)
Curlew† *Numenius arquata*	3,253 (<1 % of the population)
Grey Plover† *Pluvialis squatarola*	1,704 (<1 % of the population)
Shelduck *Tadorna tadorna*	4,464 (1.5 % of the North-western Europe population)
Redshank *Tringa totanus*	4,632 (3.6 % of the Eastern Atlantic Wintering population)
Northern Lapwing† *Vanellus vanellus*	22,765 (<1 % of population)
On passage Species Population	
Sanderling†	818 (<1 % of the population)
Dunlin	20,269 (1.5 % of the Northern Siberia/Europe/Western Africa population)
Red Knot	18,500 (4.1 % of the North-eastern Canada/Greenland/Iceland/North-western Europe population)
Ringed Plover†	1,766 (<1 % of the population)
Black-tailed Godwit	915 (2.6 % of the Icelandic Breeding population)
Whimbrel† *Numenius phaeopus*	113 (<1 % of the population
Grey Plover†	1,590 (<1 % of the population)
Greenshank† *Tringa nebularia*	77 (<1 % of the population)
Redshank	7,462 (5.7 % of the Eastern Atlantic Wintering population)
Internationally Important Assemblage of Waterfowl	
Waterfowl assemblage	153,934 waterfowl
†Species with this symbol do not represent a population that is > 1 % of the international threshold but are included in the waterfowl assemblage.	

Table 9.4: Qualifying marine features of the Humber Estuary Ramsar Site (Ref 9-41)

Ramsar Criterion
Criterion 1 – natural wetland habitats that are of international importance

Ramsar Criterion	
The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	
Criterion 3 – supports populations of plants and/or animal species of international importance	
The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.	
Criterion 5 – Bird Assemblages of International Importance	
Wintering waterfowl	153,934 waterfowl (5-year peak mean 1998/99-2002/3)
Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance	
Species	Spring/Autumn Population (5-year peak mean 1996-2000)
Golden Plover	17,996 (2.2 % of the Iceland & Faroes/East Atlantic population)
Red Knot	18,500 (4.1 % of the West & Southern African wintering population)
Dunlin	20,269 (1.5 % of the West Siberia/West Europe population)
Black-tailed Godwit	915 (2.6 % of the Iceland/West Europe population)
Redshank	7,462 (5.7 % of the population)
Species	Wintering Population (5-year peak mean 1996/7-2000/1)
Shelduck	4,464 (1.5 % of the North-western Europe Population)
Golden Plover	30,709 (3.8 % of the Iceland & Faroes/East Atlantic population)
Red Knot	28,165 (4.1 % of the West & Southern African wintering population)
Dunlin	22,222 (1.7 % of the West Siberia/West Europe population)
Black-tailed Godwit	1,113 (3.2 % of the Iceland/West Europe population)

Ramsar Criterion	
Bar-tailed Godwit	2,752 (2.3 % of the West Paleartic population)
Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path	
The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.	

9.5.7 The Greater Wash SPA is designated for a range of seabird and diving bird species and is located approximately 20 km from the Project. Qualifying features of this site is shown in **Table 9.5**.

Table 9.5: Qualifying marine features of the Greater Wash SPA (Ref 9-42)

Internationally Important Populations	
Internationally Important Populations of Regularly Occurring Annex 1 Species	
Breeding Species Population	
Little Tern *Sternula albifrons*	798 pairs (42% of GB breeding population)
Common Tern *Sterna hirundo*	510 pairs (5.1% of GB breeding population)
Sandwich Tern *Sterna sandvicensis*	852 pairs (35% of GB breeding population)
Wintering Species Population	
Little Gull *Hydrocoloeus minutus*	1,255 (no current GB population estimate)
Red-throated Diver *Gavia stellata*	1,407 (8.3% of GB non-breeding population)
Internationally Important Populations of Regularly Occurring Migratory Species	
Common Scoter *Melanitta nigra*	3,449 (0.6% of biogeographic population)

9.5.8 The Humber Estuary Site of Special Scientific Interest (SSSI) overlaps part of the Project site. This is designated for its nationally important habitat assemblage (intertidal mudflats and sandflats, and coastal saltmarsh) geological interest, importance to breeding, wintering and passage birds, breeding grey seal and the presence of river and sea lamprey.

9.5.9 North Killingholme Haven Pits SSSI is located approximately 5 km away from the Project. This site comprises saline lagoon habitats and supports important populations of waders including Black-tailed Godwits and Redshank. The Lagoons SSSI is located approximately 20 km from the Project and supports a variety of coastal habitats (such as saline lagoons and sand dunes) as well as a

population of breeding Little Terns. The impacts on species and habitats which are features for which SSSIs have been designated are assessed in **Section 9.5**.

9.5.10 The Holderness Inshore MCZ is the nearest MCZ to the Project (located approximately 20 km away). The site is designated for intertidal sand and muddy sand as well as a variety of subtidal rock and sedimentary habitats.

9.5.11 The nearest Local Nature Reserve (LNR) is Cleethorpes Sands LNR (located approximately 13 km south east of the Project) which supports a variety of intertidal and coastal habitats.

Protected species

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

a. The tentacled lagoon worm *Alkmaria romijni*;

b. The lagoon sand shrimp *Gammarus insensibilis*;

c. Twaite shad *Alosa fallax* and allis shad *Alosa alosa*;

d. Cetacean (whale and dolphin) species; and

e. All bird species.

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

a. Common seal *Phoca vitulina* and grey seal *Halichoerus grypus* (listed in Annex II and V);

b. Bottlenose dolphin *Tursiops truncatus* and harbour porpoise *Phocoena phocoena* (listed in Annex II and IV);

c. Sea lamprey Petromyzon marinus (listed in Annex II) and river lamprey (listed in Annex II and V);

d. Twaite shad *A. fallax* and allis shad *A. alosa* (listed in Annex II and V); and

e. Atlantic salmon *Salmo salar* (listed in Annex II and V).

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

9.5.15 In addition, some marine fauna and habitats are listed as priority species and habitats of principle importance in England, as required under Section 41 of the NERC Act. Species of principal importance which are of relevance to the Humber Estuary include various species of waterbird, commercial fish (such as cod *Gadus morhua* and herring *Clupea harengus*), migratory fish (such as lampreys, European smelt *Osmerus eperlanus*, Atlantic salmon *Salmo salar* and European eel *Anguilla anguilla*).

9.5.16 Habitats of principle importance which are of relevance to the Humber Estuary include intertidal mudflats, coastal saltmarsh, saline lagoons and sand dunes. Based on the current geographic extent and location of habitats of principal importance under Section 41 of the Natural Environment and Rural Communities

Act 2006 that are publicly available on the MAGIC website (Ref 9-19), the proximity of these coastal and intertidal habitats to the Project are described below:

a. Mudflats: The intertidal habitat directly overlaps the footprint of the Project;

b. Coastal saltmarsh: The nearest saltmarsh habitat is located approximately 3 km to the northwest of the Project;

c. Coastal sand dunes: The nearest coastal sand dunes within the Humber SAC are located more than 12 km southwest of the Project at Cleethorpes; and

d. Saline lagoons: The nearest coastal lagoon habitat within the Humber Estuary is located approximately 5 km from the Project at Killingholme.

9.5.17 European eels are also afforded protection as part of the Eels (England and Wales) Regulations 2009 (Ref 9-13). The regulations which apply to all freshwater and estuarine waters of England and Wales give powers to statutory bodies to implement measures for the recovery of European eel stocks including improving access, habitat quality and easing fishing pressure.

Benthic habitats and species

Humber Estuary overview

9.5.18 The Humber Estuary supports a wide variety of marine habitats including intertidal mudflats and sandflats, intertidal seagrass beds, coastal lagoons, saltmarsh, reedbeds, subtidal sandbanks and mixed sediment habitats (Ref 9-43; Ref 9-44; Ref 9-45).

9.5.19 The intertidal area of the Humber Estuary is extensive, covering approximately 10,000 ha, of which more than 90 % is mudflat and sandflat (Ref 9-46). The largest areas of mudflat occur in the outer Humber Estuary at Spurn Bight and Pyewipe, at Foul Holme and Skitter Sand in the mid Humber Estuary and across most of the Estuary width in the inner estuary above the Humber Bridge. This habitat changes from moderately exposed sandy shores at the mouth of the Humber Estuary to sheltered muddy shores within the main body of the Estuary and up into the tidal rivers. The mid and upper Humber Estuary is characterised by fringing reedbeds *Phragmites australis* on the upper shore while saltmarshes are present along the north bank and on the Lincolnshire coast east of Cleethorpes (Ref 9-46; Ref 9-20; Ref 9-21; Ref 9-45).

9.5.20 The subtidal area of the Humber Estuary is approximately 16,800 ha in extent (Ref 9-46). The subtidal environment of the Humber Estuary is highly dynamic and varies according to the composition of the bottom sediments, salinity, sediment load and turbidity and dissolved oxygen. Many of these factors vary with the season or state of the tide. Subtidal sand (including muddy sand) is the predominant subtidal sediment type in the Humber Estuary. The high mobility of sediments and high turbidity means that this habitat is typically relatively impoverished with a limited fauna characterised by very low densities of opportunistic species and species adapted to these conditions (Ref 9-20; Ref 9-21; Ref 9-46).

9.5.21 Invasive marine species known to occur in the Humber Estuary region include slipper limpet *Crepidula fornicata*, Chinese mitten crab *Eriocheir sinensis*, Pacific oyster *Magallana gigas* and acorn barnacle *Austrominius modestus* (Ref 9-44; Ref 9-24; **Appendix 9.A** (PEI Report, Volume IV)).

Intertidal habitats and species in the Port of Immingham area

9.5.22 Intertidal benthic surveys undertaken in the Port of Immingham area in 2021 recorded sandy mud habitat with the number of taxa found in the samples ranging from four to 15. The number of individuals was also highly variable and ranged from 1,100 organisms per m² to 40,600 organisms per m². The samples were predominantly characterised by nematodes, the oligochaetes *Tubificoides benedii* and *Enchytraeidae* spp., the mud shrimp *Corophium volutator*, the mudsnail *Peringia ulvae*, Baltic tellin *Limecola balthica* as well as the polychaetes *Hediste diversicolor* and *Pygospio elegans* recorded in the samples. These species dominated the assemblage and contributed almost entirely to the total abundances of organisms recorded at most of the sites surveyed.

9.5.23 The assemblage recorded was considered typical of the community recorded on mudflats in the nearby area (Ref 9-23; Ref 9-24; Ref 9-22). For example, intertidal surveys at North Killingholme (located approximately 3 km from the Project) in 2015 and 2016 also recorded a benthic assemblage characterised by species such as *Corophium volutator, Tubificoides benedii, Pygospio elegans, Hediste diversicolor, Limicola balthica* and nematodes with a broadly similar total number of individuals in the samples (up to around 50,000 organisms per m²) (Ref 9-22).

9.5.24 Many of the species recorded in the samples are considered prey species for coastal waterbirds such as polychaetes, Baltic tellin *Limecola balthica*, mudsnail *Peringia* spp. and mudshrimp *Corophium* spp. (Ref 9-56; Ref 9-57).

Project specific subtidal benthic surveys

9.5.25 In order to characterise the subtidal benthic communities present in the vicinity of the Project, subtidal sampling was undertaken in July 2022.

9.5.26 At each station, a sample was analysed for macrofaunal analysis (faunal composition, abundance and biomass), Particle Size Analysis (PSA) and Total Organic Carbon (TOC).

9.5.27 The results of these project specific benthic surveys are summarised below in **Table 9.6** with the methods and results described in more detail in **Appendix 9.A** (PEI Report, Volume IV).

9.5.28 The sediment from samples collected from the area consisted of mud and sandy mud. The TOC in the samples ranged between approximately 3 % and 6 % (**Table 9.5**).

9.5.29 The samples collected were highly impoverished with the number of taxa found in the samples ranging from one (Station 3) to 8 (Station 1), and the number of individuals from 10 organisms per m² (Station 3) to 190 organisms per m² (Station 1). The range in total species biomass in the samples was between <1 and 1.8 grams per m².

9.5.30 The faunal samples were characterised by low numbers of species (occurring in low abundances) including polychaetes (such *Nephtys* spp, *Streblospio shrubsolii* and *Scoloplos armiger*), nematodes, oligochaetes *Tubificoides* spp and crustacean *Diastylis rathkei*. All the species recorded from the samples in this area were considered commonly occurring in the region and not protected.

9.5.31 The faunal assemblage recorded is considered characteristic of subtidal habitats in this section of the Humber Estuary. For example, subtidal benthic surveys undertaken in the Immingham area in 2009, 2010, 2016 and 2021 predominantly recorded mud or muddy sand habitat which was generally impoverished (with a low number of taxa occurring at the majority of sites). The most commonly recorded infaunal species (generally recorded in low abundances) were the polychaetes *Capitella capitata*, *Streblospio shrubsolii, ,Pygospio elegans, Polydora cornuta*, oligochaetes *Tubificoides* spp., mud shrimp *Corophium volutator*, and nematodes (Ref 9-23; Ref 9-24; Ref 9-22).

Subtidal habitats and species at the disposal site

9.5.32 At present, subject to confirming a requirement for the disposal of dredge arisings and identifying alternative beneficial disposal options, it is envisaged that the majority of material would be deposited at either the Clay Huts disposal site (HU060) or Holme Channel disposal site (HU056).

9.5.33 Benthic surveys undertaken in 2021 within and near to Clay Huts disposal site (HU060) recorded predominantly sand habitat with the samples characterised by a wide range of species but typically in low abundances including nematodes, barnacle *Amphibalanus improvises*, polychaetes (such as *Pygospio elegans* and *Arenicola* spp.) and the amphipod *Corophium volutator*. Benthic sampling at the Holme Channel disposal site (HU056) recorded sand, gravelly sand and sandy gravel habitat with a highly impoverished assemblage characterised by low abundances of a few species (the amphipod *Corophium volutator*, mysid shrimp *Gastrosaccus spinifer*, bryozoan *Electra monostachys* and springtails *Collembola* spp.) (Ref 9-23).

Table 9.6: Subtidal 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)
1	Mud	6.45	8	190	0.02	*Tubificoides swirencoides* (60) *Nephtys spp* (40) *Diastylis rathkei* (20) *Nematoda* (20) *Streblospio shrubsolii* (20) *Corophium volutator* (10) *Macoma balthica* (10) *Nephtys hombergii* (10)
2	Mud	6.34	2	30	0.05	*Nematoda* (20) *Diastylis rathkei* (10)
3	Mud	5.37	1	10	<0.01	*Streblospio shrubsolii* (10)
4	Sandy Mud	4.38	2	120	0.06	*Nepthys spp* (110) *Diastylis rathkei* (10)
5	Sandy Mud	3.07	2	70	0.03	*Nepthys spp* (60) *Scoloplos armiger* (10)

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)
6	Sandy Mud	3.77	5	100	1.79	*Nepthys spp* (60) *Arenicola marina* (10) *Austrominius modestus* (10) *Scoloplos armiger* (10)
7	Sandy Mud	4.50	3	80	0.11	*Nepthys spp* (40) *Diastylis rathkei* (20) *Nematoda* (20)
8	Sandy Mud	3.67	4	110	0.03	*Nepthys spp* (80) *Mytilus edulis* (10) *Nematoda* (10) *Tubificoides swirencoides* (10)

Fish

Humber Estuary overview

9.5.34 The Humber Estuary contains a varied fish fauna, totalling over 80 species with the majority common to most UK estuaries. The Humber Estuary fish assemblage comprises resident, nursery, seasonal and migratory species, typical of estuarine fish communities (Ref 9-58; Ref 9-59).

9.5.35 In general, the abundance and diversity of fish increases towards the mouth of the estuary. The outer reaches are characterised by a community dominated by inshore marine species such as whiting *Merlangius merlangus*, cod *Gadus morhua*, plaice *Pleuronectes platessa* and Dover sole *Solea solea*. The middle and upper reaches of the estuary support more euryhaline species including flounder *Platichthys flesus*, European eel *Anguilla anguilla*, gobies and sprat *Spratus spratus* (Ref 9-60; Ref 9-59).

9.5.36 The Humber Estuary supports a fish assemblage typical of other estuaries in North Western Europe. However, a higher fish diversity than recorded in other estuaries in the UK has been found which may be due to the large catchment area and high fluvial flow allowing freshwater taxa to actively or passively occur in greater numbers into this estuary (Ref 9-61).

9.5.37 The baseline review presented in this chapter has primarily focused on key species which are of either commercial and/ or conservation importance. The functional guilds for estuarine fish used in Ref 9-58 which were based on published guild definitions (Ref 9-62; Ref 9-63) have been used to help summarise the life history and ecology of fish species occurring in the Humber Estuary, as follows:

a. Diadromous species (D): Species using estuaries as pathways of migration (for reproduction) between fresh waters and the sea; migration from fresh water to sea water to breed (catadromous species, e.g. eel), and in the opposite direction (anadromous species, e.g., salmonids and lampreys);

b. Marine migrant species (MM): Marine species that spawn at sea and regularly enter estuaries in large numbers, thus having a temporary residence in the estuarine habitat; they usually are highly euryhaline species, able to move throughout the full length of the estuary, and spending much of their life within estuaries, using these habitats as nursery grounds or visiting them regularly at sub-adult and adult life stages;

c. Estuarine resident species (ES): Species that are able to reproduce and complete their life cycle in the estuary; as such they are highly euryhaline species, able to move throughout the full length of the estuary;

d. Marine straggler species (MS); Marine species usually associated with coastal marine waters but entering estuaries accidentally in low numbers. These are predominantly stenohaline species, occurring most frequently in the lower sections of the estuary; and

e. Freshwater species (F): Species of freshwater origin that regularly or accidentally enter estuaries, in moderate to low numbers, moving varying

distances down the estuary but often restricted to low-salinity, upper reaches of estuaries and to periods of freshwater flooding.

9.5.38 **Table 9.7** provides a summary of species that have been recorded in the Humber Estuary (based on Ref 9-58) with further information on key species within each ecological guild provided below.

Table 9.7: Fish recorded in the Humber Estuary, grouped by ecological guilds.

Ecological guild	Species name	Common name	Ecological guild	Species name	Common name
Diadromous (D)	*Alosa alosa*	Allis shad	Marine stragglers (MS)	*Hyperoplus immaculatus*	Greater sandeel
	Alosa fallax	Twaite shad		*Hyperoplus lanceolatus*	Great sandeel
	Osmerus eperlanus	Smelt		*Callionymus lyra*	Dragonet
	Lampetra fluviatilis	River lamprey		*Taurulus bubalis*	Long-spined sea scorpion
	Petromyzon marinus	Sea lamprey		*Pollachius virens*	Coley / Saithe / Coalfish
	Salmo salar	Atlantic salmon		*Trisopterus minutus*	Poor cod
	Salmo trutta	Brown / sea trout		*Melanogrammus aeglefinus*	Haddock
	Gasterosteus aculeatus	3-spined stickleback		*Crystallogobius linearis*	Crystal goby
	Liza ramada	Thinlip mullet		*Pomatoschistus lozanoi*	Lozano's goby
	Anguilla	European eel		*Liparis montagui*	Montagu's seasnail
Marine migrants (MM)	*Atherina presbyter*	Sand smelt		*Gaidropsarus mediterraneus*	Shore rockling
	Clupea harengus	Atlantic herring		*Mullus surmuletus*	Striped red mullet
	Sprattus	Sprat		*Glyptocephalus cynoglossus*	Witch flounder
	Cyclopterus lumpus	Lumpsucker		*Microstomus kitt*	Lemon Sole

Ecological guild	Species name	Common name	Ecological guild	Species name	Common name
	Gadus morhua	Atlantic cod		*Scomber scombrus*	Mackerel
	Merlangius merlangus	Whiting		*Scophthalmus rhombus*	Brill
	Pollachius	Pollack		*Scyliorhinus sp.*	Spotted dogfish
	Trisopterus luscus	Pouting / Bib		*Buglossidium luteum*	Solenette
	Ciliata mustela	5-bearded rockling		*Entelurus aequoreus*	Snake pipefish
	Dicentrarchus labrax	Sea bass		*Echiichthys vipera*	Lesser weever
	Chelon labrosus	Thick lipped grey mullet		*Chelidonichthys cuculus*	Red gurnard
	Liza aurata	Golden grey and	Fresh-water species (F)	*Cobitis taenia*	Spined loach
	Limanda	Dab		*Abramis brama*	Common bream
	Platichthys flesus	Flounder		*Alburnus alburnus*	Common bleak
	Pleuronectes platessa	Plaice		*Blicca bjoerkna*	Silver bream
	Scophthalmus maximus	Turbot		*Carassius auratus*	Goldfish
	Solea solea	Dover sole		*Rutilus rutilus*	Roach
	Chelidonichthys lucernus	Tub gurnard		*Scardinius erythrophthalmus*	Rudd
	Eutrigla gurnardus	Grey gurnard		*Squalius cephalus*	Chub

Ecological guild	Species name	Common name	Ecological guild	Species name	Common name
Estuarine residents (ES)	*Agonus cataphractus*	Hooknose / Pogge		*Tinca tinca*	Tench
	Ammodytes tobianus	Lesser sandeel		*Gobio gobio*	Gudgeon
	Myoxocephalus scorpius	Shorthorn sculpin		*Leuciscus cephalus*	Chub
	Raniceps raninus	Tadpole-fish		*Leuciscus*	Dace
	Aphia minuta	Transparent goby		*Rutilus x Alburnus alburnus*	Roach x Common bleak hybrid
	Pomatoschistus microps	Common goby		*Scardinius erythrophthalmus x Abramis brama*	Rudd x Common bream hybrid
	Pomatoschistus minutus	Sand goby		*Esox lucius*	Pike
	Liparis	Sea-snail		*Pungitius pungitius*	10-spined stickleback
	Pholis gunnellus	Rock gunnel		*Perca fluviatilis*	Perch
	Syngnathus acus	Greater pipefish		*Gymnocephalus cernuus*	Ruffe
	Syngnathus rostellatus	Lesser (Nillsons) pipefish			
	Zoarces viviparus	Viviparous blenny			

Source: Ref 9-58.

Marine migrant species

9.5.39 With respect to demersal fish considered to be marine migrant species, the Humber Estuary is considered to be an important nursery ground for several commercially important gadoids including whiting *Merlangius merlangus* and cod *Gadus morhua* (**Figure 9.3** (PEI Report, Volume III)). These species are typically the most abundant gadoids occurring in the Humber Estuary (Ref 9-28; Ref 9-58). Further information on the ecology of these species is provided in **Table 9.8**. Other gadoids commonly occurring include pouting *Trisopterus luscus* and pollack *Pollachius pollachius*.

9.5.40 A range of flatfish species are commonly recorded in the Humber Estuary region with flounder *Platichthys flesus* considered to be the most commonly occurring species. Nursery grounds for the commercially important Dover *sole Solea solea* and plaice *Pleuronectes platessa* occur in the region with these species also commonly occurring. Spawning grounds for Dover sole also occur in the region (**Table 9.8** and **Figure 9.3** (PEI Report, Volume III)). In addition, dab *Limanda limanda* and turbot *Scophthalmus maximus* are also recorded.

9.5.41 With respect to pelagic marine migrant species (free-swimming fish that inhabit the mid-water column), the clupeids sprat *Sprattus sprattus* and herring *Clupea harengus* are the most commonly occurring species. The Humber Estuary is considered to be nursery ground for herring (**Figure 9.3** (PEI Report, Volume III)). These pelagic species tend to have little association with the seabed and as a result are often distributed over widespread and indistinct grounds, often forming large shoals. Sea bass *Dicentrarchus labrax* is also frequently recorded in the Humber Estuary. Further information on the ecology of these species is provided in **Table 9.8**.

Table 9.8: Background information on the most commonly recorded marine migrant species occurring in the Humber Estuary

Species	Ecology
Whiting	In the Humber Estuary, whiting is recorded throughout most of the year with the highest abundances typically occurring in autumn. Most individuals recorded are juveniles, suggesting the Humber Estuary is predominantly used as a nursery ground.
Cod	In the Humber Estuary, the species occurs throughout most of the year but at lower frequency in the spring and summer. Cod is rarely recorded in intertidal and shallow subtidal habitats within the Humber Estuary. Most individuals recorded are juveniles, suggesting the Humber Estuary is predominantly used as a nursery ground. Spawning occurs offshore between January and April, peaking during February, with spawning grounds in the North Sea usually located in the pelagic zone at depths between 20 m and 100 m.
Flounder	Flounder occurs year-round in the Humber Estuary but with higher abundance typically recorded in late spring and summer. This species occurs in inshore waters to depths of 50 m and commonly reported using estuarine systems as nurseries. In the North Sea, the species generally spawn in spring in deeper marine waters, and larvae

Species	Ecology
	and early juveniles use selective tidal transport to migrate upstream to estuaries and rivers hence it may be regarded as semi-catadromous.
Dover sole	In the Humber Estuary, sole is recorded throughout most of the year with juvenile sole generally appearing in the Humber Estuary during the late spring and summer, after larvae and juveniles are transported here from adjacent coastal spawning areas by tidal currents. In the North Sea, the species generally reproduces in spring (March to late June, with a peak in April) in coastal waters, with spawning areas along the East coast of England from the Humber Estuary down to the Norfolk coast. In the North Sea, the nurseries are in shallow (< a few metres deep) sandy or muddy bottoms.
Plaice	Plaice occur throughout most of the year in the Humber Estuary with juveniles mainly recorded, suggesting the Humber Estuary is predominantly used as a nursery ground. Plaice spawn between January and April (with peak densities on spawning grounds in May). Spawning grounds in the UK are generally located at between 20 m and 40 m water depth with spawning grounds for plaice occurring in the marine areas near the mouth of the Humber Estuary. Plaice is a marine flatfish that uses estuarine habitats as nursery grounds. Plaice live mostly on sandy bottoms, although it can also be found on gravel and mud and on sandy patches in rocky areas, habitats and coastal zones as nursery grounds.
Dab	Dab occurring in the Humber Estuary are mainly juveniles, which suggests the estuary is predominantly as a nursery ground. Dab spawn from January to June in the North Sea) with adults migrating to deeper waters between May and September.
Herring and sprat	Both sprat and herring occur in the Humber Estuary throughout most of the year but with a lower frequency in the spring and higher frequency in autumn (herring) and winter (sprat). Most individuals of both species recorded are juveniles or young individuals. Sprat is very abundant in the shallow coastal and estuarine areas of the North Sea in winter before spawning offshore between May and August in the North Sea. Herring spawn in shoals on coarse sand, gravel, shells and small stones in shallow water between 15 to 40 m depth. Herring are demersal spawners, depositing their sticky eggs on coarse sand, gravel, small stones and rock. Young herring spend some time in the inshore areas before migrating offshore to join the adult population. Stocks that spawn in spring tend to use inshore spawning grounds whilst autumn and winter spawners tend to move offshore using the edges of ocean banks (e.g. around the Dogger Bank and off the Northumberland and Yorkshire coasts).
Sea bass	The occurrence of the sea bass in the Humber Estuary is typically sporadic. Data suggests that the estuary is predominantly used by juvenile/young stages, although the typically low frequency and abundance of the species suggest that the Humber Estuary is not an important nursery ground for sea bass.

Source: Ref 9-58; Ref 9-26; Ref 9-28; Ref 9-29.

Estuarine resident fishes

9.5.42 The sand goby *Pomatoschistus minutus* is the most frequently recorded goby species in the Humber Estuary, with common goby *P. microps* and the transparent goby *Aphia minuta* also occurring.

9.5.43 Sand gobies are frequently encountered in all areas of the estuary, but mainly in shallow intertidal areas in sandy and muddy habitats. Spawning occurs in shallow waters over an extended period, mostly during the spring and summer (sand goby spawn in summer while common goby spawn after their first winter between February and September, depending on the latitude), with multiple batches of eggs laid during this season (batch spawner).

9.5.44 Other estuarine resident species occurring in the Humber Estuary include lesser sandeel *Ammodytes tobianus*, hooknose *Agonus cataprachus*, tadpole fish *Raniceps raninus*, sea snail *Liparis liparis*, rock gunnel *Pholis gunnellus,* pipefish (greater pipefish *Sygnathus acus* and lesser pipefish *S. rostellatus*), and the viviparous blenny *Zoarces viviparus*.

Marine stragglers and freshwater species

9.5.45 Marine stragglers occur relatively infrequently with species recorded including the lesser weever *Echiichthys vipera* and dragonet *Callionymus lyra*.

9.5.46 The most commonly recorded freshwater species recorded in the Humber Estuary are roach *Rutilus rutilus* and common bream *Abramis brama* with other freshwater species recorded including and silver bream *Blicca bjoerkna* and rudd *Scardinius erythrophthalmus.* These species are typically recorded in the upper and mid sections of the Humber Estuary.

Diadromous migratory fish

9.5.47 Diadromous migratory fish (species migrating between freshwater and seawater) which occur in the Humber Estuary include salmonids (Atlantic salmon *Salmo salar* and sea trout *Salmo trutta*), lampreys (river lamprey *Lampretra fluviatilis* and sea lamprey *Petromyzon marinus*), European eel *Anguilla anguilla*, shads (allis shad *Alosa alosa* and twaite shad *Alosa fallax*) and European smelt *Osmerus eperlanus*. Of these species, European eel, European smelt and river lamprey have been the species most commonly recorded in sampling in the Humber Estuary (Ref 9-58). These species are all afforded protection under various legislation as described above.

9.5.48 Further information on the ecology and migration of these species is provided in **Table 9.9**.

Table 9.9: Background information on the ecology and distribution of diadromous migratory fish

Species	Ecology
European eel	European eel is a catadromous species which migrates to the marine environment (Sargasso Sea) to spawn. The larvae (leptocephali) then drift in the Gulf Stream and then North Atlantic Drift current for 2 to 3 years across the

Species	Ecology
	Atlantic Ocean to Europe and metamorphose into juveniles (elvers). The eels usually migrate into fresh water where they remain for many years. However, not all eels migrate into fresh water 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 Humber catchment, although it is absent from the upper reaches of some rivers. In the Humber catchment, glass eels/elvers generally immigrate in spring and early summer, whereas the majority of silver eel emigrate in late summer and autumn. Eels are typically present in the Humber Estuary in the spring and summer. 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 (Ref 9-128).
European smelt	The 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 early spring. Data suggests that the highest densities of smelt in the Humber Estuary occur in the spring and summer. The spawning migration starts in September to October, when mature fishes aggregate in estuaries to overwinter. Upriver migration starts in March to April when temperatures rise above 4 to 6°C and during rainy and stormy weather. Adult smelt generally enter the tidal Trent and Ouse from the Humber Estuary in early March and presumably return to the estuary after spawning.
River and sea lamprey	The river lamprey and the sea lamprey are both anadromous species, spawning in freshwater but completing part of their lifecycle in estuaries or at sea. 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. Unlike sea lamprey, the growth phase of river lamprey is primarily restricted to estuaries. River lamprey have been frequently recorded in the Humber Estuary, with the Ouse catchment believed to support one of the most important river lamprey populations in the UK. In the Humber basin, river lamprey mainly enters the rivers from the estuary in autumn and then spawn in April. Sea lamprey spawning is almost entirely restricted to the Ouse catchment, principally the Rivers Ouse, Swale, Ure and Wharfe. The spawning migration of sea lamprey usually takes place in April and May when the adults start to migrate back into fresh water. The upstream migration of river lamprey takes place almost

Species	Ecology
	exclusively at night, with adults being sedentary and resting under rocks and riverbanks during the day.
Shads	The twaite and allis shad are anadromous species. Mature allis shad, having spent most of their lives in the sea stop feeding and move into the estuaries of large rivers, migrating into fresh water during late spring (April to June). Adult twaite shad stop feeding at sea and gather in the estuaries of suitable rivers in early summer (April and May), moving upstream to spawn from mid-May to mid-July. Within the Humber Estuary, most records of allis shad were juveniles while twaite shad adults.
Atlantic salmon and sea trout	Atlantic salmon and sea trout are anadromous species which migrate to freshwaters to spawn, whilst spending much of their life in the marine environment. They spawn in 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 occurring between April and June. 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 autumn, although a small proportion returns in the spring and summer. In the Humbler catchment, Atlantic salmon has been mainly recorded from the upper reaches of the Ouse with brown/sea trout widespread in the upper reaches of the Humber catchment. In the Humber Estuary, most Atlantic salmon and sea trout have been recorded in the spring months between April and June and have been of smolt size.

Sources, Ref 9-128; Ref 9-128; Ref 9-129.

9.5.49 In summary**,** existing data suggests that the Humber Estuary supports a wide range of fish species including commonly occurring estuarine species and migratory species including diadromous fish. The Humber Estuary is also considered an important nursery ground for a range of commercially important fish species.

Immingham area

9.5.50 Fish data collected as part of intertidal fyke net and subtidal beam trawl surveys undertaken in May/June 2010 at sites located approximately 3 to 4 km from the Project (between the Humber Sea Terminal and the Port of Immingham) has also been reviewed; despite the vintage of these data, they provide an indication of species which may be present (Ref 9-24)[4].

9.5.51 The intertidal sampling (fyke netting) catch was dominated by flatfish species (flounder and sole) which consisted of 1+group flounder (born the year before) and mostly 0+ group sole, which suggested the area is used as a flatfish nursery. Single individuals of pollock, five-bearded rockling *Ciliata Mustela* and sand goby

[4] A fyke net is a type of fish trap. It consists of long cylindrical netting bag usually with several netting cones fitted inside the netting cylinder to make entry easy and exit difficult. This fishing methods typically target demersal fish species.

were also recorded (due to the small size of sand goby, this fish is normally misrepresented in fyke net catches).

9.5.52 Sand gobies and sole were the most abundant species recorded in the subtidal sampling (beam trawls) with other species recorded in lower abundances including whiting, five-bearded rockling and river lamprey. Sole caught in the subtidal survey were significantly larger than the specimens from the fyke nets. This is consistent with earlier research by Cefas that analysed annual 2 m beam trawl and 1.5 m push net survey data from the period 1981 to1995 and found that 0-group sole were highest in the 2 m to 5.9 m depth band (Ref 9-64).

9.5.53 The results of the most recently available Environment Agency TraC fish monitoring for the sites nearest the Project (seine netting/beam trawls at Foulholme Sands and otter trawls at Burcom) are summarised in **Table 9.10**. Beach seine netting targets both demersal and pelagic species occurring in shallow inshore locations. Beam and otter trawls target demersal species[5]. The Foulholme Sands surveys were undertaken twice a year in the spring and autumn with the Burcom surveys annually in the early winter. These monitoring sites are located approximately 3 km to 5 km from the Project and are shown in **Figure 9.4** (PEI Report, Volume III). Data was available up to 2017 for Foulholme Sands and up to 2019 for Burcom (Ref 9-27).

Table 9.10: The total number of fish caught in fish surveys undertaken at Burcom and Foulhome Sands between 2013 and 2019

Species	Burcom Otter Trawl*	Foulhome Sands Beam Trawl**	Foulhome Sands Seine Net***
3-spined stickleback	-	1	41
5-bearded rockling	7	-	1
Bullrout / Short-spined sea scorpion	6	-	-
Cod	150	-	-
Common goby	7	-	8
Dab	48	-	
Dover sole	515	38	125
Dragonet	-	1	-
Flounder	81	48	63
Herring	14	4	205

[5] These bottom trawls would only accidentally capture pelagic species (such as sprat or sea bass).

Species	Burcom Otter Trawl*	Foulhome Sands Beam Trawl**	Foulhome Sands Seine Net***
Hooknose / Pogge	7	4	-
Lesser (Nillsons) pipefish	-	53	222
Lesser sandeel	-	1	-
Lesser weever	-	-	1
Plaice	4	114	1303
River lamprey	1	-	-
Sand goby	1220	21	752
Sea bass	-	1	35
Sea-snail	21	-	
Smelt	3	-	74
Sprat	9	-	20
Thin lipped grey mullet	-	-	9
Thornback ray / Roker	2		-
Turbot	-	-	4
Viviparous blenny	1	-	6
Whiting	164	10	45

* Surveys undertaken between 2013 and 2019.

** Surveys undertaken between 2014 and 2017.

*** Surveys undertaken between 2013 and 2017.

9.5.54 In summary, the most abundant species recorded in the surveys summarised in **Table 9.10** were sand gobies, the flatfish species plaice and Dover sole, the pelagic species herring and the gadoids whiting and cod. Other commonly occurring species recorded included the diadromous European smelt, flounder, 3-spined stickleback, dab and sprat. The results are consistent with data for the wider Humber Estuary region (described above) which suggests that these species are some of the most commonly occurring species in the region. In addition, of note was a single individual River lamprey recorded in the Burcom Otter Trawl.

9.5.55 While these surveys do not overlap specifically with the Project, they are considered broadly representative of the fish assemblage that could be present

within the dredge footprint and surrounding local area. This is because the surveys have used a variety of techniques to target different habitats within both the intertidal and subtidal. The TrAC surveys are also relatively contemporary and cover a range of seasons.

Marine mammals

Humber Estuary overview

Seals

9.5.56 The most commonly occurring marine mammals recorded in the Humber Estuary region are seals with populations of both grey seal *Halichoerus grypus* and common (harbour) seal *Phoca vitulina* occurring. Further information about the abundance and distribution of these species is provided below followed by a description of cetacean (whale, dolphin and porpoise) species occurring in the region.

9.5.57 The intertidal area at Donna Nook is the main haul out site in the region and is an important breeding ground for grey seals. This colony is located over 25 km from the Project at the mouth of the Humber Estuary. In 2019, there were an estimated 67,789 grey seal pups born in Britain (Ref 9-65) with approximately 3 % of the pup production occurring at Donna Nook. Breeding occurs once a year between October and December and the vast majority of seals in this colony breed at Donna Nook, with a few seals breeding on Skidbrooke Ridge, south of Donna Nook. Peak grey seal pup numbers in winter 2021/22 and 2020/21 at Donna Nook consisted of two ,122 and 2,214 seals respectively with numbers having increased substantially in recent years from under 100 pups born annually in the 1980s (see **Figure 9.5** (PEI Report, Volume III)).

9.5.58 The intertidal mudflats also provide an important habitat throughout the year for grey seals to haul out or rest, particularly during the spring when all grey seals (except young born the previous year) are moulting. Aerial seal counts undertaken in August 2021 recorded 3,897 grey seals hauled out at Donna Nook. Total numbers at this colony have increased from the low hundreds recorded in the late 1990s and early 2000s to counts over 4000-5,000 seals in more recent years (Ref 9-65) (see **Figure 9.6** (PEI Report, Volume III)).

9.5.59 Grey seals can undertake wide ranging seasonal movements over several thousand kilometres (Ref 9-66; Ref 9-34; Ref 9-35). However, while grey seals may range widely between haul out sites, tracking has shown that most foraging probably occurs within 100 km of a haul-out site (Ref 9-36). Seals tagged at Donna Nook were recorded undertaking wide ranging movements in the outer Humber Estuary and approaches as well as more widely in the North Sea (Ref 9-35). This is reflected in high predicted at-sea densities of grey seals in the approaches to the Humber Estuary (Ref 9-34).

9.5.60 The Humber Estuary region also supports a small population of common seal. As for the grey seal, Donna Nook is also the key haul out site for common seals. A total of 122 common seals were recorded as part of annual aerial monitoring in the region in August 2021. Since the 1990s numbers have generally fluctuated

between 100 and 400 counts annually in the region (Ref 9-36). Common seals typically forage within 40 km to 50 km of haul out sites (Ref 9-36).

Cetaceans

9.5.61 While over ten species of cetacean have been recorded in the southern and central North Sea, only harbour porpoise *Phocoena phocoena* is considered as regularly occurring throughout most of the year (Ref 9-30; Ref 9-67; Ref 9-33).

9.5.62 Near to the Humber Estuary, high densities of harbour porpoise have been recorded offshore from the Lincolnshire coast and the Holderness Coast (Ref 9-38; Ref 9-47). Harbour porpoise are also frequently recorded foraging in the Humber Estuary region with over 2,000 sightings since 2000 (Ref 9-30; Ref 9-32; Ref 9-31). Peak sightings and numbers occur in August, September and October. Although porpoises in the North Sea can give birth in any month of the year, breeding is typically seasonal with most births in June or July and a peak in mating in August (Ref 9-30).

9.5.63 Other cetacean species recorded in the Humber Estuary region more rarely include bottlenose dolphin *Tursiops truncatus*, common dolphin *Delphinus delphis*, white-beaked dolphin *Lagenorhynchus albirostris* killer whale *Orcinus orca* and minke whale *Balaenoptera acutorostrata* (Ref 9-30); Ref 9-31).

Immingham area

9.5.64 Marine mammal survey data or sighting records for the Immingham area are limited. However, given that seals (particularly grey seals) are regularly recorded foraging in the Humber Estuary, this species would be expected to occur relatively frequently in this area. For example, approximately 10 to 15 grey seals were observed hauling out on mudflat at Sunk Island (on the north bank of the Humber Estuary) during the project specific benthic surveys as detailed in Ref 9-48. This haul out site is located approximately 4 km north east from the Project and around 3 - 4 km from the dredge disposal sites (including transit routes). No seal haul out sites are known to occur nearer to the Project.

9.5.65 Harbour porpoises have also been regularly recorded foraging in this section of the Humber Estuary (Ref 9-30) (see **Figure 9.7** (PEI Report, Volume III)). This includes observations of a harbour porpoise foraging approximately 2 km from the Project in the mid channel, offshore from Immingham during the project specific benthic surveys as detailed in Ref 9-48.

Future Baseline

9.5.66 In the absence of the Project, the current marine coastal processes would remain the same as described in the preliminary physical processes assessment (**Chapter 16: Physical Processes**).

9.5.67 Marine species are likely to become increasingly vulnerable to anthropogenic pressures in the future due to the predicted effects of climate change and ocean acidification in combination with more local pressures. The 2020 MCCIP report card (Ref 9-49) highlighted the following changes to marine ecology receptors

could potentially occur during the operational phase of the project as a result of climate change:

a. Sea-level rise could result in deeper waters and larger waves reaching saltmarsh and other intertidal habitats, causing erosion at the seaward edge;

b. Changes in patterns of rainfall or temperature changing vegetation composition of coastal saltmarsh communities;

c. Marine communities around the UK altering as ocean acidification increases;

d. Changing sea temperatures resulting in range shifts for both benthic species and mobile species (such as fish, marine mammals). This could result in a decline of some cold-water species around certain parts of the UK and an increase in the prevalence of non-native species;

e. Changing temperatures affecting spawning in some marine species as well as the timings of migrations;

f. Coastal waterbirds showing north-easterly shifts in the winter distributions in Europe; and

g. Changes in prey distribution and availability, resulting in range shifts in some regional populations of marine mammals, fish and seabirds.

9.5.68 Data suggests that ecological changes linked to climate change (such as range shifts) are already occurring although there is currently a high degree of uncertainty with respect to predicting the magnitude of potential effects in the future.

9.6 Development Design and Impact Avoidance

Embedded Mitigation Measures

9.6.1 The Project has been designed, as far as possible, to avoid and minimise impacts and effects to marine ecology through the process of design development, and by embedding mitigation measures into the design, such as minimising the dredge requirements as far as possible.

Standard Mitigation Measures

9.6.2 A number of 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. These are as follows:

a. Even disposal deposition of dredged material: Targeting disposal loads in the central/deeper area of the disposal sites to reduce depth reductions. This will minimise the initial reduction in water depth and any environmental changes at the disposal sites;

b. Following biosecurity management procedures: Biosecurity control measures during construction will be included within the outline Construction Environmental Management Plan (CEMP) and the Applicant's existing biosecurity management procedures will be followed during operation; and

c. 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.

9.7 Potential Impacts and Effects

9.7.1 The preliminary assessment has identified potential likely significant effects on marine ecology receptors as a result of the construction and subsequent operation of the Project.

9.7.2 The preliminary physical processes assessment (**Chapter 16: Physical Processes**), water and sediment quality assessment (**Chapter 17: Marine Water and Sediment Quality**) and underwater noise assessment (**Appendix 9.B** (PEI Report, Volume IV)) have informed the outcomes of the marine ecology assessment.

9.7.3 Potential impacts on features of internationally designated sites (SACs, SPAs and Ramsar sites) have been assessed in **Section 9.5** and will also be assessed within the HRA in accordance with the HRA screening report (**Appendix 9.C** (PEI Report, Volume IV)).

9.7.4 It is noted that the Killingholme Haven Pits Site SSSI which is located approximately 6 km away from the Project could be functionally linked to the mudflat habitat in the Project footprint with local populations of species such as Dunlin and Black-tailed Godwit potentially utilising both areas. However, Killingholme Haven Pits is considered too distant to be impacted directly by the Project (such as through potential disturbance effects). Based on the predicted magnitude of potential effects and proposed mitigation, indirect impacts on the SSSI (e.g. changes in local population levels resulting from changes in distribution or mortality) are also expected to be negligible.

9.7.5 The Lagoons SSSI is located approximately 20 km from the Project with Little Tern a notified feature of the SSSI. Data suggests that this species forages within 5 km of nesting sites (Ref 9-57) with this species considered very rare within the Immingham area. On this basis, this notified feature will not overlap with any potential direct or indirect changes resulting from the construction and operational activities associated with the Project which are limited to within the vicinity of the Port of Immingham.

9.7.6 The nearest MCZ (Holderness Inshore) is located approximately 20 km from the Project and does not overlap with the zone of influence. Furthermore, there are no mobile FOCI that could overlap with any of the marine effects resulting from the Project. 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.

9.7.7 Cumulative impacts on marine ecology receptors that could arise as a result of other coastal and marine developments and activities in the Humber Estuary combined with the Project are considered as necessary as part of the cumulative

impacts and in-combination effects assessment (**Chapter 25: Cumulative and In-Combination Effects**).

Construction

9.7.8 This section contains a preliminary assessment of the potential impacts to marine ecology receptors as a result of the construction phase of the Project. Potential effects during the construction phase that are considered relevant are reviewed in **Table 9.10**. It should be noted that the table includes the rationale for the scoping in or out of individual pathways for further assessment. It should be noted that the construction of the Project may be completed in a single stage, or it may be sequenced such that the construction of Berth 2 takes place at the same time as operation of Berth 1 (see **Chapter 2: The Project)**. However, all capital dredging (and associated disposal activity) will be undertaken together at one time, before operation of Berth 1 commences. Therefore, for all impact pathways relating to capital dredge or dredge disposal, the assessment will not be altered by a single or sequenced construction period. Furthermore, in the case of a sequenced construction, the overall duration of piling will, however, be extended. However, there will be no change in the overall peak levels of underwater noise generated by the construction of the two berths at once versus a sequenced construction (i.e., the magnitude of change). Therefore, the underwater noise assessment for benthic habitats, fish and marine mammals as presented below is considered the worst-case scenario and will not be altered by a sequenced construction period.

Table 9.11: Potential effects during construction scoped in / out of further detailed assessment

Receptor	Impact Pathways/ Potential Effects	Project activity	Included in assessment?	Justification
Benthic habitats and species	Direct loss of intertidal and subtidal habitats and species as a result of the piles	Piling	Yes	Piling would result in the small loss of subtidal and intertidal habitat. This impact pathway has, therefore, been scoped into the assessment.
	Direct changes to 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 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.
		Dredge disposal	N/A	This pathway relates to changes in habitat resulting directly from seabed removal and is, therefore, not considered relevant to the dredge disposal activity. Potential effects resulting from sediment deposition at the disposal site are discussed in the row below.
	Direct changes to benthic habitats and species as a result of sediment deposition	Piling	No	Piling has the potential to result in the localised resuspension of sediment as a result of seabed disturbance. Sediment that settles out of suspension back onto the seabed as 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 the assessment.

Receptor	Impact Pathways/ Potential Effects	Project activity	Included in assessment?	Justification
		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.
	Indirect loss or change to seabed habitats and species as a result of changes to hydrodynamic and sedimentary processes	Marine works (capital dredging and piles)	Yes	The capital dredge and pile structures have the potential to result in changes to hydrodynamic and sedimentary processes (e.g. flow rates, accretion and erosion patterns). Marine invertebrates inhabiting sand and mud habitat show different tolerance ranges to physiological stresses caused by tidal exposure and tidal elevation and, therefore, hydrodynamic and bathymetric changes caused by the dredging could affect the quality of marine habitats and change the distribution of marine species. This impact pathway has, therefore, been scoped into the assessment.
		Dredge disposal	Yes	The disposal of dredged material at the marine disposal site 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). Marine invertebrates inhabiting sand and mud habitat show different tolerance ranges to physiological stresses caused by tidal

Receptor	Impact Pathways/ Potential Effects	Project activity	Included in assessment?	Justification
				exposure and tidal elevation and, therefore, hydrodynamic and bathymetric changes caused by the disposal could affect the quality of marine habitats and change the distribution of marine species. This impact pathway has, therefore, been scoped into the assessment.
	Changes in water and sediment quality	Piling	No	The 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 piling is considered unlikely to produce adverse effects in any species. The potential for accidental spillages will also be negligible during construction through following established industry guidance and protocols. This impact pathway has, therefore, been scoped out of the assessment.
		Capital dredge	Yes	Changes in water quality during capital dredging could impact benthic habitats and species through an increase in suspended sediment concentrations (SSC) and the release 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.
		Surface water drainage	No	Standard measures to control surface water run-off during construction are embedded within the Project design for legislative compliance, and therefore it is very unlikely that

Receptor	Impact Pathways/ Potential Effects	Project activity	Included in assessment?	Justification
				contaminated run-off would enter the Humber Estuary. This impact pathway has, therefore, been scoped out of the assessment.
	Underwater noise	Piling	Yes	Underwater noise generated by piling has the potential to affect benthic species. This will require further assessment and has, therefore, been scoped in.
		Capital dredge	Yes	Underwater noise generated by dredging has the potential to affect benthic species. This will require further assessment and has, therefore, been scoped in.
		Dredge disposal	Yes	Underwater noise generated by the movement of the dredger to and from the disposal site has the potential to affect benthic species if this disposal option is adopted. This will require further assessment and has, therefore, been scoped in.
	The potential introduction and spread of non-native species	Construction of marine infrastructure	Yes	Non-native species have the potential to be transported into the local area as a result of construction activity. This impact pathway has, therefore, been scoped into the assessment.
		Capital dredge	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.
		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

Receptor	Impact Pathways/ Potential Effects	Project activity	Included in assessment?	Justification
				vessel ballast water. This impact pathway has, therefore, been scoped into the assessment.
	Damage to sensitive habitats as a result of changes in air quality.	Road traffic emissions	No	The predicted number of construction vehicle movements is lower than the IAQM and EPUK screening guidance (see **Chapter 6: Air Quality**), below which a road traffic impact is unlikely to contribute to a significant effect on local air quality. This impact pathway has, therefore, been scoped out of the assessment.
		Construction vessel emissions	No	The assessment has considered a scenario of peak construction vessel operation (see **Chapter 6: Air Quality).** Given the limited number of construction vessel emissions sources, the frequency of operation and distance between source and sensitive receptors, it is considered highly unlikely that this source could contribute to a significant effect on local air quality. This impact pathway has, therefore, been scoped out of the assessment.
Fish	Direct loss or changes to fish populations and habitat	Piling	No	There is the potential for impacts to fish as a result of habitat loss due to installation of piles and the footprint of the Project. However, the direct footprint of the piling only covers a highly localised area with the mobile nature of fish allowing them to utilise nearby areas. This impact pathway has, therefore, been scoped out of the assessment.
		Capital dredge	Yes	Dredging by trailer suction hopper dredger has the potential to result in the direct uptake of fish and fish eggs by the action of the draghead (entrainment). Backhoe dredging can also directly remove fish and fish eggs in the bucket. In addition, capital dredging has the potential to result in seabed

Receptor	Impact Pathways/ Potential Effects	Project activity	Included in assessment?	Justification
				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 impact pathway has, therefore, been scoped into the assessment.
		Dredge disposal	Yes	Disposal at the marine disposal site 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. This impact pathway has, therefore, been scoped into the assessment.
	Indirect changes to seabed habitats for fish	Piling	No	Piling 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, such effects will be negligible and highly localised and will cause no direct changes to fish habitat. This impact pathway has, therefore, been scoped out of the assessment.
		Capital dredge	No	The capital dredge 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 **Chapter 16: Physical Processes**), negligible changes in estuary processes are predicted. The predicted changes are not expected to modify existing subtidal habitat types found in the area. Indirect effects on fish habitats (feeding, spawning and nursery areas) are, therefore, considered to be negligible. On

Receptor	Impact Pathways/ Potential Effects	Project activity	Included in assessment?	Justification
				this basis, this pathway has been scoped out of the assessment.
		Dredge disposal	No	Dredge 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). However, as described in more detail in **Chapter 16: Physical Processes**), only minor changes in flow rates and subtidal seabed morphology are predicted which are not expected to modify existing subtidal habitat types found in the area (i.e. mobile sand habitats characterised by an impoverished infaunal assemblage). Given the offshore location of the disposal site, no changes in wave regime are predicted. 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 the assessment.
	Changes in water and sediment quality	Piling	No	The 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 piling are considered highly unlikely to produce adverse effects in any fish species. This assessment has been made based on preliminary numerical modelling of physical processes (see **Chapter 16: Physical Processes**) and the water and sediment quality assessment (**Chapter 17: Marine Water and Sediment Quality**). The potential for accidental spillages will also be negligible during construction through following established industry

Receptor	Impact Pathways/ Potential Effects	Project activity	Included in assessment?	Justification
				guidance and protocols. This impact pathway has, therefore, been scoped out of the 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	Piling	Yes	During piling, 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 changes to fish in the vicinity of the Project. This impact pathway has, therefore, been scoped into the assessment.
		Capital dredge	Yes	Elevated underwater noise and vibration levels caused by the action of the dredger could potentially affect fish. This impact pathway has, therefore, been scoped into the assessment.
		Dredge disposal	Yes	Underwater noise and vibration levels caused by the movement of the dredger to and from the disposal site could potentially affect fish. This impact pathway has, therefore, been scoped into the assessment.

Receptor	Impact Pathways/ Potential Effects	Project activity	Included in assessment?	Justification
Marine mammals	Direct loss or changes in marine mammal foraging habitat	Construction (piling, capital dredge and dredge disposal)	No	There is the potential for impacts to marine mammals as a result of changes to marine mammal foraging habitat and prey resources. However, the footprint of the Project 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 the assessment.
	Changes in water and sediment quality	Piling	No	The negligible, highly localised and temporary changes in suspended sediment levels (as described in more detail in **Chapter 16: Physical Processes**) and related changes in sediment bound contaminants and dissolved oxygen (as described in **Chapter 17: Marine Water and Sediment Quality**) associated with bed disturbance during piling, is considered highly unlikely to produce adverse effects in any marine mammal species. The potential for accidental spillages will also be negligible during construction through following established industry guidance and protocols. This impact pathway has, therefore, been scoped out of the assessment.
		Capital dredge	No	The plumes resulting from dredging are expected to have a relatively minimal and local effect on SSC in the vicinity of the Project (as described in more detail in **Chapter 16: Physical Processes**). Marine mammals are well adapted to turbid conditions and, therefore, not sensitive to the scale of changes in SSC predicted during capital dredging (Ref 9-50). Given the limited extent of sediment dispersal significant elevations in water column contamination are unlikely. This will be confirmed following analysis of the uplift in contaminant concentrations in the water column once

Receptor	Impact Pathways/ Potential Effects	Project activity	Included in assessment?	Justification
				sediment sampling and analysis has been carried out. 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) (Ref 9-50). Furthermore, potential for accidental spillages will also be negligible during all phases through the application of established industry guidance and protocols. The potential for water quality impacts to marine mammals has, therefore, been scoped out of the assessment.
		Dredge disposal	No	The plumes resulting from dredge disposal are expected to have a relatively minimal and local effect on SSC (as described in more detail in **Chapter 16: Physical Processes**). Marine mammals are well adapted to turbid conditions and, therefore, not sensitive to the scale of changes in SSC predicted during disposal (Ref 9-50). Given the limited extent of sediment dispersal significant elevations in water column contamination are unlikely. This will be confirmed following analysis of the uplift in contaminant concentrations in the water column once sediment sampling and analysis has been carried out. 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) (Ref 9-50).

Receptor	Impact Pathways/ Potential Effects	Project activity	Included in assessment?	Justification
				Furthermore, potential for accidental spillages will also be negligible during construction through the application of established industry guidance and protocols. The potential for water quality impacts to marine mammal has therefore been scoped out of the assessment.
	Collision risk	Construction, dredging and dredge disposal	No	Vessels involved in construction and 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 speeds over 10 knots are considered to have a much higher probability of causing lethal injury (Ref 9-51). 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 (Ref 9-52; Ref 9-53). 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 (Ref 9-53). In addition, marine mammals foraging within the Humber Estuary 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 the assessment.

Receptor	Impact Pathways/ Potential Effects	Project activity	Included in assessment?	Justification
	Underwater noise	Piling	Yes	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 changes to marine mammals in the vicinity of the Project. This impact pathway has, therefore, been scoped into the assessment.
		Capital dredge	Yes	Elevated noise and vibration levels caused by the action of the dredger could potentially affect marine mammals by inducing adverse behavioural reactions. This impact pathway has, therefore, been scoped into the assessment.
		Dredge disposal	Yes	Elevated noise and vibration levels caused by the movement of the dredger to and from the disposal site could potentially affect marine mammals by inducing adverse behavioural reactions. This impact pathway has, therefore, been scoped into the assessment.
	Visual disturbance of hauled out seals	Construction, dredging and dredge disposal	No	The nearest established breeding colony for grey seals is located over 25 km away at Donna Nook. Approximately 10 to 15 grey seals were also observed hauling out on mudflat at Sunk Island (on the north bank of the Humber Estuary) during the benthic surveys as detailed in Ref 9-48. This haul out site is located approximately 4 km north east from the Project and around 3-4 km from the dredge disposal sites (including transit routes). No seal haul out sites are known to occur nearer to the Project. Seals which are hauled out on land, either resting or breeding, are considered particularly sensitive to visual disturbance (Ref 9-68).

Receptor	Impact Pathways/ Potential Effects	Project activity	Included in assessment?	Justification
				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 <150-200 m (Ref 9-69; Ref 9-70; Ref 9-71; Ref 9-72). 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 (Ref 9-73). 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 (Ref 9-74). Based on this evidence, seals hauled out on the intertidal habitats of Sunk Island (located on the opposite bank to the Project) are out of the zone of influence of any potential visual disturbance effects as a result of dredging, dredge disposal or construction activity. The potential for disturbance to hauled out seals has, therefore, been scoped out of the assessment.

Benthic Habitats and Species

9.7.10 This section contains a preliminary assessment of the potential impacts to benthic ecology receptors as a result of the construction phase of the Project. The following impact pathways have been assessed:

a. Direct loss of intertidal habitat as a result of the piles;

b. Direct loss of subtidal habitat as a result of the piles;

c. Changes to benthic habitats and species as result of the removal of seabed material during dredging;

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

e. Indirect loss or change to seabed habitats and species as a result of changes to hydrodynamic and sedimentary processes during marine works (capital dredging and piles) and dredge disposal;

f. Changes in water and sediment quality during capital dredging and dredge disposal;

g. Underwater noise and vibration during piling, capital dredging and dredge disposal; and

h. Introduction and spread of non-native species.

Direct loss of intertidal habitat as a result of the piles

9.7.11 The piles will cause a direct loss of 0.017 ha of intertidal mudflat habitat.

9.7.12 The combined worst case intertidal habitat loss as a result of the piling represents approximately 0.000048 % the Humber Estuary SAC and approximately 0.000186 % of the 'mudflats and sandflats not covered by seawater at low tide' feature of the Humber Estuary SAC[6].

9.7.13 This loss also represents 0.000046 % of the Humber Estuary SPA/Ramsar[7]. When considering this in the context of intertidal area, the area of loss represents approximately 0.000196 % of intertidal foreshore habitats[8] and approximately 0.000274 % of mudflat[9] within the SPA.

9.7.14 This habitat loss is therefore negligible in the context of the Humber Estuary SAC, SPA and Ramsar.

[6] Based on the extents given in the Standard Data Form on the JNCC website (Ref 9-39)
[7] Based on the extents given in the Standard Data Form on the JNCC website (Ref 9-40)
[8]Based on using the 'Intertidal Substrate Foreshore (England and Scotland)' data layer (https://magic.defra.gov.uk/Metadata_for_MAGIC/SPIRE%20intertidal%20substrate%20foreshore.pdf
[9] Based on using mudflat data layer of the Priority Habitat Inventory (England) (https://data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england).

9.7.15 The loss of intertidal habitat due to piling will also be highly localised and considered *de minimis* in extent. The loss is also considered to be a magnitude that will not change the overall structure or functioning of the nearby mudflats within the Port of Immingham area or more widely in the Humber Estuary. Potential effects of direct intertidal habitat loss on coastal waterbirds are considered in **Chapter 10: Ornithology**.

9.7.16 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Direct loss of subtidal habitat as a result of the piles

9.7.17 Piling in the subtidal area will result in the direct loss of 0.035 ha of seabed habitat. This habitat represents approximately 0.000096 % of the Humber Estuary SAC.

9.7.18 The project-specific subtidal survey (**Section 9.3** and **Appendix 9.A** of this PEI Report, Volume IV) recorded a highly impoverished assemblage characterised polychaetes (such *Nephtys* spp, *Streblospio shrubsolii* and *Scoloplos armiger*), nematodes, oligochaetes *Tubificoides* spp and crustacean *Diastylis rathkei)*.

9.7.19 The loss in subtidal habitat as a result of the piles is considered negligible in the context of extent of the overall amount of similar marine habitats found locally in the Humber Estuary. All the species recorded were considered commonly occurring and not protected. Furthermore, faunal assemblage recorded are also considered characteristic of subtidal habitats found more widely in this section of the Humber Estuary (Ref 9-23; Ref 9-24; Ref 9-22).

9.7.20 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

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

9.7.21 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, mortality or relocation to a disposal site.

9.7.22 The capital dredge will remove approximately 100,000 m^3 of material over a maximum area of approximately 45,000 m^2. It is expected that the majority or all of the material will be removed with a backhoe dredger, although some material may also be removed by trailer suction hopper dredger (TSHD).

9.7.23 Following the capital dredge, it is likely that the dredge pocket would provide similar habitat to that under pre-dredge conditions. This will be confirmed by sediment sampling carried out in line with OSPAR[10] requirements and subsequent analysis as part of the Physical Processes assessment for the ES.

9.7.24 The project-specific subtidal survey (**Section 9.3** and **Appendix 9.A** (PEI Report, Volume IV)) recorded an impoverished benthic community which is likely to

[10] 'OSPAR' relates to the Convention for the Protection of the Marine Environment of the North-East Atlantic.

reflect the existing high levels of physical disturbance in the area due to strong tidal currents and sediment movement.

9.7.25 Samples were characterised by polychaetes (such *Nephtys* spp, *Streblospio shrubsolii* and *Scoloplos armiger*), nematodes, oligochaetes *Tubificoides* spp and crustacean *Diastylis rathkei.* 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 (Ref 9-75; Ref 9-76; Ref 9-77). All the species recorded are commonly occurring and not protected. In addition, the faunal assemblage recorded is considered characteristic of subtidal habitats found more widely in this section of the Humber Estuary (Ref 9-23; Ref 9-24; Ref 9-22). Subtidal habitats in areas around the Port of Immingham are considered to be typically of limited ecological value.

9.7.26 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

9.7.27 It should be noted that this assessment specifically relates to the effects of the capital dredge. The frequency of dredging required as part of the proposed maintenance dredging programme, however, will mean that the seabed in the berths is likely to be disturbed on a periodic basis once the Project is operational. Changes to benthic habitats and species as result of the removal of seabed material during maintenance dredging is considered in **Table 9.12**.

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

Capital Dredging

9.7.28 Sediment changes that are predicted to occur as a result of the capital dredge are presented at this preliminary stage in **Chapter 16: Physical Processes**. In summary, however, preliminary conclusions are that maximum siltation as a result of the capital dredge within about 500 m up and down the estuary from the edge of the dredge pocket is predicted to be 3 mm. Beyond this area, deposition levels are predicted to be less than 1 mm. Furthermore, once on the bed, the deposited material will return to the background system i.e. it will be put back into suspension on subsequent peak flood or ebb tides to be further dispersed.

9.7.29 The project-specific subtidal survey (**Section 9.3** and **Appendix 9.A** of this PEI Report, Volume IV) recorded highly impoverished assemblage characterised polychaetes (such *Nephtys* spp, *Streblospio shrubsolii* and *Scoloplos armiger*), nematodes, oligochaetes *Tubificoides* spp and crustacean *Diastylis rathkei*. All the species recorded were considered commonly occurring and not protected.

9.7.30 The benthic species occurring within and near to the dredge area typically consist of burrowing infauna (such as polychaetes, oligochaetes or bivalves), which 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 fully re-establish in typically less than 1 to 2 years and for some species within a few months (Ref 9-75; Ref 9-76; Ref 9-77).

9.7.31 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Disposal

9.7.32 The requirement for disposal of dredged material at sea associated with the Project would be fulfilled at licensed disposal sites HU056 and HU060 (see **Chapter 2: The Project**).

9.7.33 A preliminary assessment of the sediment changes that are predicted to occur as a result of the capital dredging disposal is presented in **Chapter 16: Physical Processes**. In summary, sedimentation resulting from the disposal plume is predicted to be generally in the range of 4 to 6 mm at distances of several hundred metres from the disposal sites to within approximately 4 km. Further up and down estuary, maximum sedimentation as a result of the disposal activities is generally predicted to be less than 1mm to 2 mm.

9.7.34 The disposal sites are located in the mid channel and are subject to regular natural physical disturbance (and associated scouring) as a result of very strong tidal flows. This is reflected in a generally impoverished assemblage at both disposal sites. In addition millions of wet tonnes of dredge sediment are disposed of at HU060 annually which will also cause some disturbance due to sediment deposition.

9.7.35 The benthic species recorded within and adjacent to the disposal sites include mobile infauna (such as errant polychaetes e.g., *Arenicola* spp. and amphipods) 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 (Ref 9-78; Ref 9-75; Ref 9-76; Ref 9-77; Ref 9-79). On this basis, any effects are considered to be temporary and short term.

9.7.36 In summary, deposition in the wider area surrounding the disposal ground is expected to be in the order of millimetres. Sedimentation of this scale is unlikely to result in significant smothering effects to most faunal species with recoverability expected to be high.

9.7.37 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Indirect loss or change to seabed habitats and species as a result of changes to hydrodynamic and sedimentary processes

Marine works

9.7.38 A preliminary assessment of the hydrodynamic and sediment regime changes that are predicted to occur as a result of the marine works are presented in **Chapter 16: Physical Processes**. It should be noted that predicted changes are primarily as a result of the capital dredging with the effects due to the presence of the piles having a negligible, localised effect.

9.7.39 Slight increases to local peak ebb current speed landward of the berth pocket are predicted to cause a limited amount of erosion of the bed along part of the lower intertidal (at the elevation of MLWS) beneath the landward ends of the proposed jetty. This will result in a potential indirect loss in intertidal area (approximately 0.01 ha). The assessment indicates that once the softer upper layer is removed, the harder, more consolidated, underlayer of bed material is unlikely to erode further. This calculation represents a worst-case assessment of potential elevation changes and has been considered on a precautionary basis. The level of predicted change is at the limit of the accuracy of the modelled data and, in real terms, is likely to be immeasurable against the context of natural variability (as a result of storm events, for example).

9.7.40 The combined intertidal habitat loss as a result of the capital dredge and piling represents approximately 0.000027 % the Humber Estuary SAC and approximately 0.000107 % of the 'mudflats and sandflats not covered by seawater at low tide' feature of the Humber Estuary SAC[11].

9.7.41 The predicted intertidal loss also consists of a very narrow strip on the lower shore around the sublittoral fringe and it is considered that this loss in mudflat extent will not change the overall structure or functioning of the nearby mudflats within the Port of Immingham area or more widely in the Humber Estuary.

9.7.42 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Disposal

9.7.43 A preliminary assessment of the hydrodynamic and sediment regime changes that are predicted to occur as a result of the capital dredging disposal is presented in **Chapter 16: Physical Processes**.

9.7.44 Local changes to the bathymetry (as a result of material disposal to the bed) within the disposal site will be small in the context of the existing depths. Disposal activity will be targeted to the deeper areas within the site, ensuring that bed level changes are not excessive in any one area, thus, minimising the overall change. As a result, associated changes to the local hydrodynamics (and sediment transport pathways) will be negligible.

9.7.45 These changes are unlikely to result in any significant changes to local sediment transport in the region although some localised changes to seabed bathymetry and morphology could occur.

9.7.46 The predicted changes in flow rates and subtidal seabed morphology are not expected to modify existing subtidal habitat types found in the area (i.e. mobile sand habitats characterised by an impoverished infaunal assemblage).

9.7.47 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

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

Changes in water and sediment quality during dredging and dredge disposal

Capital dredge

Elevated suspended sediment concentrations

9.7.48 The changes in SSC that are predicted to occur as a result of the capital dredge are presented at this preliminary stage **Chapter 16: Physical Processes**. In summary, the increased concentrations arising from the capital dredge will be of a lower magnitude and persist for a shorter distance (and time) than that from disposal activity which is summarised below.

9.7.49 Naturally very high SSC typically occur year-round in the Humber Estuary, particularly during the winter months when storm events disturb the seabed and on spring tides (Ref 9-80; Ref 9-81). The estuarine benthic communities recorded on mudflats and the shallow mud in the region are considered tolerant to this highly turbid environment (Ref 9-75; Ref 9-76; Ref 9-77). The predicted SSCs are within the range that can frequently occur naturally and also as a result of ongoing dredge and disposal activity (**Chapter 16: Physical Processes**).

Release of contaminants

9.7.50 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 will be lifted from the bed to the hopper/barge, with only a small proportion raised into suspension and remaining in the water column (i.e., through abrasion pressure from the draghead/bucket).

9.7.51 The site-specific sediment sampling and analysis that will be undertaken to inform the Marine Water and Sediment Quality assessment (**Chapter 17: Marine Water and Sediment Quality**) has not been undertaken at this preliminary stage.

9.7.52 However, based on existing evidence on the level of contamination in sediments within the vicinity of the Project, the overall level of contamination in the proposed dredge area is likely to be low.

9.7.53 On this basis, the uplift in dissolved contaminant concentrations is anticipated to be minimal as a result of the dredge, 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 in the water column contamination are, therefore, not anticipated.

9.7.54 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Disposal

Elevated suspended sediment concentrations

9.7.55 The changes in SSC that are predicted to occur as a result of the capital dredge disposal are presented at this preliminary stage in **Chapter 16: Physical Processes**. In summary, the dredge disposal is predicted to produce peak SSC of around 600 to 800 mg/l above background at the disposal site, reducing to typically 100 to 200 mg/l within a distance of around 7 km from the source. These peak increases are predicted to persist at any given location for a single modelled timestep (10 minutes) before the tidal forcing carries the plume further up or down estuary on the respective flood or ebb tide. SSCs of this magnitude are considered to regularly occur naturally or as a result of ongoing maintenance dredging/disposal. Upstream of Hull and downstream (within the outer estuary), maximum SSC levels are lower; generally, between 20 and 100 mg/l above background, as the tidal excursion from the disposal site limits the extent of the resultant plume. However, in reality due to the existing high SSC that typically occurs in the Humber Estuary, the predicted increase in concentrations resulting from the disposal is likely to become immeasurable (against background) within approximately 1 km of the disposal site. The measurable plume from each disposal operation is also only likely to persist for a single tidal cycle (less than 6 hours from disposal) as after this time the dispersion under the peak flood or ebb tidal flows means concentrations will have reverted to background levels.

9.7.56 Naturally very high SSCs typically occur year-round in the Humber 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 (Ref 9-75; Ref 9-76; Ref 9-77). The predicted SSCs are within the range that can frequently occur naturally and also as a result of ongoing dredge and disposal activity (**Chapter 16: Physical Processes**).

9.7.57 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. Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Release of contaminants

9.7.58 The site-specific sediment sampling and analysis that will be undertaken to inform the Water and Sediment Quality assessment (**Chapter 17: Marine Water and Sediment Quality**) has not been undertaken at this preliminary stage.

9.7.59 However, based on existing evidence on the level of contamination in sediments within the vicinity of the Project, it is anticipated that the sediment will be suitable for disposal in the marine environment.

9.7.60 During disposal, sediment will be rapidly dispersed in the water column and redistributed. Furthermore, the disposal sites routinely receive dredging material from ports within the Humber Estuary and disposal is not expected to elevate contaminant concentrations above background levels.

9.7.61 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Underwater noise and vibration during piling, capital dredging and dredge disposal

9.7.62 Marine invertebrates lack a gas-filled bladder and are thus unable to detect the pressure changes associated with sound waves (Ref 9-82). 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.

9.7.63 Scientific understanding of the potential effects of underwater noise on marine invertebrates is relatively underdeveloped (Ref 9-104). There is limited research to suggest that exposure to near-field low-frequency sound may cause anatomical damage (Ref 9-82). Anecdotal evidence indicates there was pronounced statocyst and organ damage in seven stranded giant squid after nearby seismic surveys (Ref 9-131). Airgun exposure can cause damaged statocysts in rock lobsters up to a year later (Ref 9-83). However, no such effects were detected in other studies (Ref 9-84). 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 (Ref 9-82).

9.7.64 There is also increasing evidence to suggest that benthic invertebrates behaviourally respond to particle motion (vibration) (Ref 9-85). For example, blue mussels *Mytilus edulis* vary valve gape, oxygen demand and clearance rates (Ref 9-86) and hermit crabs *Paganus bernhardus* shift their shell and at very high amplitudes, leave their shell, examine it and then return (Ref 9-85). 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 (Ref 9-87). However, population level and mortality effects are considered unlikely.

Piling

9.7.65 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 Project will involve the installation of approximately 380 steel tubular piles, which are estimated to be a maximum of 1,372 mm diameter in size.

9.7.66 The duration of piling works will be defined at the next stage of the Project. Piling will not take place continuously as there will be periods of downtime, pile positioning and set up.

9.7.67 The construction of the Project may be completed in a single stage, or it may be sequenced such that the construction of the second berth takes place at the same time as operation of the first berth (refer to **Chapter 2: The Project**). In the case of a sequenced construction, the overall duration of piling will take place over a longer period. However, there will be no change in the overall peak levels of underwater noise generated by the construction of both berths at once versus a sequenced construction (i.e. the magnitude of change). Therefore, the underwater noise assessment is considered the worst case and will not be altered by a sequenced construction period.

9.7.68 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Capital dredge and disposal

9.7.69 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.

9.7.70 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

The potential introduction and spread of non-native species

9.7.71 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 (Ref 9-88). 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 (Ref 9-89).

9.7.72 The introduction and spread of non-native species can occur either accidentally or by intentional movement of species as a consequence of human activity (Ref 9-90 cited in Ref 9-91). 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 (Ref 9-92; Ref 9-85), 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 (Ref 9-85).

9.7.73 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.

9.7.74 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.

9.7.75 The UK is bound by international agreements such as 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 (Ref 9-93). Additionally, Section 14(1) of the WCA 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 WCA.

9.7.76 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 crane 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.

9.7.77 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 (Ref 9-94). 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 of the scheme. These measures will be included within the outline

CEMP. On this basis, the potential impact at this preliminary stage has been assessed as **not significant.**

Fish

9.7.78 This section contains a preliminary assessment of the potential impacts to fish receptors as a result of the construction phase of the Project. An assessment of the following impact pathways has been undertaken:

a. Direct loss or changes to fish populations and habitat as a direct result of dredging and dredge disposal;

b. Changes in water and sediment quality as a result of dredging and dredge disposal; and

c. Underwater noise and vibration during piling, capital dredging and dredge disposal.

Direct loss or changes to fish populations and habitat as a direct result of dredging and dredge disposal

Capital dredge

9.7.79 Habitat change could potentially impact on critical habitats including spawning, nursery and feeding grounds that have an important ecological function for fish. However, the dredge footprint is considered unlikely to provide important nursery or spawning functions for fish species as a result of the existing disturbed nature of this habitat despite known nursery or spawning areas for species such as Dover sole, whiting or cod occurring in the wider Humber Estuary area.

9.7.80 Potential prey items for flatfish and demersal fish such as polychaete worms were recorded during the project specific intertidal and subtidal surveys (**Appendix 9.A** (PEI Report, Volume IV)) (Ref 9-78). 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).

9.7.81 During dredging, there is the potential for fish along with roe (eggs) of these species to be removed. The region is known to support Dover sole spawning grounds. Dover sole spawn on a range of substrates in shallow water. 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, the dredge footprint is considered negligible in the context of suitable nursery habitat in the region.

9.7.82 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Disposal

9.7.83 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.

9.7.84 The disposal grounds are located in a highly dynamic area with the mobile sandbanks subject to regular natural physical disturbance (and associated scouring) as a result of very strong tidal flows and deposition due to rdredge activity. This is reflected in a highly impoverished 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, 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. Fish are also mobile species and will easily be able to move away from the zone of influence and return following the cessation of disposal activity.

9.7.85 The highly disturbed nature of the seabed is also unlikely to provide suitable conditions as a spawning or nursery area for fish.

9.7.86 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Changes in water and sediment quality as a result of dredging and dredge disposal

Capital dredge

9.7.87 The changes in SSC that could potentially occur as a result of the capital dredge are presented at this preliminary stage in the Physical Processes assessment (**Chapter 16: Physical Processes**) and summarised above in the 'Benthic habitats and species' sub-section (**Paragraphs 9.7.48** to **9.7.49**).

9.7.88 As noted in the preceding section, fish within the Humber 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.

9.7.89 As highlighted above, salmonids and other migratory fish can be sensitive to elevated SSC However, Atlantic salmon and sea trout are both known to migrate through estuaries with high SSC to get to spawning areas (including the Humber Estuary which is considered one of the estuaries in the UK with the highest levels of SSCs) (Ref 9-95; Ref 9-96; Ref 9-97; Ref 9-80; Ref 9-81). Other migratory species such as lamprey and shad species also pass through estuaries with high suspended sediments. Elevated SSCs due to dredging are expected to be of a magnitude that can occur naturally or as a result of ongoing maintenance dredging/disposal.

9.7.90 Sediment plumes resulting from dredging are also anticipated to be relatively localised (in the context of the entire width of the estuary) and dissipate relatively rapidly and be immeasurable against background levels within a relatively short duration of time. Therefore, salmonids and other migratory fish would also be able to avoid the temporary sediment plumes. Based on these factors there is therefore considered limited potential for migrating fish to be adversely affected by the predicted changes in SSC.

9.7.91 Given that elevated SSCs due to dredge and dredge disposal are considered to be in the range of variability that can occur naturally in the Humber Estuary (which has very high SSCs year-round, particularly during the winter months) as well as due to ongoing maintenance dredging/disposal and that 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.

9.7.92 With respect to dissolved oxygen, increases in SSC are expected to be brief and localised.

9.7.93 With respect to sediment contamination, the site-specific sediment sampling and analysis that will be undertaken to inform the Water and Sediment Quality assessment (**Chapter 17: Marine Water and Sediment Quality**) has not been undertaken at this preliminary stage.

9.7.94 However, based on existing evidence on the level of contamination in sediments within the vicinity of the Project, the overall level of contamination in the proposed dredge area is likely to be low.

9.7.95 On this basis, the uplift in dissolved contaminant concentrations is anticipated to be minimal as a result of the dredge, 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 in the water column contamination are, therefore, not anticipated.

9.7.96 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Dredge disposal

9.7.97 The changes in SSC that could potentially occur as a result of the disposal activities are presented at this preliminary stage in the Physical Processes assessment (**Chapter 16: Physical Processes**) and summarised above in the 'Benthic Habitats and Species' impact assessment sub-section (**Paragraphs 9.7.48** to **9.7.49**).

9.7.98 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 SSC (including the Humber Estuary which is considered one of the estuaries in the UK with the highest levels of SSC) (Ref 9-80) and the predicted SSC 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.

9.7.99 With respect to sediment contamination, the site-specific sediment sampling and analysis that will be undertaken to inform the Water and Sediment Quality assessment (**Chapter 17: Marine Water and Sediment Quality**) has not been undertaken at this preliminary stage.

9.7.100 However, based on existing evidence on the level of contamination in sediments within the vicinity of the Project, it is anticipated that the sediment will be suitable for disposal in the marine environment.

9.7.101 During disposal, sediment will be rapidly dispersed in the water column and redistributed. Furthermore, the disposal sites routinely receive maintenance dredging material from ports within the Humber Estuary and disposal is not expected to elevate contaminant concentrations above background levels.

9.7.102 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Underwater noise and vibration during piling, capital dredging and dredge disposal

9.7.103 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 Project (**Appendix 9.B** (PEI Report, Volume IV)) and is briefly summarised in this section.

9.7.104 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.

9.7.105 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 (Ref 9-98; Ref 9-99; Ref 9-100). For most dredging activities, the main source of sound relates to the vessel engine noise.

9.7.106 There is a wide diversity in hearing structures in fish which leads to different auditory capabilities across species (Ref 9-101). All fish can sense the particle motion[12] component of an acoustic field via the inner ear as a result of whole-body accelerations (Ref 9-102), 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 (Ref

[12] 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.

9-103; Ref 9-104; Ref 9-105). Although many fish are also likely to detect sound pressure[13], particle motion is considered equally or potentially more important (Ref 9-106).

9.7.107 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 (Ref 9-106). Ref 9-103 proposed the following three categories of fish which are described below:

a. Fish with a swim bladder or air cavities that aid hearing;

b. Fish with a swim bladder that does not aid hearing; and

c. Fish with no swim bladder.

9.7.108 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 shads.

9.7.109 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*).

9.7.110 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 lavate*).

Piling

9.7.111 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 9.B** (PEI Report, Volume IV).

9.7.112 The predicted range at which the quantitative instantaneous peak Sound Pressure Level (SPL) thresholds for pile driving are reached (as defined in Ref 9-103) indicates that there is a risk of mortality, potential mortal injury or recoverable injury within 22 m from the source of impact piling in fish with a swim bladder (such as herring, Atlantic salmon and European eel) and within 10 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.

9.7.113 The calculator developed by the United States National Marine Fisheries Service (NMFS) (Ref 9-107) as a tool for assessing the potential effects to fish exposed

[13] 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.

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 (Ref 9-103) are reached. Based on the assumptions highlighted in **Appendix 9.B** (PEI Report, Volume IV), there is predicted to be a risk of mortality and potential mortal injury within 72 m from the source of impact piling in fish with a swim bladder involved in hearing (such as herring), within 49 m from the source in fish with a swim bladder not involved in hearing (such as European eel) and within 15 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 121 m in fish with a swim bladder and 23 m in fish without a swim bladder. For vibro-piling, there is predicted to be a risk of mortality and potential mortal injury within 38 m from the source in fish with a swim bladder involved in hearing, within 26 m from the source in fish with a swim bladder not involved in hearing and within 8 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 64 m in fish with a swim bladder and 12 m in fish without a swim bladder.

9.7.114 Given the mobility of fish, any individuals that might be present within the localised areas associated with potential mortality/injury during pile driving activities would be expected to easily move away and avoid harm. Furthermore, the area local to the Project is not considered a key foraging, spawning or nursery habitat for fish and, therefore, this localised zone of injury is unlikely to result in any significant effects on fish.

9.7.115 The range at which the Ref 9-108 quantitative instantaneous peak SPL behaviour thresholds for percussive pile driving are reached indicates that there is a risk of a behavioural response in fish within around 1.6 km from the impact piling. Behavioural reactions during impact piling are, therefore, anticipated to occur across 67 % width of the Humber Estuary at low water and 46 % of the estuary width at high water, potentially creating a partial temporary barrier to fish movements. For vibro-piling, there is a risk of a behavioural response in fish within around 1.1 km from the source which equates to 48 % of the width of the Humber Estuary at low water and 33 % of the estuary width at high water.

9.7.116 The scale of the behavioural response is partly dependent on the hearing sensitivity of the species. The key fish in the study area include species across the range of Ref 9-103 fish hearing groups. Fish with a swim bladder involved in hearing (e.g. herring) may exhibit a moderate behavioural reaction within a 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. European eel) are likely to display a milder behavioural reaction. Fish without a swim bladder (e.g. river lamprey) are likely to show only very subtle changes in behaviour in this zone.

9.7.117 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.

9.7.118 The effects of piling noise on fish also need to be considered in terms of the duration of exposure. Information on duration of piling activities will be available at the next stage of the Project and will inform the environmental assessments that support the DCO application. Although the total duration of piling activities is still to be defined it is recognised that piling will not take place continuously as there will be periods of downtime, pile positioning and set up.

9.7.119 The piling works will be undertaken 7 am to 7 pm (Monday to Sunday). The maximum impact piling scenario is for 4 tubular piles to be installed each day from either front (i.e. the land and water), involving approximately 180 minutes of impact piling per day and 20 minutes of vibro piling per day in a 12-hour shift. There will, therefore, be significant periods over a 24-hour period when fish will not be disturbed by any piling noise. The actual proportion of piling is estimated to be at worst around 1 % (based on 180 minutes of impact piling and 20 minutes of vibro piling each working day) over any given construction week. In other words, any fish that remain within the predicted behavioural effects zone at the time of piling will be exposed a maximum of up to 13 % of the time.

9.7.120 It is also important to consider the noise from piling against existing background or ambient noise conditions. The wider local 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 anthropogenic background noise.

9.7.121 Based on the available information provided above, whilst only temporary and short term in duration, the effect to Atlantic salmon, sea trout, European smelt, shads, European eel is considered to be potentially **significant**. In terms of other fish occurring in the Humber Estuary, the potential impact at this preliminary stage has been assessed as **not significant.**

Capital dredge and dredge disposal

9.7.122 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 and operation of the Project are included in **Appendix 9.B** (PEI Report, Volume IV).

9.7.123 The worst case source level (SL) generated by dredging and vessels is below the Ref 9-103 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 Ref 9-103 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.

9.7.124 According to Ref 9-103, 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.

9.7.125 Ref 9-103 advises 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.

9.7.126 Ref 9-103 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 farfield (i.e. thousands of metres from the source) there is considered to be a low risk of a response in all fish.

9.7.127 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 for extended periods given the distances at which recoverable injury or TTS are predicted in fish as a result of the dredging and vessel movements. 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 period of dredging will be relatively short term.

9.7.128 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Marine Mammals

9.7.129 This section contains a preliminary assessment of the potential impacts to marine mammal receptors as a result of the construction phase of the Project. The following impact pathway has been assessed:

a. Underwater noise and vibration during piling, capital dredging and dredge disposal.

Underwater noise and vibration during piling, capital dredging and dredge disposal

9.7.130 Elevated underwater noise and vibration levels during construction activities has the potential to cause physiological damage and induce adverse behavioural

reactions. A detailed Underwater Noise assessment has been undertaken for the Project (**Appendix 9.B** (PEI Report, Volume IV)) and is briefly summarised in this section.

9.7.131 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.

9.7.132 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 (Ref 9-98; Ref 9-99; Ref 9-100). For most dredging activities, the main source of sound relates to the vessel engine noise.

9.7.133 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.

9.7.134 The National Oceanic and Atmospheric Administration (Ref 9-111) 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 Ref 9-109 for preventing auditory/physiological injuries in marine mammals. Further recommendations have recently been published regarding marine mammal noise exposure by Ref 9-110 which complement the Ref 9-111 thresholds and also look at a wider range of marine mammal species.

9.7.135 The Ref 9-111 and Ref 9-110 thresholds are categorised according to marine mammal hearing groups. The key marine mammal species found in the study area for the scheme comprise harbour porpoise, common seal and grey seal. According to Ref 9-111, 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”).

9.7.136 There are no equivalent SPL behavioural response criteria that would represent the sources of underwater noise associated with the Project. 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 (Ref 9-109).

9.7.137 Field studies have demonstrated behavioural responses of harbour porpoises to anthropogenic noise (Ref 9-112). A number of studies have shown avoidance of pile driving activities during offshore wind farm construction (Ref 9-113; Ref 9-114; Ref 9-115), with the range of measurable responses extending to at least 21 km in some cases (Ref 9-116). Seismic surveys have also elicited avoidance

behaviour in harbour porpoises, albeit short-term (Ref 9-117), and monitoring of echolocation activity suggests possible negative effects on foraging activity in the vicinity of seismic operations (Ref 9-118). There is a scarcity of studies quantifying behavioural impacts from dredging (Ref 9-119). One investigation showed that harbour porpoises temporarily avoided an area of sand extraction off the Island of Sylt in Germany (Ref 9-120). This study 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 (Ref 9-120).

9.7.138 Few studies have documented responses of seals to underwater noise in the field (Ref 9-112). Tracking studies found reactions of the grey seals to pile driving during the construction of windfarms were diverse (Ref 9-121). 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.

9.7.139 A telemetry study found no overall significant displacement of common seal during construction of a wind farm in The Wash, south-east England (Ref 9-35). 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 dB 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.

9.7.140 A playback experiment was conducted 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) (Ref 9-122). 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: Animals have been reported swimming away and avoidance within ~150 m of a seismic survey(Ref 9-130), while other studies have found no discernible difference in seal densities in response to construction and drilling for an oil pipeline (Ref 9-123).

9.7.141 A number of field observations of harbour porpoise and pinnipeds to multiple pulse sounds have been made and are reviewed by Ref 9-109). 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 dBht metric and its limitations is provided in **Appendix 9.B** (PEI Report, Volume IV).

Piling

9.7.142 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 Project are included in **Appendix 9.B** (PEI Report, Volume IV).

9.7.143 There is predicted to be a risk of instantaneous PTS and TTS in harbour porpoise within 42 m and 90 m respectively from the source of the percussive piling noise. The risk of instantaneous PTS and TTS in seals is within 5 m and 12 m respectively.

9.7.144 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 harbour porpoise is 1.8 km and 12.6 km respectively. The maximum distance for PTS and TTS in seals is 0.9 km and 6.5 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 harbour porpoise is 94 m and 1.2 km respectively. The maximum distance for PTS and TTS in seals is 44 m and 581 m respectively.

9.7.145 Assuming a worst case of a lower swimming speed of 1.5 m/s for all marine mammal species (including both adults and juveniles), the maximum time that would take harbour porpoise to leave the centre of the cumulative SEL weighted PTS and TTS injury zones during impact piling is estimated to be 20 minutes and 2.3 hours respectively. This is less than 10 % of the time that would be required for an injury to occur and, therefore, assuming harbour porpoise evade the injury effects zone, they are not considered to be at risk of any permanent or temporary injury during impact piling. The maximum time that would take seals to leave the PTS and TTS zones is estimated to be 10 minutes and 1.2 hours respectively. This is less than 5 % of the time that would be required for an injury to occur and, therefore, assuming seals evade the injury effects zone, they are not considered to be at risk of any permanent or temporary injury during impact piling.

9.7.146 Assuming a worst case of a lower swimming speed of 1.5 m/s for all marine mammal species (including both adults and juveniles), the maximum time that would take harbour porpoise to leave the centre of the cumulative SEL weighted PTS and TTS injury zones during vibro piling is estimated to be 1 minute and 14 minutes respectively. This is less than 1 % of the time that would be required for an injury to occur and, therefore, assuming harbour porpoise evade the injury

effects zone, they are not considered to be at risk of any permanent or temporary injury during vibro piling. The maximum time that it would take seals to leave the PTS and TTS zones is estimated to be 29 seconds and 6 minutes respectively. This is less than 0.4 % of the time that would be required for an injury to occur and, therefore, assuming seals evade the injury effects zone, they are not considered to be at risk of any permanent or temporary injury during vibro piling.

9.7.147 Impact piling is predicted to cause instantaneous injury effects within close proximity to the activity and strong behavioural responses over a wider area although this will be constrained to within the outer section of the Humber Estuary between Hull and Cleethorpes.

9.7.148 The results indicate that if any marine mammals present in the Humber Estuary were to remain stationary within the cumulative SEL distances from the source of piling over a 24 hour period, it could result in temporary and/or permanent hearing injury. However, it is considered highly unlikely that any individual marine mammal will stay within this “injury zone” during the piling operations.

9.7.149 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 (Ref 9-109). Mild to moderate behavioural responses of any individuals within these zones could include movement away from a sound source and/or visible startle response (Ref 9-109).

9.7.150 Any evasive response could also lead to the potential temporary avoidance of the outer section of the Humber Estuary between Hull and Cleethorpes. There is therefore considered the potential for the restriction of the movements of marine mammals upstream and downstream (i.e. a barrier to movements). The Humber Estuary upstream of the Project is not known to be used as a breeding site for seals (with the nearest known breeding colony located over 25 km away at Donna Nook at the mouth of the estuary). However, seals and harbour porpoise are frequently recorded foraging in the Humber Estuary. Any barrier to movements caused by the noise during piling would be temporary with significant periods of a 24-hour period when no piling will be undertaken (see below) which will allow the unconstrained movements of marine mammals through the Humber Estuary. Marine mammals are also highly mobile and wide ranging and therefore are likely to be able to exploit other areas for foraging during any piling.

9.7.151 The effects of piling noise on marine mammals also need to be considered in terms of the duration of exposure. Piling noise will take place over a period of approximately 13 weeks. Piling will not take place continuously as there will be periods of downtime, pile positioning and set up.

9.7.152 The piling works will be undertaken 7 am to 7 pm (Monday to Sunday). At present, the maximum impact piling scenario is for 4 tubular piles to be installed each day from either front (i.e. the land and water), involving approximately 180 minutes of impact piling per day and 20 minutes of vibro piling per day in a 12 hour shift. There will, therefore, be significant periods over a 24-hour period when marine mammals will not be disturbed by any piling noise. The actual proportion of impact piling is estimated to be at worst around 13 % (based on 180

minutes of impact piling and 20 minutes of vibro piling each working day) over any given construction week. In other words, any marine mammals that remain within the predicted behavioural effects zone at the time of percussive piling will be exposed a maximum of up to 13 % of the time.

9.7.153 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 constant vessel operations and ongoing maintenance dredging, and, therefore, marine mammals are likely to be habituated to a certain level of anthropogenic background noise.

9.7.154 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as potentially **significant.**

Capital dredge and dredge disposal

9.7.155 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 Project are included in **Appendix 9.B** (PEI Report, Volume IV).

9.7.156 NOAA's user spreadsheet tool (Ref 9-111) has been used to predict the range at which the weighted cumulative SEL acoustic thresholds (Ref 9-111) for PTS and TTS are reached during the proposed dredging and disposal activity based on the assumptions highlighted in **Appendix 9.B** (PEI Report, Volume IV).

9.7.157 There is predicted to be no risk of PTS in harbour porpoise and the risk of TTS is limited to within less than 44 m from the dredging or vessel activity. There is predicted to be no risk of PTS in seals and the risk of TTS is limited to within 12 m from the source.

9.7.158 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 Immingham for the Project even if the dredging and vessel movements were to take place continuously 24/7.

9.7.159 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant.**

Operation

9.7.160 This section contains a preliminary assessment of the potential impacts to marine ecology receptors as a result of the operational phase of the Project – those effects being reviewed in **Table 9.11**. This section includes an explanation of the rationale that was adopted for scoping in or out individual pathways for further assessment.

9.7.161 It is noted that maintenance dredging is an activity which is ongoing within the Port of Immingham. Maintenance dredging for the Project is expected to be required periodically and will be carried out in line with the existing regime. The frequency and volume of material deposited at the disposal site from each load will not change compared with current maintenance dredging activities as the same plant and methods are proposed to be used. Furthermore, the volume of

material that will need to be maintenance dredged from the berth pocket will be lower than the volumes of capital dredge material. Overall, the changes brought about as a result of the maintenance dredge and disposal of maintenance dredge material during operation will be comparable to that which already arises from the ongoing maintenance of the existing Port of Immingham berths. Therefore, it is considered that the likely impacts on marine receptors as a result of maintenance dredging will be comparable to the existing maintenance dredge regime. The magnitude of potential impacts are also considered to be either equivalent to or lower than the capital dredge. On this basis, potential effects associated with all the maintenance dredging pathways are discussed in **Table 9.12** but have been scoped out of a more detailed assessment.

Table 9.12: Potential effects during operation scoped in / out of the further detailed assessment undertaken

Receptor	Impact Pathways/Potential Effects	Project activity	Included in more detailed assessment?	Justification
Benthic habitats and species	Direct changes to benthic habitats and species beneath marine infrastructure due to shading	Operation	Yes	Changes in sunlight levels as a result of shading due to marine infrastructure has the potential to cause changes to the benthic community occurring in an area. This impact pathway has, therefore, been scoped into the assessment.
	Changes to benthic habitats and species as result of seabed removal during dredging	Maintenance dredging	No	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. As summarised in the preliminary physical processes assessment (**Chapter 16: Physical Processes**), maintenance dredging is expected to be required periodically with a lower level of maintenance to that which is presently afforded to the Immingham berths. Maintenance dredging will be carried out periodically throughout operation and will create similar seabed sedimentary conditions to that occurring following capital dredging. However, maintenance dredging will cause an ongoing source of seabed disturbance, albeit in localised areas. It should be noted that no dredging will be required around the jetty structures. Furthermore, the project-specific subtidal survey (**Section 9.3** of this chapter and **Appendix 9.A** (PEI Report, Volume IV)) recorded an impoverished benthic community which is likely to reflect the existing high levels of physical disturbance in the area due to strong near bed tidal currents and sediment transport.

Receptor	Impact Pathways/Potential Effects	Project activity	Included in more detailed assessment?	Justification
				All the species recorded are considered commonly occurring and not protected with the faunal assemblage recorded considered characteristic of subtidal habitats found more widely in this section of the Humber Estuary (Ref 9-124; Ref 9-23; Ref 9-24; Ref 9-22). Subtidal habitats in the area around the Port of Immingham are also considered to be typically of limited ecological value. Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.
		Dredge disposal	N/A	This pathway relates to changes in habitat resulting directly from seabed removal and is, therefore, not considered relevant to the dredge disposal activity. Potential effects resulting from sediment deposition at the disposal site are discussed below.
	Changes to habitats and species as a result of sediment deposition	Maintenance dredging and disposal	No	Maintenance dredge and dredge disposal will result in the deposition of sediments which has the potential to cause physical disturbance and smothering of seabed habitats. 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 and sedimentation (within the dredge plumes and at the disposal site) as compared to the capital dredge. Deposition of sediment as a result of dredging will be highly localised and similar to background variability. The benthic species occurring within and near to the dredge area typically consist of burrowing infauna (such as polychaetes, oligochaetes or bivalves), which are considered tolerant to some sediment deposition. The predicted millimetric changes in deposition are, therefore, considered unlikely to cause smothering effects. In addition, the species recorded in the benthic invertebrate surveys are fast growing and/or have rapid reproductive rates which

Receptor	Impact Pathways/Potential Effects	Project activity	Included in more detailed assessment?	Justification
				allow populations to typically rapidly recolonise disturbed habitats, many within a few months following the disturbance events (Ref 9-78; Ref 9-75; Ref 9-76; Ref 9-77). The disposal site is located in the mid channel and is subject to regular natural physical disturbance (and associated scouring) as a result of very strong tidal flows. This is reflected in a generally impoverished assemblage at both disposal sites. In addition, millions of wet tonnes of dredge sediment are disposed of at HU060 annually which will also cause some disturbance due to sediment deposition. The benthic species recorded include mobile infauna (such as errant polychaetes e.g. *Arenicola* spp. and amphipods) 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 (Ref 9-78; Ref 9-75; Ref 9-76; Ref 9-77). On this basis, any effects are considered to be temporary and short term. Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.
	Indirect changes to seabed habitats and species as a result of changes to hydrodynamic and sedimentary processes	Maintenance dredging and disposal	No	The predicted physical processes impacts from future maintenance dredging will be similar to that which already arises from the ongoing maintenance of the existing Immingham berths. Maintenance dredging 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, changes in hydrodynamic and sedimentary processes that are of a

Receptor	Impact Pathways/Potential Effects	Project activity	Included in more detailed assessment?	Justification
				negligible magnitude are expected. Such changes are unlikely to be discernible against natural processes at nearby intertidal habitats. Furthermore, such changes are not expected to modify existing subtidal habitat types found in the area. Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.
	Changes in water and sediment quality	Maintenance dredge and dredge disposal	No	Changes in water quality lower than for the capital dredge and similar to existing maintenance dredging. Elevated SSCs due to maintenance dredging and dredge disposal are anticipated to be of a magnitude that can occur naturally or as a result of existing maintenance dredging/disposal and sediment plumes resulting from dredging would also be expected to dissipate relatively rapidly and be immeasurable against background levels within a relatively short duration of time. Naturally very high SSCs typically occur year-round in the Humber Estuary, particularly during the winter months when storm events disturb the seabed and on spring tides. The estuarine benthic communities recorded in the region are considered tolerant to this highly turbid environment (Ref 9-78; Ref 9-75; Ref 9-76; Ref 9-77). The site-specific sediment sampling and analysis that will be undertaken to inform the Water and Sediment Quality assessment (**Chapter 17: Marine Water and Sediment Quality**) has not been undertaken at this preliminary stage. However, based on existing evidence on the level of contamination in sediments within the vicinity of the Project, there is no reason to believe the sediment will be unsuitable for disposal in the marine environment.

Receptor	Impact Pathways/Potential Effects	Project activity	Included in more detailed assessment?	Justification
				During maintenance dredging and dredge 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. Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.
		Surface water drainage	No	Standard measures to control surface water run-off during operation are embedded within the Project design for legislative compliance, and therefore there would be no potential for pollution to the Humber Estuary. This impact pathway has, therefore, been scoped out of the assessment.
	Underwater noise	Vessel operations, maintenance dredge and dredge disposal	No	Population level and mortality effects in benthic invertebrates are considered unlikely for piling or blasting. Maintenance dredging is known to produce lower noise levels than piling or blasting, and, therefore, there is unlikely to be significant effects on benthic invertebrates and this impact pathway has been scoped out of the 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.
	Damage to sensitive habitats as a result of changes in air quality.	Road traffic emissions	No	The predicted number of operational vehicle movements is lower than the IAQM and EPUK screening guidance (see **Chapter 6: Air Quality**), below which a road traffic impact is unlikely to contribute to a significant effect on local air quality. This impact pathway has, therefore, been scoped out of the assessment.

Receptor	Impact Pathways/Potential Effects	Project activity	Included in more detailed assessment?	Justification
		Marine vessel emissions and landside plant emissions	Yes	Emissions from docked marine vessels and landside plant during operation have been modelled in **Chapter 6: Air Quality**. The potential for NO_x, NH_3, SO_2 and N deposition to affect designated habitats within the Humber Estuary EMS has been identified, and this impact pathway has, therefore, been scoped into the assessment.
Fish	Changes to fish populations and habitat	Maintenance dredge and dredge disposal	No	As summarised above, impacts on benthic prey and fish receptors as a result of maintenance dredging are anticipated to be equivalent to or lower than the capital dredge and comparable to the existing maintenance dredge regime. The maintenance dredge footprint and proposed disposal site are considered unlikely to provide important nursery or spawning functions for fish species as a result of the disturbed nature of these habitats despite known nursery or spawning areas occurring in the wider Humber Estuary area[14]. Therefore, while during dredging, there is the potential for fish along with roe (eggs) of these species to be removed, sub-optimal spawning conditions are likely to be present with more optimal habitat occurring in the wider Humber Estuary area. In addition, the dredge footprint is considered negligible in the context of suitable spawning habitat in the region. As summarised above, the predicted impacts on benthic habitats and species (and therefore prey for fish receptors) as a result of maintenance dredging are considered to be equivalent or lower than the capital dredge and comparable to the existing maintenance dredge

[14] The maintenance dredge footprint and nearby area is already subject to regular natural seabed disturbance as a result of existing vessel movements and ongoing maintenance dredging. The disposal ground is located in a highly dynamic area with the mobile sandbanks subject to regular natural physical disturbance (and associated scouring) as a result of very strong tidal flows and deposition due to regular maintenance dredge activity.

Receptor	Impact Pathways/Potential Effects	Project activity	Included in more detailed assessment?	Justification
				regime. 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 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). Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.
	Changes in water and sediment quality	Maintenance dredge and dredge disposal	No	Changes in water quality are also expected to be lower than for the capital dredge and similar to existing maintenance dredging. Fish within the Humber Estuary are well adapted to living in an area with variable and typically 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. With specific respect to migratory fish, salmonids and other migratory fish can be sensitive to elevated suspended sediment concentrations. However, these species are known to migrate through estuaries with high suspended sediment concentrations (including the Humber Estuary). Elevated SSCs due to dredging are anticipated to be of a magnitude that can occur naturally or as a result of ongoing maintenance dredging/disposal. Sediment plumes resulting from dredging and dredge disposal are also expected to dissipate relatively rapidly and be immeasurable against

Receptor	Impact Pathways/Potential Effects	Project activity	Included in more detailed assessment?	Justification
				background levels within a relatively short duration of time. Therefore, salmonids and other migratory fish would also be able to avoid the temporary sediment plumes. Based on these factors there is therefore considered limited potential for migrating fish to be adversely affected by the predicted changes in SSC. Given that elevated SSCs due to dredge and dredge disposal are considered to be in the range of variability that can occur naturally in the Humber Estuary (which has very high SSCs year-round, particularly during the winter months) as well as due to existing ongoing maintenance dredging/disposal and that 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 effected by the dredging. The site-specific sediment sampling and analysis that will be undertaken to inform the Water and Sediment Quality assessment (**Chapter 17: Marine Water and Sediment Quality**) has not been undertaken at this preliminary stage. However, based on existing evidence on the level of contamination in sediments within the vicinity of the Project, there is no reason to believe the sediment will be unsuitable for disposal in the marine environment. Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.
	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

Receptor	Impact Pathways/Potential Effects	Project activity	Included in more detailed assessment?	Justification
				applicable to both the maintenance and capital dredging activities. Underwater noise effects on fish were assessed as not significant during capital dredging. The magnitude of potential impact is considered equivalent during maintenance dredging. The potential effect is, therefore, considered to be **not significant** 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 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 vessels are anticipated with noise levels unlikely to be discernible above ambient levels in the wider Humber Estuary area. The potential effect has been scoped out of more detailed assessment.
	Lighting	Vessel operations	No	The jetty/pier decking will be lit for safety and operational purposes. For any shoaling fish near the surface, the Project will potentially only cause minor changes in behaviour such as increased shoaling in the vicinity of the light source. Such responses could increase the risk of predation but could also have positive effects such as enhancing feeding efficiency. The low levels of lighting would not cause disruption or blocking of migratory routes. The potential effect has been scoped out of more detailed assessment.

Receptor	Impact Pathways/Potential Effects	Project activity	Included in more detailed assessment?	Justification
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 not significant 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 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 vessels are anticipated with noise levels unlikely to be discernible above ambient levels in the wider Humber Estuary area. The potential effect has been scoped out of more detailed assessment.
	Visual disturbance of hauled out seals	Vessel operations, maintenance dredge and dredge disposal	No	The nearest established breeding colony for grey seals is located over 25 km away at Donna Nook. Approximately 10 to 15 grey seals were also observed hauling out on mudflat at Sunk Island (on the north bank of the Humber Estuary) during the project benthic surveys as detailed in Ref 9-48. This haul out site is located approximately 4 km north east from the Project. No seal haul out sites are known to occur nearer to the Project.

Receptor	Impact Pathways/Potential Effects	Project activity	Included in more detailed assessment?	Justification
				Seals which are hauled out on land, either resting or breeding, are considered particularly sensitive to visual disturbance (Ref 9-68). 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 <150-200 m (Ref 9-69; Ref 9-70; Ref 9-71; Ref 9-72). 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 (Ref 9-73). 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 (Ref 9-74). Based on this evidence, seals hauled out on the intertidal habitats of Sunk Island (located on the opposite bank to the Project) are out of 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 the 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 speeds over 10 knots are considered to have a much higher probability of causing lethal injury (Ref 9-51). Furthermore, the region is already characterised by heavy

Receptor	Impact Pathways/Potential Effects	Project activity	Included in more detailed assessment?	Justification
				shipping traffic. The additional operational vessel movements resulting from the Project will only constitute a small increase in vessel traffic in the area on a typical day. There will also be periodic maintenance dredger and barge movements. In general, incidents of mortality or injury of marine mammals caused by vessels remain a relatively rare occurrence in UK waters (Ref 9-52; Ref 9-53). 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 (Ref 9-53). 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 the assessment.

Benthic Habitats and Species

9.7.162 This section contains an assessment of the potential impacts to benthic ecology receptors as a result of the operational phase of the Project. The following impact pathways have been assessed:

a. Direct changes to benthic habitats and species beneath marine infrastructure due to shading;

b. Non-native species transfer during vessel operations; and

c. Changes in air quality due to marine vessel and landside plant emissions.

Direct changes to benthic habitats and species beneath marine infrastructure due to shading

9.7.163 Artificial shading such as due to jetty/pier decking has the potential to cause localised changes to the structure and functioning of biological communities in natural ecosystems (Ref 9-125; Ref 9-126; Ref 9-127).

9.7.164 Changes in sunlight levels as a result of shading have the potential to cause changes to the benthic community occurring in an area. In particular, shading can reduce the amount of light available for species that perform photosynthesis such as macroalgae species (seaweeds), macrophytes (such as saltmarsh plants) and microphytobenthos.

9.7.165 The open piled approach jetty could cause some shading to intertidal mudflat habitat. Given that these structures will be located several metres above the seabed, however, some natural light would be expected to reach the mudflat from either side of these structures at different times of day. Shading at the level predicted would only be expected to cause negligible changes to the growth rates of macroalgae species (seaweeds) and microphytobenthos occurring on the foreshore. Furthermore, no saltmarsh and only limited macroalgae occurs on mudflats in this area.

9.7.166 Based on the available information provided above, the potential impact at this preliminary stage has been assessed as **not significant**.

Non-native species transfer during vessel operations

9.7.167 Non-native species have the potential to be transported into the study area on ships' hulls during maintenance dredging and through operational vessels. 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.

9.7.168 Based on the available information provided above (**Paragraphs 9.7.71** to **9.7.77**), the potential impact at this preliminary stage has been assessed as **not significant**.

Changes in air quality due to marine vessel and landside plant emissions

9.7.169 Emissions from docked marine vessels and landside plant during operation have been modelled in **Chapter 6: Air Quality**. The potential for NOx, NH_3, SO_2 and

N deposition to affect designated habitats within the Humber Estuary EMS has been identified.

9.7.170 At the worst affected nature conservation receptor (E11, which relates to saltmarsh habitat on the northern shore of the Estuary), the change in annual mean NH_3 and SO_2 can be screened as insignificant in line with Environment Agency guidance. However, the annual mean NOx concentration and annual N deposition rate cannot be screened as insignificant.

9.7.171 For saltmarsh, the APIS provides a Critical Load range of 20 to 30 kg/ha/yr and nitrogen inputs have been experimentally demonstrated to have an effect on overall species composition of saltmarsh. However, the Critical Loads on APIS are relatively generic for each habitat type and cover a wide range of deposition rates. They do not (and are not intended to) take other influences (to which the habitat on a given site may be exposed) into consideration.

9.7.172 Moreover, it is important to note from APIS that the experimental studies which underlie conclusions regarding the sensitivity of saltmarsh have *'… neither used very realistic N doses nor input methods i.e. they have relied on a single large application more representative of agricultural discharge'*, which is far in excess of anything that would be deposited from atmosphere. Therefore, APIS indicates that determining which part of the critical load range to use for saltmarsh requires expert judgment. Overall, there is good reason to believe the upper part of the critical load range (30 kg N/ha/yr) may be more appropriate than the lower part (20 kg N/ha/yr) for upper saltmarsh.

9.7.173 Generally, nitrogen inputs from the air are not as important as nitrogen from other sources. Effects of nitrogen deposition from atmosphere are likely to be dominated by much greater impacts from marine or agricultural sources. This is reflected on APIS itself, which states regarding saltmarsh that '*Overall, N deposition [from atmosphere] is likely to be of low importance for these systems as the inputs are probably significantly below the large nutrient loadings from river and tidal inputs*'. Another mitigating factor is that the nature of intertidal saltmarsh in the Humber estuary means that there is daily flushing from tidal incursion. This is likely to further reduce the role of nitrogen from atmosphere in controlling botanical composition.

9.7.174 Therefore the additional predicted contribution from nitrogen emissions from the Project does not result in any exceedance of the Critical Load range for saltmarsh, and it is concluded that there will be a neutral effect (not significant) on the Humber Estuary designated site, which is **not significant**.

Decommissioning

9.7.175 The DCO for the Project would not make any provision for the decommissioning of the marine infrastructure above and below water level. This is because the development would, once constructed, become part of the fabric of the Immingham port estate and would, in simple terms, continue to be maintained so that it can be used for port related activities to meet a long-term need. Decommissioning impacts have therefore been scoped out of the assessment.

9.8 Mitigation and Enhancement Measures

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

9.8.1 In order to reduce the level of potential impact associated with underwater noise and vibration on fish and marine mammals during construction (piling), a number of mitigation measures are being considered including the use of soft start procedures, the use of vibro piling where possible with seasonal/night time piling restrictions specifically for migratory fish species and JNCC piling protocols for marine mammals (Ref 9-18).

9.8.2 These mitigation measures would be further developed, if required, through ongoing engagement with statutory authorities as part of the statutory consultation process and taking into account the final scheme design information and latest understanding of potential effects.

9.9 Preliminary Assessment of Residual Effects

Construction

9.9.1 The following sections summarise the likely effects on marine ecology receptors. Potential effects on the following receptors during construction were assessed as potentially significant:

a. Underwater noise and vibration on fish as a result of piling; and

b. Underwater noise and vibration on marine mammals as a result of piling.

9.9.2 With the implementation of appropriate mitigation measures, the residual effects on these receptors are considered likely to be not significant at this preliminary stage.

9.9.3 All the other potential impacts on nature conservation and marine ecology receptors have, at this preliminary stage, and based on the current project design, been assessed as **not significant**.

Operation

9.9.4 All potential impacts on nature conservation and marine ecology receptors during operation have, at this preliminary stage, and based on the current project design, been assessed as **not significant**.

Decommissioning

9.9.5 The DCO for the Project would not make any provision for the decommissioning of the marine infrastructure above and below water level. This is because the development would, once constructed, become part of the fabric of the Immingham port estate and would, in simple terms, continue to be maintained so that it can be used for port related activities to meet a long-term need. On this basis, potential effects on marine ecology receptors from decommissioning have been scoped out.

9.9.6 The final outcomes of the likely significant effects of the Project on marine ecology will be reported within the ES.

9.10 Summary of Preliminary Assessment

9.10.1 A summary of the impact pathways that have been assessed at this preliminary stage, together with the identified residual impacts and level of confidence is presented in **Table 9.20**.

Table 9.13: Summary of potential impact, mitigation measures and residual effects

Receptor	Impact pathway	Impact Significance	Mitigation Measure	Residual Effect	Confidence
Construction Phase					
Benthic habitats and species	Direct loss of intertidal habitat as a result of the piles	Not significant	N/A	Not significant	**Medium**
	Direct loss of subtidal habitat as a result of the piles	Not significant	N/A	Not significant	**High**
	Changes to benthic habitats and species as result of the removal of seabed material during dredging	Not significant	N/A	Not significant	**High**
	Changes to habitats and species as a result of sediment deposition during dredging and dredge disposal	Not significant	Target disposal loads in the central/ deeper area of the disposal sites to reduce depth reductions	Not significant	**Medium**
	Indirect loss or change to seabed habitats and species as a result of changes to hydrodynamic and sedimentary processes during capital dredging and dredge disposal	Not significant	N/A	Not significant	**Medium**
	Changes in water and sediment quality during capital dredging and dredge disposal	Not significant	N/A	Not significant	**Medium**

Receptor	Impact pathway	Impact Significance	Mitigation Measure	Residual Effect	Confidence
	Underwater noise and vibration during piling, capital dredging and dredge disposal	Not significant	N/A	Not significant	**Medium**
	Introduction and spread of non-native species	Not significant	Include biosecurity control measures within the CEMP	Not significant	**Medium**
Fish	Direct loss or changes to fish populations and habitat as a direct result of dredging and dredge disposal	Not significant	N/A	Not significant	**Medium**
	Changes in water and sediment quality as a result of dredging and dredge disposal	Not significant	N/A	Not significant	**Medium**
	Underwater noise disturbance and vibration during piling, capital dredging and dredge disposal	Potentially significant (migratory fish during piling) Not significant (other fish species during piling) Not significant (dredge and dredge disposal)	In order to reduce the level of potential impact associated with underwater noise and vibration on fish during piling, a number of mitigation measures are being considered including the use of soft start procedures, the use of vibro piling where possible and seasonal/night time piling restrictions specifically for migratory fish.	Not significant	**Medium**
Marine mammals	Underwater noise disturbance and vibration during piling, capital dredging and dredge disposal	Potentially significant (piling) Not significant (dredge and dredge disposal)	In order to reduce the level of potential impact associated with underwater noise and vibration on fish during piling, a number of mitigation measures are being considered including the use of soft start	Not significant	**Medium**

Receptor	Impact pathway	Impact Significance	Mitigation Measure	Residual Effect	Confidence
			procedures, the use of vibro piling where possible and JNCC piling protocols f (Ref 9-18).		
Operational Phase					
Benthic habitats and species	Direct changes to benthic habitats and species beneath marine infrastructure due to shading	Not significant	N/A	Not significant	**Medium**
	Non-native species transfer during vessel operations	Not significant	N/A	Not significant	**Medium**
	Damage to sensitive habitats as a result of changes in air quality from marine vessel and landside plant emissions	Not significant	N/A	Not significant	**High**

9.11 References

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Ref 9-4 European Commission (2009). Council Directive 2009/147/EC of 30 November 2009 on the conservation of wild birds.

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9.12 Abbreviations and Glossary of Terms

Table 9.14: Glossary and Abbreviations

Term	Acronym	Definition
Appropriate Assessment	AA	The assessment of the impact on the integrity of a European site of a project or plan, either alone or in combination with other projects or plans, with respect to the site's structure and function and its conservation objectives.
Associated British Ports	ABP	One of the UK's leading and best-connected ports groups, owning and operating 21 ports across England, Wales and Scotland.
Biodiversity Action Plan	BAP	A Biodiversity Action Plan is an internationally recognised program addressing threatened species and habitats and is designed to protect and restore biological systems.
Department for Business, Energy and Industrial Strategy	BEIS	The Government department responsible for policy and regulations on business, energy and industry issues.
Biodiversity Net Gain	BNG	An approach that aims to leave biodiversity within the natural environment in a measurably better state than its condition prior to implementation of a project.
British Trust for Ornithology	BTO	The British Trust for Ornithology is an organisation founded in 1932 for the study of birds in the British Isles.
Centre for Environment, Fisheries and Aquaculture Science	Cefas	The Centre for Environment, Fisheries and Aquaculture Science is an executive agency of the United Kingdom government Department for Environment, Food and Rural Affairs.
Chartered Institute of Ecology and Environmental Management	CIEEM	The leading professional membership body representing and supporting ecologists and environmental managers in the UK, Ireland and abroad.
Countryside and Rights of Way Act 2000	CRoW	The Countryside and Rights of Way Act gives greater freedom for people to explore open countryside as well as provisions designed to reform and improve rights of way in England and Wales. Additionally, the Act gives greater protection to wildlife and natural features by making provision for the conservation of biological diversity, and by improving protection for Sites of Special Scientific Interest in England and Wales and the enforcement of wildlife legislation as well as the introduction of provisions to allow the

Term	Acronym	Definition
		better management and protection of Areas of Outstanding Natural Beauty.
Candidate Special Areas of Conservation	cSAC	A site proposed for designation under EU legislation for the protection of habitats and species considered to be of European interest.
Diadromous species	D	Species using estuaries as pathways of migration (for reproduction) between fresh waters and the sea; migration from fresh water to sea water to breed (catadromous species, e.g. eel), and in the opposite direction (anadromous species, e.g., salmonids and lampreys);
Decibel	dB	The scale used to measure noise is the decibel scale which extends from 0 to 140 decibels, corresponding to the intensity of the sound pressure level.
Development Consent Order	DCO	The consent for a Nationally Significant Infrastructure Project required under the Planning Act 2008.
Department of Energy and Climate Change	DECC	The Department of Energy and Climate Change was a department of the Government of the United Kingdom created on 3rd October 2008 and became part of the Department for Business, Energy and Industrial Strategy in July 2016.
Department for Environment, Food and Rural Affairs	Defra	The Government department responsible for policy and regulations on environmental, food and rural issues. The department's priorities are to grow the rural economy, improve the environment and safeguard animal and plant health.
Department for Transport	DfT	The Department for Transport is the United Kingdom government department responsible for the English transport network.
European Commission	EC	An executive branch of the European Union.
Ecological Impact Assessment	EcIA	The process of identifying, quantifying and evaluating the potential impacts of defined actions on ecosystems or their components.
European Economic Community	EEC	The European Economic Community (EEC) was a regional organisation created by the Treaty of Rome of 1957 to create a common market for its members through the elimination of most trade barriers.
Environmental Impact Assessment	EIA	The statutory process through which the likely significant effects of a development project on the environment are identified and assessed.

Term	Acronym	Definition
European Marine Site	EMS	European Marine Sites are areas at sea, partly or completely covered by tidal water, which are protected by European law.
Environmental Statement	ES	A statutory document which reports the EIA process, produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations.
Estuarine resident Species	ES	Species that are able to reproduce and complete their life cycle in the estuary; as such they are highly euryhaline species, able to move throughout the full length of the estuary
European Union	EU	An economic and political union of 28 countries which operates an internal (or single) market which allows the free movement of goods, capital, services and people between member states.
Freshwater species	F	Species of freshwater origin that regularly or accidentally enter estuaries, in moderate to low numbers, moving varying distances down the estuary but often restricted to low-salinity, upper reaches of estuaries and to periods of freshwater flooding
Feature of Conservation Importance	FOCI	Features of Conservation Importance are marine features that are particularly threatened, rare, or declining species and habitats.
Great Britain	GB	-
Humber International Terminal	HIT	A terminal located within the Port of Immingham.
Heavily Modified Water Body	HMWB	Significant water bodies that have changed water category due to modifications.
Habitats Regulations Assessment	HRA	An assessment of projects (or plans) potentially affecting European Sites in the UK, required under the Habitats Directive and Regulations. Also known as an assessment of implications on European Sites
The Institute of Estuarine & Coastal Studies	IECS	The Institute of Estuarine & Coastal Studies (IECS) is a multi-disciplinary Environmental Research Consultancy with experience in the marine, coastal and estuarine environment.
Institute of Environmental Management and Assessment	IEMA	A professional body for practitioners working in the fields of environmental management and assessment.

Term	Acronym	Definition
International Maritime Organisation	IMO	The International Maritime Organisation is a specialised agency of the United Nations responsible for regulating shipping.
Invasive Non-native Species	INNS	Non-native UK plants that are invasive, for example Japanese Knotweed.
Immingham Outer Harbour	IOH	Immingham Outer Harbour is an area which partly makes up infrastructure located at the Port of Immingham.
Immingham Oil Terminal	IOT	An oil terminal operating out of the Port of Immingham.
Improvement Programme for England's Natura 2000 Sites	IPENS	A programme to develop a strategic approach to achieving favourable condition on these sites by reviewing: the risks and issues that are impacting on and/or threatening the condition of the site.
Joint Cetacean Protocol	JCP	This survey was undertaken to inform the identification of discrete and persistent areas of relatively high harbour porpoise density in the UK marine area.
In-combination Climate Change Impacts	JNCC	The JNCC are the public body that advises the UK Government and devolved administrations on UK-wide and international nature conservation.
Lincolnshire Ecological Records Centre	LERC	A statutory designation made under Section 21 of the National Parks and Access to the Countryside Act 1949 by principal local authorities.
Local Geological Sites	LGS	Non-statutory geological sites considered worthy of protection for their earth science or landscape importance. Formerly known as Regionally Important Geological Sites.
Local Nature Reserve	LNR	A statutory designation made under Section 21 of the National Parks and Access to the Countryside Act 1949 by principal local authorities.
Likely Significant Effect	LSE	Schedule 4 of the Regulations requires an environmental statement to include a description of the likely significant effects of the development on the environment.
Local Wildlife Site	LWS	Non-statutory sites of nature conservation value that have been designated 'locally'. These sites are referred to differently between counties with common terms including site of importance for nature conservation, county wildlife site, site of biological importance, site of local importance and sites of metropolitan importance.

Term	Acronym	Definition
Multi-Agency Geographic Information for the Countryside	MAGIC	A website which provides geographic information about the natural environment.
Marine Aggregate Levy Sustainability Fund	MALSF	The Levy was introduced as a means to better reflect the environmental costs of winning primary construction aggregates, and to encourage the use of alternative, secondary and recycled construction materials.
Marine and Coastal Access Act 2009	MCAA	The Act introduces a new system of marine management. This includes a new marine planning system, which makes provision for a statement of the Government's general policies, and the general policies of each of the devolved administrations, for the marine environment, and also for marine plans which will set out in more detail what is to happen in the different parts of the areas to which they relate
Marine Conservation Zone	MCZ	Marine Conservation Zones are areas that protect a range of nationally important, rare or threatened habitats and species
Mean High Water Springs	MHWS	The height of Mean Water High Springs is the average throughout the year, of two successive high waters, during a 24-hour period in each month when the range of the tide is at its greatest.
Marine Migrant species	MM	Marine species that spawn at sea and regularly enter estuaries in large numbers, thus having a temporary residence in the estuarine habitat; they usually are highly euryhaline species, able to move throughout the full length of the estuary, and spending much of their life within estuaries, using these habitats as nursery grounds or visiting them regularly at sub-adult and adult life stages.
Marine Management Organisation	MMO	The Marine Management Organisation is an executive non-departmental public body in the United Kingdom established under the Marine and Coastal Access Act 2009, with responsibility for English waters.
Marine Policy Statement	MPS	The UK Marine Policy Statement provides the framework for preparing Marine Plans and is key when making decisions directly affecting the marine environment.
Marine Straggler species	MS	A category of fish that enter estuaries infrequently and usually in low numbers,
National Biodiversity Network	NBN	A collaborative venture in the United Kingdom, which facilitates access to biodiversity information.

Term	Acronym	Definition
Nationally Significant Infrastructure Project	NSIP	A type of project listed in the Planning Act 2008, which must be consented by a Development Consent Order.
Natural England	NE	Executive non-departmental public body constituted under the Natural Environment and Rural Communities Act 2006 (section 2(1)) to ensure that the natural environment is conserved, enhanced and managed for the benefit of present and future generations, thereby contributing to sustainable development.
Natural Environment and Rural Communities	NERC	The act created Natural England and the Commission for Rural Communities and, amongst other measures, it extended the biodiversity duty set out in the Countryside and Rights of Way Act to public bodies and statutory undertakers to ensure due regard to the conservation of biodiversity.
National Policy Statement for Ports	NPSfP	The National Policy Statement for Ports provides the framework for decisions on proposals for new port development.
OSPAR Convention	OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic.
Permanent Threshold Shift	PTS	A permanent reduction of the sensitivity of the ear, decreasing the ability of the ear to detect sound.
Planning Act 2008	PA	An Act of Parliament in the UK intended to speed up the process of approving major new infrastructure projects.
Polycyclic Aromatic Hydrocarbons	PAH	A polycyclic aromatic hydrocarbon is a chemical compound containing only carbon and hydrogen that is
Preliminary Environmental Information Report	PEIR	A report that compiles and presents the Preliminary Environmental Information gathered for a project.
The World Association for Waterborne Transport Infrastructure	PIANC	The World Association for Waterborne Transport Infrastructure is an international professional organisation founded in 1885.
Planning Inspectorate	PINS	An executive agency with responsibilities for planning appeals, national infrastructure planning applications, local plan examinations and other planning-related casework in England and Wales.
Particle Size Analysis	PSA	Particle size analysis is used to characterise the size distribution of particles in a given sample.

Term	Acronym	Definition
Potential Special Protection Areas	pSPA	These are potential site boundaries for SPAs. As a result of consultation there may be minor changes to the final boundary of the site once classified. A Special Protection Area (SPA) is the land designated under Directive 2009/147/EC on the Conservation of Wild Birds. Special Protection Areas (SPAs) are strictly protected sites classified in accordance with Article 4 of the EC Birds Directive, which came into force in April 1979.
Wetlands of international importance, designated under The Convention on Wetlands (Ramsar, Iran, 1971)	Ramsar	Wetlands of international importance designated under the Ramsar Convention
Regional Environmental Characterisation	REC	A regional assessment of the geology, ecology and archaeology of the seafloor using information gathered through desk based assessment, geophysical data and sampling surveys.
Roll On-Roll Off	Ro-Ro	A design to allow vehicles to drive on and drive off ships.
Royal Society for the Protection of Birds	RSPB	Nature conservation charity for the protection of birds.
Special Area of Conservation	SAC	Sites designated under EU legislation for the protection of habitats and species considered to be of European interest.
Small Cetaceans in European Atlantic Waters and the North Sea	SCANS	A series of large-scale surveys for cetaceans in European Atlantic waters was initiated in 1994 and continued in 2005 and 2007 with the purpose of providing estimates of abundance needed to put bycatch in a population context and to allow EU member States to discharge their responsibilities under the Habitats Directive.
Special Committee on Seals	SCOS	Sites designated under the European Directive on the Conservation of Wild Birds for the protection of birds in member states.
Sea Mammal Research Unit	SMRU	The parameter by which sound levels are measured in air. It is measured in decibels. The threshold of hearing has been set at 0dB, while the threshold of pain is approximately 120dB. Normal speech is approximately 60dB at a distance of 1 metre and a change of 3dB in a time varying sound signal is commonly regarded as being just detectable. A change of 10dB is subjectively twice, or half, as loud.

Term	Acronym	Definition
Special Protection Area	SPA	Sites designated under the European Directive on the Conservation of Wild Birds for the protection of birds in member states.
Sound Pressure Levels	SPL	The parameter by which sound levels are measured in air. It is measured in decibels. The threshold of hearing has been set at 0dB, while the threshold of pain is approximately 120dB. Normal speech is approximately 60dB at a distance of 1 metre and a change of 3dB in a time varying sound signal is commonly regarded as being just detectable. A change of 10dB is subjectively twice, or half, as loud.
Suspended Sediment Concentrations	SSC	Suspended sediment concentration is the total value of both mineral and organic material carried in suspension by a river.
Site of Special Scientific Interest	SSSI	Area of land notified by Natural England under section 28 of the Wildlife and Countryside Act 1981 as being of special interest due to its flora, fauna or geological or physiological features
Total Organic Carbon	TOC	Total Organic Carbon (TOC) is a measure of the total amount of carbon in organic compounds in pure water and aqueous systems.
Transitional and Coastal Waters	TraC	The transitional zone of water between river and sea.
Trailer Suction Hopper Dredger	TSHD	Trailer suction hopper dredgers are oceangoing vessels that can collect sand and silt from the seabed and transport it over large distances.
Temporary Threshold Shift	TTS	A noise-induced threshold shift that fully recovers over time.
United Kingdom	UK	-
Wildlife and Countryside Act 1981	WCA	This legislation protects various animals, plants, habitats in the UK.
Wetland Bird Survey	WeBS	The Wetland Bird Survey monitors non-breeding waterbirds in the UK.
Water Framework Directive	WFD	A European Union Directive which commits member states to achieve good status of all waterbodies (both surface and groundwater), and also requires that no such waterbodies experience deterioration in status. Good status is a function of good ecological and good chemical status, defined by a number of elements.