Immingham Green Energy Terminal

TR030008

Volume 6

6.4 Environmental Statement Appendices

Appendix 17.A: Water Framework Directive Compliance Assessment

Planning Act 2008

Regulation 5(2)(a)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

September 2023

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

Immingham Green Energy Terminal

Development Consent Order 2023

6.4 Environmental Statement Appendices

Appendix 17.A: Water Framework Directive Compliance Assessment

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Regulation Reference	APFP Regulation 5(2)(a)
Planning Inspectorate Case Reference	TR030008
Application Document Reference	TR030008/APP/6.4
Author	Associated British Ports Air Products BR

Version	**Date**	**Status of Version**
Revision 1	21 September 2023	DCO Application

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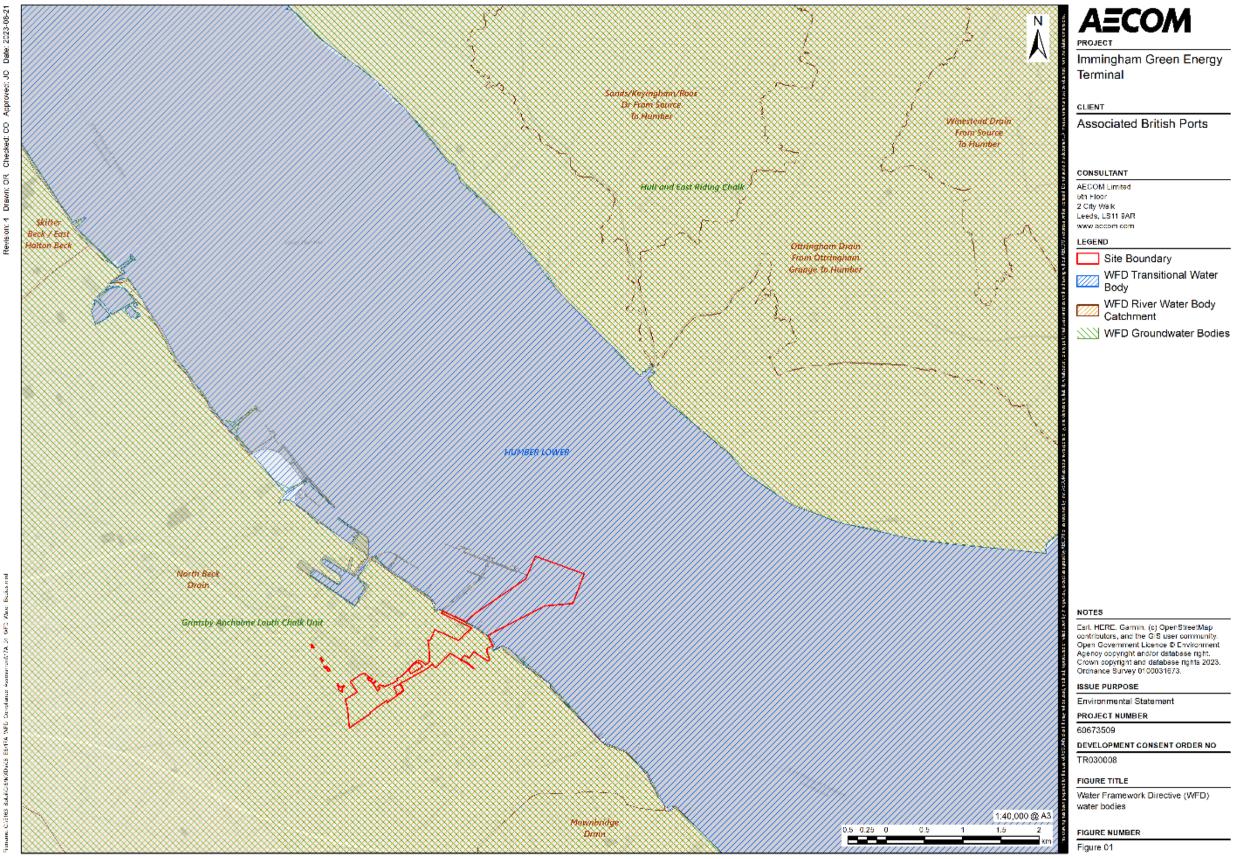
1. Introduction

1.1.1. A Water Framework Directive ("WFD") compliance assessment has been undertaken to determine whether the proposed Immingham Green Energy Terminal ("IGET") (the Project) complies with the objectives of the WFD. The information presented in this appendix, should be read together with **Chapter 17: Marine Water and Sediment Quality** and **Chapter 18: Water Quality, Coastal Protection, Flood Risk and Drainage [TR030008/APP/6.2]**, and will support the application for a Development Consent Order ("DCO") for the Project.

1.1.2. The Site Boundary is located North East of Immingham on the South bank of the Humber Estuary. **Plate** shows the location of the proposed works and surrounding WFD water bodies.

Plate 1: Location of the Project and surrounding WFD water bodies



1.2. Water Framework Directive

1.2.1. The WFD (2000/60/EC) (Ref 1-1) came into force in 2000 and establishes a framework for the management and protection of Europe's water resources through river basin districts ("RBDs") and aimed to improve water quality by progressively reducing specific priority substances and, ultimately, eliminating use of priority hazardous substances. Related to the WFD as its "daughter" directives are the Groundwater Directive 2006 (2006/118/EC) (Ref 1-2) and the Priority Substances Directive 2008 (2008/105/EC) (Ref 1-3) and the Priority Substances (Amendment) Directive 2013 (2013/39/EU) (collectively, the PSD) (Ref 1-4).

1.2.2. The Groundwater Directive 2006 (2006/118/EC) (Ref 1-2) introduced (among other things) measures to prevent the discharge of hazardous substances and limit discharges of non-hazardous pollutants into groundwaters. The PSD sets environmental quality standards ("EQS") for priority substances and other pollutants.

1.2.3. The WFD is implemented in England through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (the WFD Regulations)[1] (Ref 1-5) which also transposed aspects of the Groundwater Directive 2006 (2006/118/EC) (Ref 1-2) and the PSD (Ref 1-3). The WFD Regulations refer heavily to the EU instruments.

1.2.4. The WFD aims to protect and enhance the water environment, the overall objectives of the WFD (as set out in Regulation 13 of the WFD Regulations) are to prevent the deterioration of the status of each body of surface and ground water and to achieve good status ("GS") in all inland, transitional, coastal and ground waters by 22 December 2021, unless alternative objectives are set and there are appropriate reasons for time limited derogation.

1.2.5. The WFD divides rivers, lakes, lagoons, estuaries, coastal waters (out to one nautical mile from the low water mark), man-made docks and canals into a series of discrete surface water bodies. It sets ecological as well as chemical targets (objectives) for each surface water body. For a surface water body to be at overall GS, it must be achieving good ecological status ("GES") and good chemical status ("GCS"). Ecological status is measured on a scale of high, good, moderate, poor or bad, while chemical status is measured as good or fail (i.e. failing to achieve good).

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1 Following the UK leaving the EU, the WFD Regulations formed part of the body of EU Retained Law under the European Union (Withdrawal) Act 2018. Schedule 5 of the WFD Regulations was inserted by the Floods and Water (Amendment etc.) (EU Exit) Regulations 2019 which modifies how the WFD should be read in its application to England to ensure continuity at the end of the transition period. (accessed January 2021).

1.2.6. Each surface water body has a hydromorphological designation that describes how modified a water body is from its natural state. Water bodies are either undesignated (i.e. natural, unchanged), designated as a heavily modified water body ("HMWB") or designated as an artificial water body ("AWB"). HMWBs are defined as bodies of water which, as a result of physical alteration by human use activities (such as flood protection and navigation) are substantially changed in character and cannot, therefore, meet GES. AWBs are artificially created through human activity. The default target for HMWBs and AWBs under the WFD is to achieve good ecological potential ("GEP"), a status recognising the importance of their human use while ensuring ecology is protected as far as possible.

1.2.7. The ecological status/potential of surface waters is classified using information on the biological (e.g. fish, benthic invertebrates, phytoplankton, angiosperms and macroalgae), physico-chemical (e.g. dissolved oxygen and dissolved inorganic nitrogen) and hydromorphological (e.g. hydrological regime) quality of the water body, as well as several specific pollutants (e.g. copper and zinc). Compliance with chemical status objectives is assessed in relation to EQS for the specified list of priority substances as set out in the Priority Substances Directive ("PSD".

1.2.8. Under the WFD Regulations, groundwater bodies are assessed against different criteria than surface water bodies since they do not support ecological communities (i.e. it is not appropriate to consider the ecological status of a groundwater). Therefore, groundwater bodies are classified as either good or poor quantitative status in terms of their quantity (groundwater levels and flow directions) and quality (pollutant concentrations and conductivity), along with chemical (groundwater) status which is also classified as good or poor.

1.2.9. River Basin Management Plans ("RBMPs") are a requirement of the WFD, setting out measures for each RBD to maintain and improve quality in surface and groundwater bodies where necessary. In England, the Environment Agency is the "appropriate agency" responsible for preparing and reviewing RBMPs which are then submitted to and approved by the "appropriate authority", being the Secretary of State for the Environment, Food and Rural Affairs in England. In 2009, the Environment Agency published the first cycle (2009 to 2015) of RBMPs for England, reporting the status and objectives of each individual water body. The Environment Agency subsequently published updated RBMPs for England as part of the second cycle (2015 to 2021), as well as providing water body classification results from 2015 and interim classifications via the Catchment Data Explorer (Ref 1-6). The latest updates to RBMPs took place in December 2022 (Ref 1-7).

1.2.10. Regulation 33of the WFD Regulations states that public bodies in exercising their functions "*so far as affecting*" a RBD, must have regard to the RBMP for that district and "*any supplementary plans*". Local authorities must therefore reflect water body improvement priorities as outlined in RBMPs.

1.2.11. The Project is located within the Humber Lower transitional water body and North Beck Drain river body water catchment (see **Plate 1**). It is also located within the Grimsby Ancholme Louth Chalk Unit groundwater body. These water bodies are located within the Humber River Basin District which is reported in the Humber RBMP (Ref 1-8).

1.2.12. Consideration of the WFD is necessary for works which have the potential to cause deterioration in ecological, quantitative and/or chemical status of a water body or to compromise improvements which might otherwise lead to a water body meeting its WFD objectives. Therefore, it is necessary to consider the potential for the Project to impact water bodies, specifically referring to the following environmental objectives of the WFD:

a. Prevent deterioration in status of all surface water bodies (Article 4.1 (a)(i)).

b. Protect, enhance and restore all surface water bodies with the aim of achieving good surface water status by 2015 or later assuming grounds for time limited derogation (Article 4.1 (a)(ii)).

c. Protect and enhance all HMWBs/AWBs, with the aim of achieving GEP and GCS by 2015 or later assuming grounds for time limited derogation (Article 4.1 (a)(iii)).

d. Reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances (Article 4.1 (a)(iv)).

e. Prevent or limit the input of pollutants into groundwater and prevent deterioration of the status of all groundwater bodies (Article 4.1 (b)(i)).

f. Protect, enhance and restore all groundwater bodies and ensure a balance between abstraction and recharge of groundwater (Article 4.1 (b)(ii)).

g. Ensure the achievement of objectives in other water bodies is not compromised (Article 4.8).

h. Ensure compliance with other community environmental legislation (Article 4.9).

1.2.13. The Environment Agency (Ref 1-44) has published guidance (Clearing the Waters for All) regarding how to assess the impact of activities in transitional and coastal waters for the WFD. The guidance sets out the following three discrete stages to WFD assessments:

a. **Screening**: Identification of the proposed work activities that are to be assessed and determination of which WFD water bodies could potentially be affected through identification of a Zone of Influence(“ZoI”). Excludes any activities that do not need to go through the scoping or impact assessment stages.

b. **Scoping**: For each water body identified in Stage 1, an assessment is carried out to identify the effects and potential risks to quality elements from all activities. The assessment is made taking into consideration embedded mitigation (measures that can reasonably be incorporated into the design of the proposed works) and good practice mitigation (measures that would occur with or without input from the WFD assessment process).

c. **Impact Assessment**: A detailed assessment of the water bodies and activities carried forward from the WFD screening and scoping stages, Impact Assessment considers the potential impacts of an activity, identifies ways to avoid or minimise impacts, and indicates if an activity may cause deterioration or jeopardise the water body achieving GS.

1.2.14. The Planning Inspectorate's Advice Note Eighteen (Ref 1-9) also explains the information that the Inspectorate considers applicants must provide with their DCO application to clearly demonstrate that the WFD and the WFD Regulations have been appropriately considered.

1.2.15. Advice Note Eighteen (Ref 1-9) also refers to Environment Agency guidance (as described above) in terms of the WFD process and the information required.

1.2.16. Both sets of guidance have been followed in this WFD Compliance Assessment.

2. Screening

2.1. Project Overview

2.1.1. The following paragraphs provide an overview of the Project. Full details of the marine and landside infrastructure associated with the Project are provided in **Chapter 2: The Project [TR030008/APP/6.2]**.

2.1.2. The Project would comprise the construction, operation and maintenance of a multi-user liquid bulk terminal, which would be located on the eastern side of the Port of Immingham ("the Port"), as well as associated development (collectively termed "the Project"). The associated development includes the construction and operation of a green hydrogen production facility for the by Air Products BR Ltd ("Air Products").

2.1.3. Initially, the terminal would be used for the import and export of green ammonia to be converted to green hydrogen. To facilitate this, a hydrogen production facility, comprising associated ammonia handling equipment, storage and processing units would be constructed as part of the Project. Other proposed uses for the green energy terminal will come forward in due course and separate applications submitted as required. It is anticipated that a future use of the terminal will be the import of liquefied carbon dioxide to connect to adjacent carbon transport and storage networks for sequestration in the North Sea.

2.2. Potentially Affected Water Bodies

2.2.1. To determine which water bodies could potentially be affected by the Project, all surface and groundwater bodies located within the ZoI of the Project were recorded (see **Plate 1**). The ZoI in relation to water and sediment quality impacts is considered to be the wider Humber Estuary from the mouth to up estuary of the Hull Bend (see **Chapter 17: Marine Water and Sediment Quality [TR030008/APP/6.2]**), and the ZoI relating to water quality, coastal protection, flood risk and drainage is considered to be 1km from the Site Boundary (see **Chapter 18: Water Quality, Coastal Protection, Flood Risk and Drainage [TR030008/APP/6.2]**).

2.2.2. Given that impacts may propagate downstream, where relevant the assessment also considers a wider study area to as far downstream as a potential impact may influence the quality or quantity of the water body (which in this case is typically for a few kilometres). In this case, impacts may propagate along the North Beck Drain for approximately half a kilometre after which the flow is into the Humber Estuary. The Humber Estuary is therefore included in the assessment. Given the size and scale of the Humber Estuary no other water features downstream need to be considered. Therefore, the following water bodies were initially screened in:

a. Humber Lower transitional water body (ID: GB530402609201).

b. North Beck Drain river body water catchment (ID: GB104029067575).

c. Grimsby Ancholme Louth Chalk Unit (ID: GB40401G401500).

2.2.3. There are also several tributaries of the North Beck Drain present within the study area; these are predominantly Internal Drainage Board ("IDB") managed drains, agricultural ditches, road ditches and springs.

2.2.4. The Humber Lower and North Beck Drain water bodies overlap with the Project. The proposed dredge disposal sites for the Project also fall within the Humber Lower transitional water body.

2.2.5. Based on the scale and nature of the Project, it is considered unlikely that the Project would cause a significant non-temporary effect on the Grimsby Ancholme Louth Chalk Unit groundwater body. It is noted that this groundwater body covers a large proportion of the Humber River Basin District (905km²), and thus the Project is considered unlikely to cause deterioration in status at the water body level. Furthermore, the Project is not within a Drinking Water Safeguard Zone. In addition, it should be noted that there is a significant thickness of superficial deposits, including low permeability clays, overlying the Flamborough Chalk and Burnham Chalk Formations (see **Chapter 21: Ground Conditions and Land Quality [TR030008/APP/6.2]**). Therefore, the Grimsby Ancholme Louth Chalk Unit groundwater body has been screened out of the assessment and will not be discussed further within this WFD Compliance Assessment.

2.2.6. **Table 1** provides a summary of the Humber Lower transitional water body, including current water body status (ecological and chemical) and parameters currently failing to achieve good status. This body of water is a HMWB and in 2022 (the latest interim classification) had a moderate ecological potential. The chemical status in 2022 was noted as 'does not require assessment', however, in 2019 the water body had a failing chemical status (i.e. failing to achieve good) (Ref 1-10). The overall ecological and chemical potential/status is determined by the "one-out, all-out" principle, whereby the poorest individual parameter classification defines the assessment level. Therefore, if any parameter is assessed as less than good (e.g. moderate ecological potential or fail chemical status), then the potential/status for that water body is reported at that level. Moderate ecological potential of the Humber Lower transitional water body is due to the biological quality elements 'angiosperms' (moderate) and 'invertebrates' (moderate), the physico-chemical quality element 'dissolved inorganic nitrogen' (moderate) and supporting element 'Mitigation Measures Assessment' (moderate or less). The failing chemical status (in 2019) is due to the priority substances cypermethrin and dichlorvos, and priority hazardous substances polybrominated diphenyl ethers ("PBDE"), perfluorooctane sulphonate ("PFOS"), benzo(a)pyrene, benzo(b)fluoranthene, benzo(g-h-i) perylene, mercury and its compounds, and tributyltin compounds.

Table 1: Humber Lower transitional water body summary

Water Body Name	Humber Lower
Water Body ID	ID: GB530402609201
Water Body Type	Transitional
Water Body Area	246.455km²

Water Body Name	Humber Lower
Hydromorphological Designation (Reasons for Designation)	HMWB (coastal protection, flood protection, navigation, ports and harbours)
Protected Area Designations	Conservation of Wild Birds Directive (Special Protection Area, ("SPA")), Habitats and Species Directive (Special Area of Conservation, ("SAC")), Urban Waste Water Treatment Directive, Bathing Water Directive
Ecological Potential (2022)	Moderate
Chemical Status (2019)	Fail (in 2022 the chemical status was recorded as 'does not require assessment')
Parameters Not At Good Status	Angiosperms, Invertebrates, Dissolved Inorganic Nitrate, Mitigation Measures Assessment, Cypermethrin, Dichlorvos, PBDE, PFOS, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g-h-i)perylene, Mercury and its Compounds, and Tributyltin Compounds.
Higher Sensitivity Habitats	Chalk reef (689.36ha) Saltmarsh (1072.31ha)
Lower Sensitivity Habitats	Cobbles, gravel and shingle (280.54ha) Intertidal soft sediment (8788.69ha) Subtidal soft sediments (11286.66ha)
Phytoplankton Status	High
History of Harmful Algae	No

2.2.7. **Table 2** provides a summary of the North Beck Drain river water body. This is a HMWB due to use for coastal protection, flood protection and navigation use. In 2022, it had a moderate ecological potential. The chemical status in 2022 was noted as 'does not require assessment', however, in 2019 the water body had a failing chemical status (Ref 1-10). Moderate ecological potential is due to the supporting element 'Mitigation Measures Assessment' (moderate or less) and 'hydrological regime' (does not support good). The failing chemical status of the water body (in 2019) is due to PBDEs and Mercury and its Compounds.

Table 2: North Beck Drain river water body summary

Water Body Name	North Beck Drain
Water Body ID	ID: GB104029067575
Water Body Type	River
Catchment Area	56.647km²

Water Body Name	North Beck Drain
Hydromorphological Designation (Reasons for Designation)	HMWB (coastal protection, flood protection, navigation, ports and harbours)
Protected Area Designations	Nitrates Directive
Ecological Potential (2022)	Moderate
Chemical Status (2019)	Fail (in 2022 the chemical status was recorded as 'does not require assessment')
Parameters Not At Good Status	Mitigation Measures Assessment, Hydrological Regime, PBDE, Mercury and its Compounds.

2.3. Protected Areas

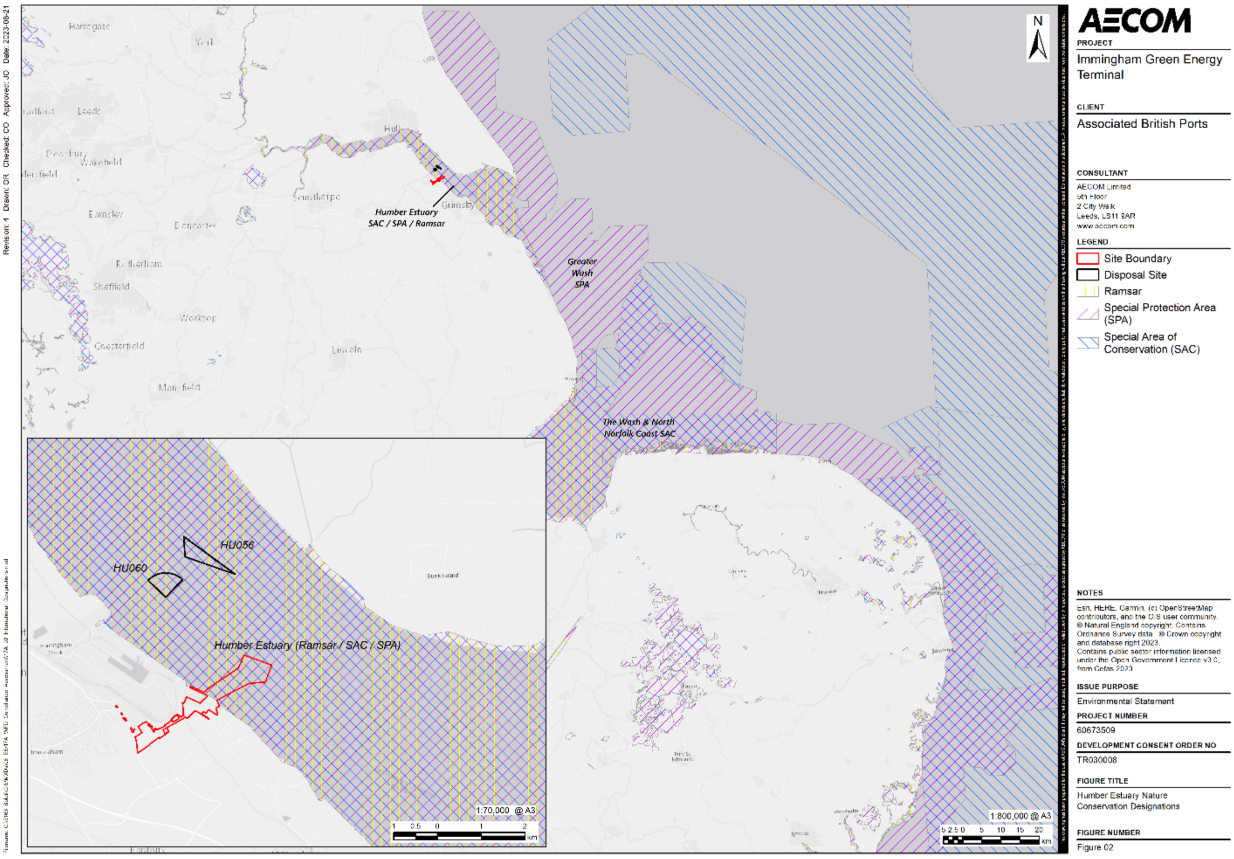
2.3.1. Surface waters require special protection under other European legislation. The WFD therefore brings together the planning processes of a range of other European Directives such as the Habitats Directive (92/43/EEC as amended) (Ref 1-11), the Birds Directive (2009/147/EC) (Ref 1-12), Ramsar Convention (Ref 1-13), Bathing Water Directive (2006/7/EC) (Ref 1-14), Nitrates Directive (91/676/EEC) (Ref 1-15), Urban Waste Water Treatment Directive (91/271/EEC) (Ref 1-16) a and the Shellfish Waters Directive (2006/113/EC) (Ref 1-17).

Nature conservation designations

2.3.2. The Conservation of Habitats and Species Regulations 2017 (Ref 1-18) (as amended) (the Habitats Regulations) transpose the Habitats Directive (Directive 92/43/EEC) and the Birds Directive (2009/147/EC) into English law. Article 3 of the Habitats Directive (92/43/EEC as amended) requires the establishment of a European network of important high-quality conservation sites known as Special Areas of Conservation (SAC) that will contribute to conserving habitats and species identified in Annexes I and II of the Directive. The listed habitat types and species are those considered to be most in need of conservation at a European level (excluding birds). In accordance with Article 4 of the Birds Directive (2009/147/EC), SPA are strictly protected sites classified for rare and vulnerable birds (Annex I of the Directive), and for regularly occurring migratory species. Ramsar sites are wetlands of international importance designated under the Ramsar Convention (adopted in 1971 and came into force in 1975), providing a framework for the conservation and wise use of wetlands and their resources.

2.3.3. The Project falls within the boundaries of the Humber Estuary SAC, SPA and Ramsar site (collectively forming the Humber European Marine Site ("EMS")). The Greater Wash SPA and the Wash and North Norfolk Coast SAC are also located outside the Humber Estuary. These sites are shown in **Plate 2**.

Plate 2: Location of the Project and surrounding international nature conservation designations



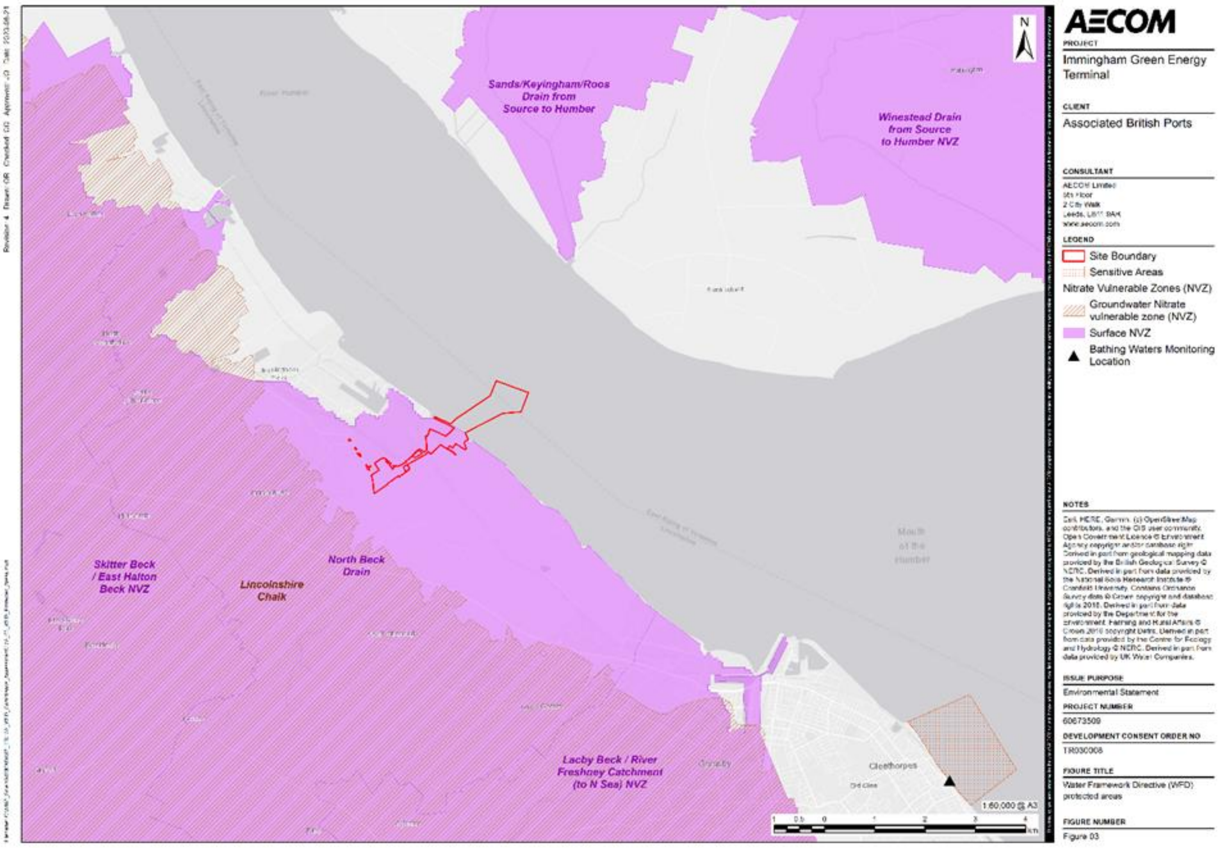
Bathing Water Directive

2.3.4. The revised Bathing Water Directive (2006/7/EC) (Ref 1-14) came into force in 2006, updating the microbiological and physico-chemical standards set by the original Bathing Water Directive (76/160/EEC) (Ref 1-19) and the process used to measure/monitor water quality at identified bathing waters. It is implemented in England under the Bathing Water Regulations 2013 (as amended) (Ref 1-20). The revised Bathing Water Directive focuses on fewer microbiological indicators, whilst setting higher standards, compared to those of the original Bathing Water Directive. Bathing waters under the revised Bathing Water Directive are classified as excellent, good, sufficient or poor according to the levels of certain types of bacteria (intestinal enterococci and *Escherichia coli*) in samples obtained during the bathing season (May to September).

2.3.5. The original Bathing Water Directive was repealed at the end of 2014 and the UK Government's target under the revised Bathing Water Directive was to achieve a classification of 'sufficient' for all bathing waters by 2015, as described under the Bathing Water Regulations 2013[2] (Ref 1-21) (as amended) (Ref 1-20). Monitoring of bathing water quality has been reported against revised Bathing Water Directive indicators since 2015. The new classification system considers all samples obtained during the previous four years and, therefore, data has been collected for revised Bathing Water Directive indicators since 2012.

2.3.6. Cleethorpes designated bathing waters is located approximately 11.5km south east of the Project, and Humberston Fitties is located approximately 15km south east (Plate 3). Cleethorpes was assessed as having 'good' bathing water quality in 2022 (Ref 1-22), declining from an 'excellent' classification in 2019. Humberston Fitties was assessed as having 'good' bathing water quality in 2022 (Ref 1-22), which has been the case since 2019.

Plate 3: Location of the Project and surrounding WFD protected areas



2 From 31 January 2020, this is replaced by The Floods and Water (Amendment etc.) (EU Exit) Regulations 2019.

Shellfish Waters Directive

2.3.7. The Shellfish Waters Directive (2006/113/EC) (Ref 1-17) was repealed in December 2013 and subsumed within the WFD (and therefore transposed in the WFD Regulations which provides for the designation of shellfish water protected areas).

2.3.8. The Shellfish Water Protected Areas (England and Wales) Directions 2016 (the Shellfish Directions) require the Environment Agency (in England) to endeavour to observe a microbial standard in all ‘shellfish water protected areas’. The microbial standard is 300 or fewer colony forming units of *E. coli* per 100ml of shellfish flesh and intravalvular liquid.

2.3.9. The Shellfish Directions also require the Environment Agency to assess compliance against this standard to monitor microbial pollution (75% of samples taken within any period of 12 months below the microbial standard and sampling/analysis in accordance with the Shellfish Directions).

2.3.10. There are no Shellfish Water Protected Areas in the vicinity of the Project (Ref 1-23). The nearest is the West Wash Shellfish Water Protected Area, located over 65km south.

Nitrates Directive

2.3.11. The Nitrates Directive (91/676/EEC) (Ref 1-15) is implemented in England under the Nitrate Pollution Prevention Regulations 2015 (as amended) which aims to reduce water pollution from agricultural sources and to prevent such pollution occurring in the future (nitrogen is one of the nutrients that can affect plant growth) through the designation of Nitrate Vulnerable Zones (“NVZs”). Vulnerable surface waters are identified by reference to the concentration of nitrates.

2.3.12. The landside extent of the Project is located on land included in the North Beck Drain NVZ, covering Immingham as well as South Killingholme and Healing (Ref 1-24) (**Plate 3**).

Urban Waste Water Directive

2.3.13. The Urban Waste Water Treatment Directive (91/271/EEC) (Ref 1-16) is implemented in England through the Urban Waste Water Treatment (England and Wales) Regulations 1994 (as amended). It aims to protect the environment from the adverse effects of the collection, treatment, and discharge of urban waste water. It sets treatment levels on the basis of sizes of sewage discharges and the sensitivity of waters receiving the discharges. In general, the Urban Waste Water Treatment Directive (Ref 1-16) requires that collected waste water is treated to at least secondary treatment standards for significant discharges. Secondary treatment is a biological treatment process where bacteria are used to break down the biodegradable matter (already much reduced by primary treatment) in waste water. Sensitive areas under the Urban Waste Water Treatment Directive (Ref 1-16) are water bodies affected by eutrophication due to elevated nitrate concentrations and act as an indication that action is required to prevent further pollution caused by nutrients.

2.3.14. There are no sensitive areas designated under the Urban Waste Water Treatment Directive (91/271/EEC) (Ref 1-16) in the vicinity of the Project (Ref 1-25).

3. Scoping

3.1. Introduction

3.1.1. The Clearing the Water for All guidance provides a scoping template to record findings and consider potential risks for several key receptors, specifically:

a. Hydromorphology

b. Biology (habitats)

c. Biology (fish)

d. Water quality

e. Protected areas

f. Invasive non-native species ("INNS")

3.1.2. Each receptor is considered in the following sections and summarised in a table. Potential risks that have been scoped into the assessment are highlighted in red and considered within the impact assessment stage, while those scoped out of the assessment are highlighted in green.

3.2. Hydromorphology

3.2.1. Hydromorphology is the physical characteristics of rivers, estuaries and coasts, including the size, shape and structure of the water body and the flow and quantity of water and sediment. **Table 3** presents a summary of hydromorphological considerations and associated risk issues for the Project.

Table 3: Hydromorphology scoping summary

Hydromorphology Considerations	Hydromorphology Risk Issue(s)	
	Humber Lower	North Beck Drain
Consider if your activity could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status?	No (morphology status 'not assessed'). Impact assessment not required.	No (hydrological regime status reported as 'supports good'). Impact assessment not required.
Consider if your activity could significantly impact the hydromorphology of any water body?	Yes (potential changes to hydromorphology as a result of Project). Requires impact assessment.	No (activity not within water body and negligible changes to hydrodynamics and morphology). Impact assessment not required.
Consider if your activity is in a water body that is heavily modified for the same use as your activity?	Yes (reason for hydromorphological designation is 'Navigation, ports and harbours'). Requires impact assessment.	No (activity not within water body). Impact assessment not required.

3.2.2. As at least one hydromorphological consideration indicates that a risk could be associated with the Project, this receptor has been scoped into the impact assessment (see Section 4).

3.3. Biology

Habitats

3.3.1. It is necessary to consider the impact of the physical footprint of an activity on nearby marine and coastal habitats. This specifically refers to habitats of higher sensitivity (e.g. intertidal seagrass, maerl and saltmarsh) and lower sensitivity (e.g. cobbles, gravel and shingle, subtidal rock reef and intertidal soft sediments like sand and mud). **Table 4** presents a summary of biology (habitat) considerations and associated risk issues for the Project. As the biology (habitats) considerations indicate that it is unlikely a risk could be associated with these works, this receptor has been scoped out of the assessment.

Table 4: Biology (habitat) scoping summary

Biology (Habitat) Considerations	Biology (Habitat) Risk Issue(s)	
	Humber Lower	North Beck Drain
Is the footprint of the activity 0.5km^2 or larger?	No (marine works within water body <0.5km^2). Impact assessment not required.	No (landside works not within water body). Impact assessment not required.
Is the footprint of the activity 1% or more of the water body's area?	No (marine works comprise <1% of water body). Impact assessment not required.	No (landside works not within water body). Impact assessment not required.
Is the footprint of the activity within 500m of any higher sensitivity habitat?	No (nearest higher sensitivity habitat >500m from the Project). Impact assessment not required.	No (nearest higher sensitivity habitat >500m from the Project). Impact assessment not required.
Is the footprint of the activity 1% or more of any lower sensitivity habitat?	No (<1% lower sensitivity habitats). Impact assessment not required.	No (landside works not within water body). Impact assessment not required.

Fish

3.3.2. Activities occurring within an estuary could impact on normal fish behaviour such as movement, migration or spawning. **Table 5** presents a summary of biology (fish) considerations and associated risk issues for the Project. As at least one biology (fish) consideration indicates that a risk could be associated with the activity, this receptor has been scoped into the assessment (see **Section 4**).

Table 5: Biology (fish) scoping summary

Biology (Fish) Considerations	Biology (Fish) Risk Issue(s)	
	Humber Lower	North Beck Drain
Consider if your activity is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary?	Yes. "Continue with questions".	Yes. "Continue with questions".
Consider if your activity could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)?	Yes. Requires impact assessment.	No (Project does not occur within this water body). Impact assessment not required.
Consider if your activity could cause entrainment or impingement of fish?	Yes. Requires impact assessment.	No (proposed works do not occur within this water body). Impact assessment not required.

3.4. Water Quality

3.4.1. Consideration has been given to whether phytoplankton status and harmful algae could be affected by the Project, as well as identifying the potential risks of using, releasing or disturbing chemicals. **Table 6** presents a summary of water quality considerations and associated risk issues of the Project. As at least one water quality consideration indicates that a risk could be associated with the Project, this receptor has been scoped into the impact assessment (see **Section 4**).

Table 6: Water quality (physical parameters) scoping summary

Water Quality Considerations	Water Quality Risk Issue(s)	
	Humber Lower	North Beck Drain
Consider if your activity could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)?	No (while the Project duration exceeds 14 days, the potential to affect water quality is intermittent and unlikely to persist continuously for greater than 14 days). Impact assessment not required.	No (while the Project duration exceeds 14 days, the potential to affect water quality is intermittent and unlikely to persist continuously for greater than 14 days). Impact assessment not required.

Water Quality Considerations	Water Quality Risk Issue(s)	
	Humber Lower	**North Beck Drain**
Consider if your activity is in a water body with a phytoplankton status of moderate, poor or bad?	No (phytoplankton status is high). Impact assessment not required.	No (phytoplankton status not assessed). Impact assessment not required.
Consider if your activity is in a water body with a history of harmful algae?	No (no history of harmful algae). Impact assessment not required.	No (not monitored). Impact assessment not required.
If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if the chemicals are on the Environmental Quality Standards Directive ("EQSD") list?	Yes (potential for sediment-bound chemicals above Cefas AL1 to be disturbed and dispersed during dredging and piling). Requires impact assessment.	Yes (potential for migration of contamination during landside works). Requires impact assessment.
If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if it disturbs sediment with contaminants above Cefas Action Level 1?		
If your activity has a mixing zone (like a discharge pipeline or outfall) consider if the chemicals released are on the Environmental Quality Standards Directive (EQSD) list?	No (not applicable). Impact assessment not required.	No (not applicable). Impact assessment not required.

3.5. Protected Areas

3.5.1. Consideration has been given to whether WFD protected areas are at risk from the Project, including SACs and SPAs (European sites), bathing waters, shellfish waters and nutrient sensitive areas. **Table 7** presents a summary of protected area considerations and associated risk issues of the proposed works. As the protected areas considerations indicate that a risk could be associated with the Project, this receptor has been scoped into the impact assessment (see Section 4).

Table 7: Protected area risk issues in the study area water bodies

Protected Area Considerations	Protected Area Risk Issue(s)	
	Humber Lower	North Beck Drain
Consider if your activity is within 2 km of any WFD protected area?	Yes (overlap with SPAs, SACs). Impact assessment required.	Yes (overlap with NVZ). Impact assessment required.

3.6. Invasive Non-native Species

3.6.1. Consideration has been given to whether there is a risk the Project could introduce or spread INNS. Risks of introducing or spreading INNS include materials or equipment that have come from, had use in or travelled through other water bodies, as well as activities that help spread existing INNS, either within the immediate water body or other water bodies. **Table 8** presents a summary of INNS considerations and associated risk issues for the proposed works. As the INNS considerations indicate that a risk could be associated with these ongoing works, this receptor has been scoped into the impact assessment (see **Section 4**).

Table 8: Invasive non-native species (INNS) risk issues in the study area water bodies

INNS Considerations	INNS Risk Issue(s)	
	Humber Lower	North Beck Drain
Consider if your activity could introduce or spread INNS?	Yes (potential for introduction or spread of INNS). Requires impact assessment.	Yes (potential for introduction or spread of INNS). Requires impact assessment.

4. Impact Assessment

4.1. Introduction

4.1.1. An impact assessment has been conducted for each receptor identified during the scoping stage as being at risk from an activity. The following receptors have been scoped into the impact assessment:

a. Hydromorphology

b. Biology (fish)

c. Water quality[3]

d. Protected areas

e. INNS

4.1.2. Each of these WFD parameters have been evaluated in order to determine whether the proposed activities might cause deterioration to the status of the relevant water body (defined as a non-temporary effect on status at water body level), or an effect that prevents the water body from meeting its WFD objectives.

4.2. Hydromorphology

4.2.1. Changes in hydromorphology may occur as a result of the capital and maintenance dredge, piling and disposal of material during construction, as well as the presence of the marine facilities and dredge pocket. A detailed physical processes assessment has been undertaken for the Project (**Chapter 16: Physical Processes [TR030008/APP/6.2]**) and is briefly summarised here.

4.2.2. The greatest increase in suspended sediment concentrations ("SSC") from the piling, dredging and disposal activities will occur during the barge depositing material at the licensed disposal site. Material within the passive plume will be dispersed throughout the water column as the load drops to the bed, with the potential to be transported up- and down-estuary through the full tidal excursion (dependent on tidal state at the point of release). Initial SSC values within the dynamic plume will be very high but, given the very high natural levels within the estuary, excess levels are likely to be reduced to below natural storm disturbance conditions very quickly (and before the next disposal operation commences four hours later). This is typically the same scenario that occurs for the existing maintenance dredging of the local Immingham berths, which has been undertaken frequently (multiple times during the year) since the berths were first implemented.

3 At this stage, the assessment for North Beck Drain has focussed primarily on its water quality and not on other factors, due to limited data being available on these aspects e.g. hydromorphology, biology etc.

4.2.3. At the disposal site, the effect of deposition of capital dredge arisings will be similar to that which already occurs as a result of ongoing maintenance dredging and disposal. 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. As is currently the practice, 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. Ongoing monitoring of depths within the disposal site (an activity already undertaken to assess bed level changes as a result of existing dredge disposal activities) will continue into the future. Consequently, the impact of the disposal from both capital and future maintenance dredging of the proposed IGET berth will be monitored.

4.2.4. Marginal changes to hydrodynamics (local flow speed) are likely to result from the Project within, and adjacent to, the proposed berth pocket. Slight changes in flow speed are predicted to extend up-estuary to Immingham Outer Harbour ("IOH") and Immingham Oil Terminal ("IOT") jetty and down-estuary. The largest predicted magnitude of change is anticipated within the berth pocket itself and the eastern and western end of the jetty platform.

4.2.5. Hydrodynamic forcing within (and adjacent to) the Project will only be marginally altered and, therefore, changes in the sediment pathways will be small. Predicted changes to future sediment transport are small in magnitude and limited in extent to the berth pocket and the landward end of the approach jetty. Outside the proposed berth pocket, the Project has limited impact on the baseline sedimentation and erosion rates.

4.2.6. Marginal changes to significant wave height (Hs) are likely to result from the Project within, and adjacent to, the proposed berth pocket. For the various wave events assessed, slight changes in wave height (typically less than -6% of baseline values) are predicted to extend up-estuary as far as Bellmouth (for a wave event approaching from the southeast). The largest predicted magnitude of change is anticipated in the immediate vicinity of the jetty platforms.

4.2.7. Changes to flows and waves are likely to result from the Project marine facilities within, and adjacent to, the proposed berth pocket and jetty infrastructure. These changes are predicted to be greatest in closest proximity to the Project, reducing in magnitude with distance. Due to the small extent and low magnitude of effect on the driving hydrodynamics, coupled with the relatively stable nature of the estuary morphology across the near-field study area, it is considered that the changes arising from the Project will not affect the existing, longer-term cyclic patterns in the estuary banks and channels.

4.2.8. It is considered that any future maintenance dredging (if required) will result in negligible changes in SSC and sedimentation. Furthermore, the predicted impacts from future maintenance dredging (if required) will be similar to that which already arises from the ongoing maintenance of the existing Immingham berths.

4.2.9. Overall, the Project will, therefore, not result in any changes in hydromorphology. The proposed works are, therefore, not expected to lead to a deterioration of the assessed hydromorphological elements within the Humber Lower transitional water body, nor prevent this water body from meeting its WFD objectives.

4.3. Biology (fish)

4.3.1. 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 [TR030008/APP/6.4]**) and is briefly summarised here.

4.3.2. For most piling activities, the main source of noise and vibration relates to where piles are hammered or vibrated into the ground. Percussive (impact) 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.

4.3.3. 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 1-26; Ref 1-27; Ref 1-25; Ref 1-28). For most dredging activities, the main source of sound relates to the vessel engine noise.

4.3.4. There is a wide diversity in hearing structures in fish which leads to different auditory capabilities across species (Ref 1-29). All fish can sense the particle motion[4] component of an acoustic field via the inner ear as a result of whole-body accelerations (Ref 1-30), 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 1-31; Ref 1-32; Ref 1-33; Ref 1-18). Although many fish are also likely to detect sound pressure[5], particle motion is considered equally or potentially more important (Ref 1-34).

4.3.5. 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 1-34). Popper *et al.* (Ref 1-31) proposed the following three categories of fish:

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

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

c. Fish with no swim bladder.

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4 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.

5 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.

4.3.6. 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.

4.3.7. 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*).

4.3.8. 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 (*Petromyzon marinus*), sole (*Solea solea*) and thornback ray (*Raja clavata*).

Marine Piling

4.3.9. The Project will involve the installation of piles of varying sizes. The highest peak noise levels are generally associated with larger-sized piles given the larger surface area of the pile in contact with the water and the larger hammer energy and/or pile driving time involved in driving them. On this project, the largest piles are up to 2.3m in diameter. However, given that only a total of two of these piles will be driven for the Project, they only represent a very small proportion of all the piles (<1%). In addition to modelling the propagation of noise associated with these larger 2.3m diameter piles as a worst case, therefore, the propagation of noise associated with the second largest 15 m diameter piles, which comprise a more significant proportion of all the piles (45%), has also been modelled.

4.3.10. The predicted range (R) at which the Popper *et al.* (Ref 1-31) quantitative instantaneous peak Sound Pressure Level (SPL) thresholds for pile driving are reached indicates that for the 2.3m diameter piles, there is a risk of mortality, potential mortal injury or recoverable injury within 80m from the source of impact piling in fish with a swim bladder (such as herring, Atlantic salmon and European eel) and within 40m in fish with no swim bladder (such as lamprey and flatfish). For 1.5m diameter piles, there is a risk of mortality, potential mortal injury or recoverable injury within 20m from the source of impact piling in fish with a swim bladder (such as herring, Atlantic salmon and European eel) and within 10m 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 3m from the source in fish with a swim bladder and within 2m in fish with no swim bladder.

4.3.11. The calculator developed by the United States National Marine Fisheries Service (“NMFS”) (Ref 1-31) as a tool for assessing the potential effects to fish exposed to elevated levels of underwater sound produced during pile driving was used to calculate the range at which the cumulative Sound Exposure Levels (“SEL”) thresholds for pile driving (Ref 1-31) are reached. Based on the assumptions highlighted in **Appendix 9.B [TR030008/APP/6.4]**, for the 2.3m diameter piles, there is predicted to be a risk of mortality and potential mortal injury within 200m from the source of impact piling in fish with a swim bladder involved in hearing (such as herring), within 100m from the source in fish with a swim bladder not involved in hearing (such as European eel) and within 40m in fish with no swim bladder (such as sole). For 1.5m diameter piles, there is predicted to be a risk of mortality and potential mortal injury within 60m from the source of impact piling in fish with a swim bladder involved in hearing (such as herring), within 40m from the source in fish with a swim bladder not involved in hearing (such as European eel) and within 10m in fish with no swim bladder (such as sole). For the 2.3m diameter piles, the distance at which the received level of impact piling noise is within the limits of the recoverable injury threshold is within 300m in fish with a swim bladder and 60m in fish without a swim bladder. For 1.5m diameter piles, the distance at which the received level of noise is within the limits of the recoverable injury threshold is within 100m in fish with a swim bladder and 20m in fish without a swim bladder.

4.3.12. For vibro piling of either 2.3m or 1.5m diameter piles, there is predicted to be a risk of mortality and potential mortal injury within 50m from the source in fish with a swim bladder involved in hearing, within 30m from the source in fish with a swim bladder not involved in hearing and within 10m 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 80m in fish with a swim bladder and 10m in fish without a swim bladder.

4.3.13. Given the mobility of fish, any 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.

4.3.14. The range at which the Popper *et al.* (Ref 1-31) temporary threshold shift (“TTS”) and Hawkins *et al*. (Ref 1-35) 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 2-3km from the source of impact piling for 2.3m diameter piles and 1-2km from the source of impact piling 1.5m diameter piles. For the 2.3m diameter piles, TTS and behavioural reactions during impact piling are, therefore, anticipated to occur across 87% to 100% width of the Humber Estuary at low water and 59% to 88% of the width of the estuary at high water. For the 1.5m diameter piles, TTS and behavioural reactions are anticipated to occur across 43% to 87% of the width of the Humber Estuary at low water and 29% to 59% of the estuary width at high water. Impact piling, therefore, has the potential to create a partial to full temporary barrier to fish movements. For vibro piling, there is a risk of TTS and behavioural responses in fish within around 1km from the source which equates to 43% of the width of the Humber Estuary at low water and 29% of the estuary width at high water.

4.3.15. 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 Popper *et al.* (Ref 1-31) fish hearing groups. Fish with a swim bladder involved in hearing (e.g., herring) may exhibit a moderate behavioural reaction within distance in which a behavioural response is predicted (e.g., a sudden change in swimming direction, speed or depth). Fish with a swim bladder that is not involved in hearing (e.g., European eel) are likely to display a milder behavioural reaction. Fish without a swim bladder (e.g., river lamprey) are anticipated to only show very subtle changes in behaviour in this zone.

4.3.16. 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.

4.3.17. The effects of marine piling noise on fish also need to be considered in terms of the duration of exposure. It is anticipated that piling noise will take place over a period of approximately 343 days. However, piling will not take place continuously as there will be periods of downtime, pile positioning and set up.

4.3.18. During the periods 1 March to 31 March, 1 June to 30 June and 1 August to 31 October inclusive, piling will be restricted at night. Specifically, no percussive piling will be undertaken from 19:00 to 07:00 in March, September and October and between sunset and sunrise in June and August. The maximum impact piling scenario is for three tubular piles to be installed each day using up to two piling rigs pile driving at any one time, involving approximately 270 minutes of impact (percussive) piling per day and 60 minutes of vibro piling per day. There will, therefore, be significant periods over a 24-hour period when fish will not be disturbed by any piling noise. The actual proportion of piling is estimated to be at worst around 23% over a 24 hour period (based on 270 minutes of impact piling and 60 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 not be exposed up to 77 % of the time over the period of a day.

4.3.19. As described above the marine piling will occur between 07:00 to 19:00 in the winter months and sunrise to sunset in the summer months. This has the potential to disproportionately affect fish that migrate during daylight hours, whilst reducing the potential exposure of fish that predominantly migrate during night-time hours (e.g., river lamprey and glass eel).

4.3.20. It is also important to consider the noise from piling against existing background or ambient noise conditions. The levels of underwater noise generated by impact piling are predicted to reach existing background levels previously measured in the Humber Estuary within around 2 to 3km from the source. The levels of underwater noise generated by vibro piling are predicted to reach background levels within around 1km from the source. Furthermore, the area in which the construction will take place already experiences regular vessel operations and ongoing maintenance dredging, and, therefore, fish are likely to be habituated to a certain level of anthropogenic background noise.

4.3.21. In conclusion, the proposed piling activity is not expected to lead to a deterioration of the assessed fish elements within the Humber Lower transitional water body, nor prevent this water body from meeting its WFD objectives.

Dredging and disposal

4.3.22. The qualitative guidelines for continuous noise sources (Ref 1-31) consider that the risk of mortality and potential mortal injury in all fish is low in the near, intermediate and far-field. Applying the cumulative SEL thresholds for piling (Ref 1-31) on a precautionary basis, indicate that there is a risk of mortality/potential mortal injury within 50m in fish with a swim bladder involved in hearing, within 30m in fish with a swim bladder that is not involved in hearing and 10m for fish with no swim bladder.

4.3.23. According to Popper *et al.* (Ref 1-31), 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 10m. Applying the cumulative SEL thresholds for piling (Ref 1-31) on a precautionary basis, indicate that there is a risk of recoverable injury within 80 m in fish with a swim bladder and 20m for fish with no swim bladder.

4.3.24. Popper *et al.* (Ref 1-31) advises that there is a moderate risk of 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 50m. Applying the cumulative SEL thresholds for piling (Ref 1-31) on a precautionary basis, indicate that there is a risk of TTS occurring within 700m in all fish.

4.3.25. Popper *et al*. (Ref 1-31) 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.

4.3.26. 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. 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 mortality/potential mortal injury or recoverable injury are predicted in fish as a result of the dredging and vessel movements, as explained above. TTS and behavioural responses are anticipated to be relatively localised in scale and, in the context of the estuary width and the unconstrained nature of the location, fish will be able to move away and avoid the source of the noise as required. Furthermore, the period of dredging will be very short term and temporary, lasting a period of approximately 12 days in total.

4.3.27. It is also important to consider the noise from dredging and vessel movements against existing background or ambient noise conditions. The levels of underwater noise generated by dredging and vessel movements are predicted to reach existing background levels previously measured in the Humber Estuary within around 100m from the source. Furthermore, the estuary and location of the proposed works already experiences regular vessel operations and ongoing maintenance dredging, and, therefore, fish are already habituated to a similar level of anthropogenic background noise.

4.3.28. It is noted that there is potential for fish to become entrained during the use of trailer suction hopper dredger ("TSHD") (if required). However, the scale of such impacts is considered negligible given the regular maintenance dredging activity that is already undertaken at the Port of Immingham.

4.3.29. In conclusion, the proposed dredging and disposal activity is not expected to lead to a deterioration of the assessed fish elements within the Humber Lower transitional water body, nor prevent this water body from meeting its WFD objectives.

4.4. Water Quality

4.4.1. Changes in water quality may occur as a result of the capital and maintenance dredge, piling and disposal of material during construction, as well as from surface water run-off during construction and operation. A detailed assessment has been undertaken for the Project in **Chapter 17: Marine Water and Sediment Quality [TR030008/APP/6.2]** and **Chapter 18: Water Quality, Coastal Protection, Flood Risk and Drainage [TR030008/APP/6.2]** and is briefly summarised here.

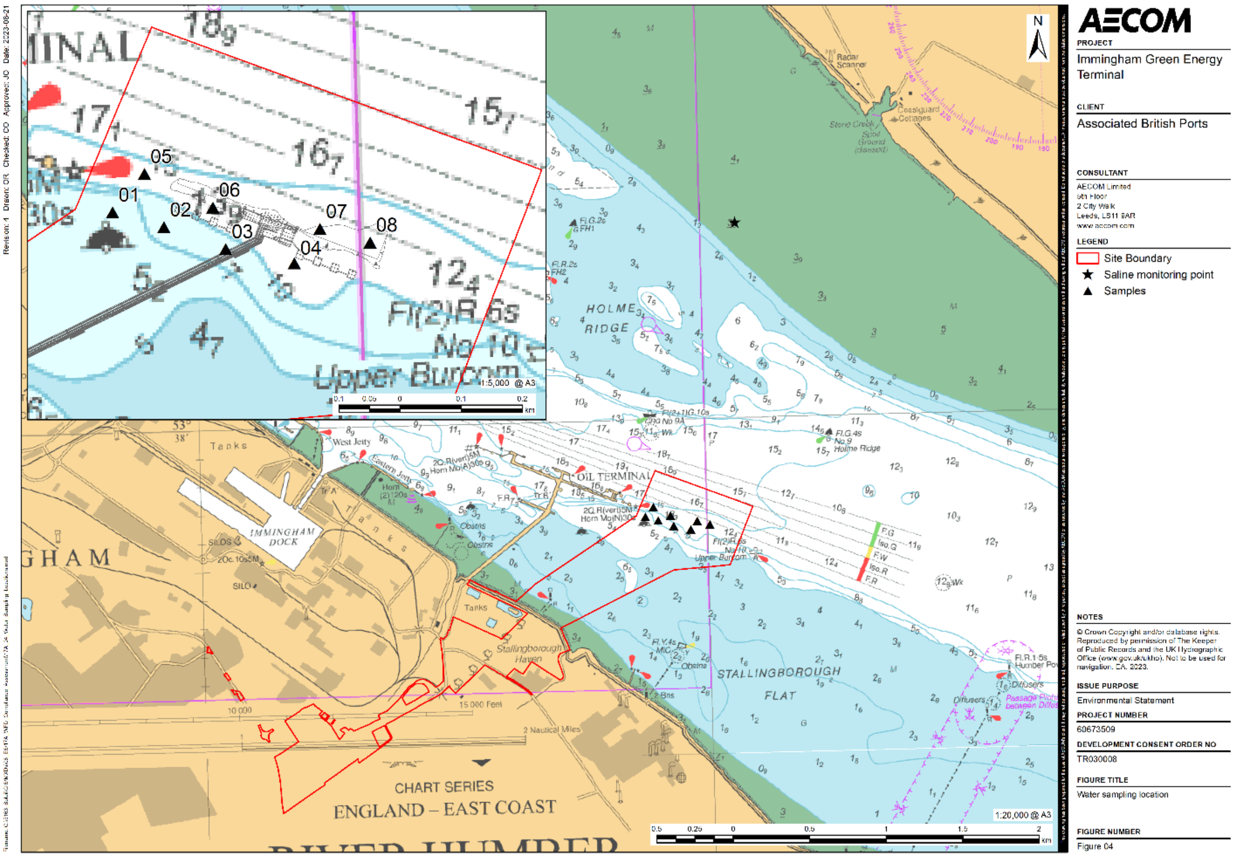
Baseline

4.4.2. The UK has not adopted formal quantitative EQS for sediments. In the absence of any quantified UK standards, therefore, common practice for characterising baseline sediment quality conditions is to compare against the Cefas Guideline Action Levels for the disposal of dredged material (Ref 1-36).

4.4.3. Cefas Guideline Action Levels are used as part of a 'weight of evidence' approach to assessing material suitability for disposal at sea. Cefas guidance indicates that, in general, contaminant levels below Action Level 1 (AL1) are of no concern. Material with contaminant levels above Action Level 2 (AL2), however, is generally considered unsuitable for disposal at sea whilst dredged material with contaminant levels between AL1 and AL2 requires further consideration before a decision can be made as to disposal. Consequently, the Action Levels should not be viewed as pass/fail thresholds, and it is also recognised that these guidelines are not statutory requirements. Cefas Action Levels are not available for every determinand and where appropriate comparisons may be made to other alternative guidance levels, e.g. Canadian Sediment Quality Guidelines or thresholds from other European/OSPAR[6] nations, to provide context. It is also noted that Cefas Action Levels in the UK are currently being reviewed but have yet to be formally updated (Ref 1-36).

4.4.4. In February 2023, a sample plan (SAM/2022/00106) was provided by the Marine Management Organisation ("MMO"), prepared in consultation with Cefas. In March 2023, sediment samples were collected from eight stations (1 to 8) across the proposed dredge area comprising the Project, including subsurface samples (**Plate 4**).

Plate 4: Sediment sampling locations within proposed dredge area and water quality monitoring location



4.4.5. The sampling regime and analysis was undertaken in accordance with the sample plan. The sediment samples were analysed by an MMO-approved laboratory for the following physical and chemical parameters:

a. Particle size analysis ("PSA")

b. Trace metals

6 Countries signed up to the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic.

c. Organotins

d. Polycyclic aromatic hydrocarbons (“PAHs”)

e. Polychlorinated biphenyls (“PCBs”)

f. Total hydrocarbon content (“THC”)

g. Organochlorine pesticides (“OCPs”)

4.4.6. The PSA results are presented in **Table 9**. Sediments from most sampling locations were dominated by silt material with limited amounts of gravel. Samples from Sample 1 (1m), Sample 2 (2m), and Sample 3 (1m) were predominantly comprised of sand. Sample 2 (0m), Sample 7 (0m), and Sample 8 (0m and 2.9m) were predominantly comprised of gravel.

4.4.7. Sediment samples have also been analysed for total organic carbon (“TOC”) (**Table 9**). Values typically ranged from about 0.5% to 2%, with a minimum of 0.17% and a maximum of 6.36%. The average organic carbon content across all samples was 1.31%. Generally, samples with higher proportions of sand and gravel had lower TOC as organic matter tends to accumulate in finer grained sediments.

4.4.8. A summary of sediment quality (chemical analysis) of samples from the dredge areas is provided in **Table 10** to **Table 17**. Concentrations above or below Cefas Guideline Action Levels are highlighted to provide an indication of sediment quality (comparisons to other thresholds are noted below where these do not exist). Contaminant concentrations were generally low, with most values below the respective Cefas Guideline Action Level (“AL”) 1 or marginally exceeding AL1. There were no instances where the concentration exceeded the respective AL2 (or a sample concentration was close to exceeding this threshold).

4.4.9. Trace metal concentrations were typically below AL1 in most samples, with some minor exceedances of AL1 for some metals (mainly in Samples 4, 5 and 6). Most individual PAHs were found to be below AL1, though some samples exceeded AL1, particularly in Samples 4, 5 and 6. There is currently no AL2 for individual or total PAHs. Cefas and Defra are proposing to introduce updated ALs for these contaminants, however, these proposed ALs are still subject to review and are not yet implemented. Nevertheless, at the request of the MMO, PAH concentrations have been compared against the proposed Cefas ALs for the sum of low molecular weight (“LMW”) and high molecular weight (“HMW”) PAHs. Most samples were also below the proposed AL1, though again some exceeded the proposed AL1 (again in Vibrocores 4, 5 and 6). None exceeded the proposed AL2 for PAHs. The CSQGs define a Probable Effect Level (“PEL”) concentration (considered the concentration which adverse effects frequently occur) for benzo(a)pyrene (763 µg/kg) and fluoranthene (1494 µg/kg); all samples were below these concentrations.

4.4.10. PCB concentrations were low, mostly below the limit of detection (“LOD”), and both the sum of ICES 7 and the sum of 25 congeners were below AL1 for all samples. Organochlorine pesticide (“OCP”) concentrations were also often below the LOD in most samples; dieldrin concentrations were below AL1 in all samples, and p,p'-Dichlorodiphenyltrichloroethane (“DDT”) concentrations were predominantly below AL1 in most samples, with some minor exceedances of AL1.

4.4.11. Sampling of surface water quality was also undertaken around the works area. Two rounds of sampling were conducted 31 March 2023 and 18 May 2023 to provide baseline watercourse quality for the two drains that flow to the East and West boundaries of the Site for the Project. These results provided confirmation of water quality conditions currently in the two watercourses nearest to the Site; i.e., Habrough Marsh Drain (SW1 and 2) and North Beck Drain (SW3).

4.4.12. The sampling was undertaken to better understand baseline conditions in support of the **Chapter 18: Water Quality, Coastal Protection, Flood Risk and Drainage [TR030008/APP/6.2]**. The Project has the potential to impact watercourses and so there is a need to understand baseline environment given that there is no Environment Agency (“EA”) data for Habrough Marsh Drain and some EA data to 2019 for North Beck Drain. The results presented here are a summary of data presented in full within **Appendix 18.C [TR030008/APP/6.4]** to the **Chapter 18: Water Quality, Coastal Protection, Flood Risk and Drainage**.

4.4.13. Two rounds of sampling were undertaken; the first round of sampling was collected between 09:00 and 11:30 on the 31 March 2023 on an outgoing tide (3.5m – 4.5m above chart datum (ACD2)) and the second round of sampling was also collected between 09:00 and 11:30 on 18 May 2023 on an incoming tide (1.5m – 3m ACD).

4.4.14. The samples undertaken under different coastal conditions will provide a comparison to the opposite flow regime and if the tidal influence influences water quality. Since the Humber Estuary is tidal, the water within both the North Beck Drain and Habrough Marsh Drain is heavily influenced by the river. Due to the saline influence of the Humber River, the water conditions are be compared to The Water Framework Directive (Standards and Classification) Directions (Ref 1-38) (where available), these guidelines outline the physicochemical parameters, priority substances and specific pollutants that dictate a water bodies classification within the WFD.

4.4.15. The results of the water quality sampling have been provided in Table 18. Overall, it is considered that the exceedances of PAHs, metals and inorganics are indicative of wider contamination within nearby surface watercourses associated with the historical and current industrial land use within the wider Immingham area. Sampling location SW1 is located within Habrough Marsh Drain approximately 40m west from the East Site (Hydrogen Production site).

4.4.16. As part of RSK (2020) Immingham BCP Phase 2 Geo-environmental and Geotechnical Site Investigation (Ref 1-45), PAH exceedances recorded in surface water samples were not recorded in soil leachate or groundwater samples from the Site, therefore indicating an off-site source. The elevated metals in surface water may be indicative of natural conditions, with the soil leachate and groundwater across the wider site recording elevated concentrations.

4.4.17. The results obtained from the sampling conducted within terrestrial water bodies has provided some data on the surface water bodies on the site. The data has helped define the risks to each of the three local WFD water bodies that could potentially be impacted by the construction and operation of the Project. The effects these activities could have, and their potential impacts, have been compiled within this WFD report and the Environmental Statement **Chapter 18 for Water Quality, Coastal Protection, Flood Risk and Drainage [TR030008/APP/6.2]**.

4.4.18. The assessment for the North Beck Drain river water body and the Habrough Marsh Drain river identified the current known conditions of the Site's surrounding surface waters, the key findings being:

a. The presence of low levels of upstream contamination identified from baseline sampling.

b. Relatively high levels of contamination within the Site.

c. Water quality investigations are ongoing to further understand contaminant risks and better define appropriate mitigation.

d. SuDS would to be designed to mitigate risks, as described in more detail in **Appendix 18.B [TR030008/APP/6.4]**.

e. The assessment of risks to the North Beck Drain river water body has used a 'realistic worst case scenario' and the Sustainable Drainage systems ("SuDs") strategy, which adopts best practice, has been completed with the mitigation of this risk in mind.

Table 9: Particle size analysis (PSA) results from sediment samples collected in March 2023

Sample	Depth (m)	Visual Appearance	Total organic carbon (TOC) M/M%	Particle Size Distribution (%)		
				Gravel (>2 mm)	Sand (2 mm – 63 µm)	Silt (<63 µm)
Sample 1	0	Odourless Brown Mud with Organic Matter.	6.07	0.39	16.25	83.36
Sample 1	1	Odourless Brown Gravelly Sandy Mud with Organic Matter.	0.85	1.91	52.30	45.79
Sample 1	2.2	Odourless Brown Gravelly Mud.	1.02	8.26	14.19	77.55
Sample 2	0	Odourless Brown Gravelly Sandy Mud with Shell Fragments.	0.79	49.45	8.79	41.76
Sample 2	1	Odourless Brown Gravelly Mud.	0.98	6.96	15.49	77.56
Sample 2	2	Odourless Brown Gravelly Muddy Sand.	0.17	2.58	61.59	35.83
Sample 2	2.95	Odourless Brown Sandy Mud.	0.59	0.00	21.59	78.41
Sample 3	0	Brown Mud with Organic Matter and a Peat Odour.	6.36	0.00	37.51	62.49
Sample 3	1	Odourless Brown Muddy Sand.	0.56	0.00	60.13	39.87
Sample 3	2	Odourless Brown Gravelly Mud.	1.05	10.46	10.71	78.84
Sample 3	2.5	Odourless Brown Gravelly Mud.	0.97	11.93	12.58	75.48
Sample 4	0	Odourless Brown Sandy Mud.	1.44	0.00	20.09	79.91

Sample	Depth (m)	Visual Appearance	Total organic carbon (TOC) M/M%	Particle Size Distribution (%)		
				Gravel (>2 mm)	Sand (2 mm – 63 µm)	Silt (<63 µm)
Sample 4	1	Odourless Brown Mud.	1.60	0.00	17.23	82.77
Sample 4	2	Odourless Brown Mud.	2.01	0.00	15.53	84.47
Sample 4	3	Odourless Brown Sandy Mud.	2.22	0.00	40.04	59.96
Sample 4	4	Odourless Brown Mud.	0.93	0.00	0.00	100.00
Sample 5	0	Odourless Brown Mud.	1.39	0.00	20.27	79.73
Sample 5	1	Odourless Brown Sandy Mud.	0.86	0.00	32.08	67.92
Sample 5	2	Odourless Brown Mud.	1.55	0.00	24.55	75.45
Sample 5	3	Odourless Brown Sandy Mud.	1.13	0.00	2.23	97.77
Sample 5	4	Odourless Brown Gravelly Sandy Mud.	0.71	9.57	5.38	85.05
Sample 6	0	Odourless Brown Mud.	1.68	0.00	13.94	86.06
Sample 6	1	Brown Mud with a Peat Odour.	1.50	0.00	13.34	86.66
Sample 6	2	Brown Sandy Mud with a Peat Odour.	0.79	0.00	37.24	62.76
Sample 6	3	Odourless Brown Gravelly Mud.	0.79	4.87	5.84	89.29
Sample 6	4	Odourless Brown Sandy Mud.	0.94	0.00	0.00	100.00
Sample 7	0	Odourless Brown Muddy Gravel.	0.41	80.07	11.06	8.87

Sample	Depth (m)	Visual Appearance	Total organic carbon (TOC) M/M%	Particle Size Distribution (%)		
				Gravel (>2 mm)	Sand (2 mm – 63 µm)	Silt (<63 µm)
Sample 7	1	Odourless Brown Sandy Mud.	0.59	0.00	1.76	98.24
Sample 7	1.4	Odourless Brown-White Gravelly Mud.	0.33	20.20	8.42	71.37
Sample 8	0	Odourless White Muddy Gravel.	1.11	47.44	6.16	46.40
Sample 8	1	Odourless Brown Gravelly Mud.	0.85	5.98	2.36	91.66
Sample 8	2	Odourless Brown Gravelly Mud.	0.46	4.20	10.72	85.09
Sample 8	2.9	Odourless Other Muddy Gravel.	0.39	72.45	4.46	23.09

Table 10: Sediment contamination data for Sample 1 collected in March 2023

Contaminant	Units	Cefas Action Level		Sample Concentration		
		AL1	AL2	Sample (0m)	Sample 1 (1.0m)	Sample 1 (2.2m)
Arsenic	mg/kg	20	100	12.3	9.4	9.6
Cadmium	mg/kg	0.4	5	0.59	0.05	0.12
Chromium	mg/kg	40	400	36.8	7.80	21.8
Copper	mg/kg	40	400	23.4	5.90	16.9
Lead	mg/kg	50	500	20.4	5.40	11.2
Mercury	mg/kg	0.3	3	0.06	0.04	0.03
Nickel	mg/kg	20	200	43.9	6.40	26.9
Zinc	mg/kg	130	800	143	38.4	48.1
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	<0.001	<0.001
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.001	<0.001
Acenaphthene	µg/kg	100	-	<5	<5	5.0
Acenaphthylene	µg/kg	100	-	<5	<5	2.3
Anthracene	µg/kg	100	-	<5	<5	7.0

Contaminant	Units	Cefas Action Level		Sample Concentration		
		AL1	AL2	Sample (0m)	Sample 1 (1.0m)	Sample 1 (2.2m)
Benzo[a]anthracene	µg/kg	100	-	17.1	<5	24.9
Benzo[a]pyrene	µg/kg	100	-	23.3	<5	34.1
Benzo[b]fluoranthene	µg/kg	100	-	34.4	<5	35.8
Benzo[e]pyrene	µg/kg	100	-	58.4	<5	56.9
Benzo[ghi]perylene	µg/kg	100	-	62.2	<5	80.7
Benzo[k]fluoranthene	µg/kg	100	-	23.9	<5	19.5
C1-naphthalenes	µg/kg	100	-	190.0	<5	132.0
C1-phenanthrene	µg/kg	100	-	163.0	7.5	159.0
C2-naphthalenes	µg/kg	100	-	183.0	<5	141.0
C3-naphthalenes	µg/kg	100	-	123.0	<5	150.0
Chrysene	µg/kg	100	-	51.1	<5	51.5
Dibenzo[ah]anthracene	µg/kg	100	-	<5	<5	5.2
Fluoranthene	µg/kg	100	-	35.2	<5	42.9
Fluorene	µg/kg	100	-	28.7	<5	11.9

Contaminant	Units	Cefas Action Level		Sample Concentration		
		AL1	AL2	Sample (0m)	Sample 1 (1.0m)	Sample 1 (2.2m)
Indeno[1,2,3-cd]pyrene	µg/kg	100	-	14.4	<5	19.1
Naphthalene	µg/kg	100	-	48.6	<5	23.8
Perylene	µg/kg	100	-	869.0	5160.0	14.5
Phenanthrene	µg/kg	100	-	141.0	6.2	108.0
Pyrene	µg/kg	100	-	44.4	<5	60.6
Total Hydrocarbon Content (THC)	mg/kg	-	-	6.09	4.11	24.8
PCBs – Sum of ICES 7	mg/kg	0.02	0.01	0.00056	0.00056	0.00056
PCBs – Sum of 25 Congeners	mg/kg	0.2	-	0.002	0.002	0.002
AHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	0.0002	<0.0001	<0.0001
HCB	mg/kg	-	-	<0.0001	<0.0001	<0.0001

Contaminant	Units	Cefas Action Level		Sample Concentration		
		AL1	AL2	Sample (0m)	Sample 1 (1.0m)	Sample 1 (2.2m)
PPTDE	mg/kg	-	-	0.0001	<0.0001	<0.0001
PPDDE	mg/kg	-	-	<0.0001	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	0.0018	<0.0001	<0.0001
Key	Below AL1					
	Above AL1, Below AL2					
	Above AL2					

Table 11: Sediment contamination data for Sample 2 collected in March 2023

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 2 (0m)	Sample 2 (1.0m)	Sample 2 (2.0m)	Sample 2 (2.95m)
Arsenic	mg/kg	20	100	11.2	11.5	3.5	3.9
Cadmium	mg/kg	0.4	5	<0.04	0.11	<0.04	<0.04
Chromium	mg/kg	40	400	22.8	21.3	6.60	9.40
Copper	mg/kg	40	400	15.8	14.1	7.60	9.60
Lead	mg/kg	50	500	14.3	9.80	3.60	5.10
Mercury	mg/kg	0.3	3	0.05	0.02	0.01	0.03
Nickel	mg/kg	20	200	23.3	25.2	8.10	11.2
Zinc	mg/kg	130	800	96.0	53.6	18.0	24.2
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	<0.001	<0.001	<0.001
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.001	<0.001	<0.001
Acenaphthene	µg/kg	100	-	14.0	8.1	1.7	20.8
Acenaphthylene	µg/kg	100	-	7.0	2.3	<1	6.9
Anthracene	µg/kg	100	-	19.2	11.3	1.9	26.0

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 2 (0m)	Sample 2 (1.0m)	Sample 2 (2.0m)	Sample 2 (2.95m)
Benzo[a]anthracene	µg/kg	100	-	61.4	30.8	6.9	106.0
Benzo[a]pyrene	µg/kg	100	-	79.0	39.6	9.8	100.0
Benzo[b]fluoranthene	µg/kg	100	-	78.6	46.1	8.5	82.2
Benzo[e]pyrene	µg/kg	100	-	89.2	58.6	12.6	113.0
Benzo[ghi]perylene	µg/kg	100	-	128.0	87.7	19.6	134.0
Benzo[k]fluoranthene	µg/kg	100	-	75.5	27.7	6.9	71.3
C1-naphthalenes	µg/kg	100	-	216.0	130.0	28.8	400.0
C1-phenanthrene	µg/kg	100	-	212.0	205.0	38.3	607.0
C2-naphthalenes	µg/kg	100	-	192.0	142.0	34.9	475.0
C3-naphthalenes	µg/kg	100	-	197.0	175.0	46.1	625.0
Chrysene	µg/kg	100	-	87.5	54.1	11.8	153.0
Dibenzo[ah]anthracene	µg/kg	100	-	14.2	7.7	1.7	16.3
Fluoranthene	µg/kg	100	-	101.0	51.2	8.4	139.0
Fluorene	µg/kg	100	-	24.2	22.9	2.7	29.2

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 2 (0m)	Sample 2 (1.0m)	Sample 2 (2.0m)	Sample 2 (2.95m)
Indeno[1,2,3-cd]pyrene	µg/kg	100	-	57.7	23.4	5.0	44.5
Naphthalene	µg/kg	100	-	60.9	26.0	5.6	80.3
Perylene	µg/kg	100	-	29.6	15.2	2.8	23.1
Phenanthrene	µg/kg	100	-	142.0	122.0	23.1	375.0
Pyrene	µg/kg	100	-	118.0	67.8	16.2	198.0
Total Hydrocarbon Content (THC)	mg/kg	-	-	71.6	15.3	19.1	86.7
PCBs – Sum of ICES 7	mg/kg	0.02	0.01	0.00057	0.00056	0.00056	0.00056
PCBs – Sum of 25 Congeners	mg/kg	0.2	-	0.00201	0.002	0.002	0.002
AHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	0.0001	<0.0001	<0.0001	<0.0001
HCB	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 2 (0m)	Sample 2 (1.0m)	Sample 2 (2.0m)	Sample 2 (2.95m)
PPTDE	mg/kg	-	-	0.0014	<0.0001	<0.0001	<0.0001
PPDDE	mg/kg	-	-	0.0002	<0.0001	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	0.0002	<0.0001	0.0009	<0.0001
Key	Below AL1						
	Above AL1, Below AL2						
	Above AL2						

Table 12: Sediment contamination data for Sample 3 collected in March 2023

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 3 (0m)	Sample 3 (1.0m)	Sample 3 (2.0m)	Sample 3 (2.5m)
Arsenic	mg/kg	20	100	10.2	6.1	10.4	7.3
Cadmium	mg/kg	0.4	5	0.47	<0.04	0.11	0.28
Chromium	mg/kg	40	400	34.5	9.20	20.4	19.6
Copper	mg/kg	40	400	20.3	11.5	18.0	15.4
Lead	mg/kg	50	500	18.0	6.90	12.2	10.4
Mercury	mg/kg	0.3	3	0.04	0.02	0.03	0.02
Nickel	mg/kg	20	200	38.6	17.5	29.4	24.4
Zinc	mg/kg	130	800	130.0	24.1	56.7	41.0
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	<0.001	<0.001	<0.001
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.001	<0.001	<0.001
Acenaphthene	µg/kg	100	-	<5	<5	7.6	15.4
Acenaphthylene	µg/kg	100	-	<5	<5	2.6	2.6
Anthracene	µg/kg	100	-	<5	<5	9.0	6.9

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 3 (0m)	Sample 3 (1.0m)	Sample 3 (2.0m)	Sample 3 (2.5m)
Benzo[a]anthracene	µg/kg	100	-	21.6	<5	24.9	24.2
Benzo[a]pyrene	µg/kg	100	-	23.8	<5	29.3	31.6
Benzo[b]fluoranthene	µg/kg	100	-	54.5	12.3	36.6	38.7
Benzo[e]pyrene	µg/kg	100	-	65.1	16.3	53.0	54.2
Benzo[ghi]perylene	µg/kg	100	-	84.6	19.2	77.7	80.0
Benzo[k]fluoranthene	µg/kg	100	-	20.5	<5	21.4	17.8
C1-naphthalenes	µg/kg	100	-	194.0	12.0	111.0	111.0
C1-phenanthrene	µg/kg	100	-	171.0	31.1	162.0	187.0
C2-naphthalenes	µg/kg	100	-	229.0	14.0	125.0	136.0
C3-naphthalenes	µg/kg	100	-	135.0	14.9	140.0	188.0
Chrysene	µg/kg	100	-	56.3	14.8	49.9	49.1
Dibenzo[ah]anthracene	µg/kg	100	-	10.2	<5	7.4	7.7
Fluoranthene	µg/kg	100	-	36.4	9.3	49.6	44.4
Fluorene	µg/kg	100	-	30.3	<5	17.0	27.4

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 3 (0m)	Sample 3 (1.0m)	Sample 3 (2.0m)	Sample 3 (2.5m)
Indeno[1,2,3-cd]pyrene	µg/kg	100	-	23.8	<5	17.7	19.2
Naphthalene	µg/kg	100	-	47.2	<5	18.9	20.8
Perylene	µg/kg	100	-	973.0	<5	12.0	12.3
Phenanthrene	µg/kg	100	-	138.0	20.2	101.0	140.0
Pyrene	µg/kg	100	-	45.1	12.8	63.6	56.8
Total Hydrocarbon Content (THC)	mg/kg	-	-	9.24	16.4	14.5	19.1
PCBs – Sum of ICES 7	mg/kg	0.02	0.01	0.00056	0.00056	0.00056	0.00056
PCBs – Sum of 25 Congeners	mg/kg	0.2	-	0.00201	0.002	0.002	0.002
AHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	<0.0001	<0.0001	<0.0001	<0.0001
HCB	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 3 (0m)	Sample 3 (1.0m)	Sample 3 (2.0m)	Sample 3 (2.5m)
PPTDE	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
PPDDE	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	<0.0001	<0.0001	<0.0001	<0.0001
Key	Below AL1						
	Above AL1, Below AL2						
	Above AL2						

Table 13: Sediment contamination data for Sample 4 collected in March 2023

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 4 (0m)	Sample 4 (1.0m)	Sample 4 (2.0m)	Sample 4 (3.0m)	Sample 4 (4.0m)
Arsenic	mg/kg	20	100	14.8	26.2	31.4	26.8	5.1
Cadmium	mg/kg	0.4	5	0.48	0.57	0.6	0.37	0.25
Chromium	mg/kg	40	400	32.2	49.8	59.2	50.5	22.0
Copper	mg/kg	40	400	21.7	30.2	37.9	32.6	16.4
Lead	mg/kg	50	500	42.0	60.6	75.3	63.1	10.5
Mercury	mg/kg	0.3	3	0.12	0.18	0.25	0.2	0.02
Nickel	mg/kg	20	200	23.1	26.6	31.4	26.6	25.1
Zinc	mg/kg	130	800	103	151	189	160	47.5
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.001	<0.005
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.005	0.00828	<0.001	<0.005
Acenaphthene	µg/kg	100	-	9.6	54.5	106.0	<5	7.3
Acenaphthylene	µg/kg	100	-	5.6	35.7	36.2	<5	2.5
Anthracene	µg/kg	100	-	19.6	108.0	137.0	<5	10.9

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 4 (0m)	Sample 4 (1.0m)	Sample 4 (2.0m)	Sample 4 (3.0m)	Sample 4 (4.0m)
Benzo[a]anthracene	µg/kg	100	-	43.9	237.0	263.0	14.4	34.1
Benzo[a]pyrene	µg/kg	100	-	56.6	323.0	336.0	12.8	39.5
Benzo[b]fluoranthene	µg/kg	100	-	52.3	281.0	304.0	14.2	47.2
Benzo[e]pyrene	µg/kg	100	-	44.4	242.0	247.0	17.5	61.4
Benzo[ghi]perylene	µg/kg	100	-	52.2	295.0	292.0	21.2	90.0
Benzo[k]fluoranthene	µg/kg	100	-	48.6	275.0	276.0	10.6	23.3
C1-naphthalenes	µg/kg	100	-	151.0	775.0	814.0	63.2	154.0
C1-phenanthrene	µg/kg	100	-	95.0	461.0	503.0	75.9	179.0
C2-naphthalenes	µg/kg	100	-	123.0	606.0	653.0	65.3	148.0
C3-naphthalenes	µg/kg	100	-	109.0	528.0	584.0	75.4	160.0
Chrysene	µg/kg	100	-	53.1	281.0	307.0	23.3	62.2
Dibenzo[ah]anthracene	µg/kg	100	-	9.1	51.4	52.6	<5	8.9
Fluoranthene	µg/kg	100	-	87.9	503.0	560.0	19.9	59.3
Fluorene	µg/kg	100	-	17.8	101.0	126.0	6.1	21.1

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 4 (0m)	Sample 4 (1.0m)	Sample 4 (2.0m)	Sample 4 (3.0m)	Sample 4 (4.0m)
Indeno[1,2,3-cd]pyrene	µg/kg	100	-	43.1	257.0	257.0	<5	21.7
Naphthalene	µg/kg	100	-	55.5	295.0	322.0	15.6	31.2
Perylene	µg/kg	100	-	18.9	119.0	136.0	<5	16.8
Phenanthrene	µg/kg	100	-	90.5	443.0	531.0	50.8	121.0
Pyrene	µg/kg	100	-	84.9	474.0	524.0	26.1	87.9
Total Hydrocarbon Content (THC)	mg/kg	-	-	22.5	64.9	49.3	33.5	8.90
PCBs – Sum of ICES 7	mg/kg	0.02	0.01	0.00228	0.00507	0.00707	0.00056	0.00056
PCBs – Sum of 25 Congeners	mg/kg	0.2	-	0.00537	0.01148	0.01538	0.002	0.002
AHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	<0.0001	0.0001	0.0003	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	0.0003	0.0008	0.0010	<0.0001	<0.0001
HCB	mg/kg	-	-	0.0004	0.0007	0.0010	<0.0001	<0.0001

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 4 (0m)	Sample 4 (1.0m)	Sample 4 (2.0m)	Sample 4 (3.0m)	Sample 4 (4.0m)
PPTDE	mg/kg	-	-	0.0042	0.0070	0.0103	0.0001	<0.0001
PPDDE	mg/kg	-	-	0.0008	0.0017	0.0021	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	0.0002	<0.0001	0.0034	<0.0001	<0.0001
Key	Below AL1							
	Above AL1, Below AL2							
	Above AL2							

Table 14: Sediment contamination data for Sample 5 collected in March 2023

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 5 (0m)	Sample 5 (1.0m)	Sample 5 (2.0m)	Sample 5 (3.0m)	Sample 5 (4.0m)
Arsenic	mg/kg	20	100	15.4	12.4	25.8	7.7	8.6
Cadmium	mg/kg	0.4	5	0.18	0.2	0.57	0.38	0.41
Chromium	mg/kg	40	400	32.4	21.3	46.8	28.0	22.0
Copper	mg/kg	40	400	21.6	14.2	30.0	21.4	19.2
Lead	mg/kg	50	500	41.0	28.4	58.7	16.7	13.3
Mercury	mg/kg	0.3	3	0.12	0.07	0.18	0.01	0.03
Nickel	mg/kg	20	200	22.6	15.2	25.1	33.2	45.5
Zinc	mg/kg	130	800	104	73.0	154	63.7	56.6
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	<0.005	0.008	<0.001	<0.001
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.005	0.029	<0.001	<0.001
Acenaphthene	µg/kg	100	-	45.7	26.7	155.0	14.1	<5
Acenaphthylene	µg/kg	100	-	25.8	16.3	62.0	<5	<5
Anthracene	µg/kg	100	-	84.7	46.6	215.0	10.3	<5

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 5 (0m)	Sample 5 (1.0m)	Sample 5 (2.0m)	Sample 5 (3.0m)	Sample 5 (4.0m)
Benzo[a]anthracene	µg/kg	100	-	210.0	105.0	424.0	47.9	15.1
Benzo[a]pyrene	µg/kg	100	-	267.0	125.0	507.0	70.3	21.4
Benzo[b]fluoranthene	µg/kg	100	-	242.0	112.0	432.0	104.0	65.5
Benzo[e]pyrene	µg/kg	100	-	206.0	98.9	360.0	168.0	78.2
Benzo[ghi]perylene	µg/kg	100	-	232.0	110.0	395.0	154.0	60.5
Benzo[k]fluoranthene	µg/kg	100	-	209.0	104.0	415.0	37.4	15.7
C1-naphthalenes	µg/kg	100	-	683.0	335.0	1240.0	569.0	236.0
C1-phenanthrene	µg/kg	100	-	454.0	224.0	682.0	387.0	148.0
C2-naphthalenes	µg/kg	100	-	550.0	264.0	988.0	389.0	140.0
C3-naphthalenes	µg/kg	100	-	488.0	242.0	886.0	277.0	106.0
Chrysene	µg/kg	100	-	261.0	125.0	481.0	153.0	64.0
Dibenzo[ah]anthracene	µg/kg	100	-	41.3	17.1	62.9	20.2	8.6
Fluoranthene	µg/kg	100	-	429.0	210.0	878.0	71.3	26.7
Fluorene	µg/kg	100	-	72.6	36.8	157.0	77.8	14.4

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 5 (0m)	Sample 5 (1.0m)	Sample 5 (2.0m)	Sample 5 (3.0m)	Sample 5 (4.0m)
Indeno[1,2,3-cd]pyrene	µg/kg	100	-	190.0	83.4	348.0	38.2	14.8
Naphthalene	µg/kg	100	-	259.0	125.0	464.0	147.0	80.5
Perylene	µg/kg	100	-	92.1	50.3	147.0	10.8	<5
Phenanthrene	µg/kg	100	-	396.0	184.0	794.0	324.0	146.0
Pyrene	µg/kg	100	-	410.0	201.0	835.0	116.0	39.3
Total Hydrocarbon Content (THC)	mg/kg	-	-	99.8	77.7	129	14.7	6.86
PCBs – Sum of ICES 7	mg/kg	0.02	0.01	0.00247	0.00155	0.005	0.00056	0.00056
PCBs – Sum of 25 Congeners	mg/kg	0.2	-	0.0055	0.00358	0.01141	0.002	0.002
AHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	<0.0001	<0.0001	0.0002	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	0.0003	0.0004	0.0008	<0.0001	<0.0001
HCB	mg/kg	-	-	0.0004	0.0003	0.0009	<0.0001	<0.0001

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 5 (0m)	Sample 5 (1.0m)	Sample 5 (2.0m)	Sample 5 (3.0m)	Sample 5 (4.0m)
PPTDE	mg/kg	-	-	0.0059	0.0036	0.0061	<0.0001	<0.0001
PPDDE	mg/kg	-	-	0.0008	0.0005	0.0014	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	0.0050	0.0003	0.0010	<0.0001	<0.0001
Key	Below AL1							
	Above AL1, Below AL2							
	Above AL2							

Table 15: Sediment contamination data for Sample 6 collected in March 2023

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample6 (0 m)	Sample6 (1.0 m)	Sample6 (2.0 m)	Sample6 (3.0 m)	Sample6 (4.0 m)
Arsenic	mg/kg	20	100	15.6	23.5	26.5	6	6
Cadmium	mg/kg	0.4	5	0.4	0.41	0.38	0.3	0.38
Chromium	mg/kg	40	400	33.5	42.4	28.8	21.3	27.2
Copper	mg/kg	40	400	22.2	24.8	18.3	13.3	21.5
Lead	mg/kg	50	500	42.1	54.4	39.9	9.70	15.5
Mercury	mg/kg	0.3	3	0.13	0.17	0.1	0.02	0.01
Nickel	mg/kg	20	200	25.5	25.8	19.2	24.1	33.7
Zinc	mg/kg	130	800	109	136	105	43.3	62.6
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.001	<0.001
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	0.01	<0.005	<0.001	<0.001
Acenaphthene	µg/kg	100	-	49.2	50.8	42.0	6.6	17.8
Acenaphthylene	µg/kg	100	-	23.5	33.4	22.0	<5	9.6
Anthracene	µg/kg	100	-	74.6	97.2	79.9	9.0	10.4

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample6 (0 m)	Sample6 (1.0 m)	Sample6 (2.0 m)	Sample6 (3.0 m)	Sample6 (4.0 m)
Benzo[a]anthracene	µg/kg	100	-	211.0	201.0	163.0	21.5	59.7
Benzo[a]pyrene	µg/kg	100	-	257.0	293.0	220.0	29.2	93.4
Benzo[b]fluoranthene	µg/kg	100	-	240.0	262.0	186.0	34.1	161.0
Benzo[e]pyrene	µg/kg	100	-	206.0	219.0	155.0	47.8	242.0
Benzo[ghi]perylene	µg/kg	100	-	227.0	254.0	179.0	63.8	214.0
Benzo[k]fluoranthene	µg/kg	100	-	247.0	248.0	179.0	21.5	53.8
C1-naphthalenes	µg/kg	100	-	708.0	697.0	566.0	149.0	744.0
C1-phenanthrene	µg/kg	100	-	429.0	395.0	321.0	156.0	510.0
C2-naphthalenes	µg/kg	100	-	577.0	540.0	433.0	134.0	497.0
C3-naphthalenes	µg/kg	100	-	512.0	545.0	410.0	154.0	326.0
Chrysene	µg/kg	100	-	280.0	239.0	190.0	46.2	219.0
Dibenzo[ah]anthracene	µg/kg	100	-	39.1	41.1	29.6	6.2	21.6
Fluoranthene	µg/kg	100	-	429.0	427.0	354.0	39.5	93.7
Fluorene	µg/kg	100	-	78.1	77.6	62.4	18.3	115.0

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample6 (0 m)	Sample6 (1.0 m)	Sample6 (2.0 m)	Sample6 (3.0 m)	Sample6 (4.0 m)
Indeno[1,2,3-cd]pyrene	µg/kg	100	-	180.0	209.0	158.0	15.0	49.9
Naphthalene	µg/kg	100	-	255.0	237.0	222.0	32.4	175.0
Perylene	µg/kg	100	-	90.3	100.0	79.5	15.9	14.3
Phenanthrene	µg/kg	100	-	389.0	352.0	293.0	110.0	425.0
Pyrene	µg/kg	100	-	402.0	425.0	336.0	56.9	146.0
Total Hydrocarbon Content (THC)	mg/kg	-	-	94.2	122	59.9	16.6	17.2
PCBs – Sum of ICES 7	mg/kg	0.02	0.01	0.00302	0.00443	0.00292	0.00056	0.00056
PCBs – Sum of 25 Congeners	mg/kg	0.2	-	0.00639	0.00959	0.00651	0.002	0.002
AHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	<0.0001	<0.0001	0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	0.0006	0.0008	0.0003	<0.0001	0.0001
HCB	mg/kg	-	-	0.0003	0.0005	0.0005	<0.0001	<0.0001

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample6 (0 m)	Sample6 (1.0 m)	Sample6 (2.0 m)	Sample6 (3.0 m)	Sample6 (4.0 m)
PPTDE	mg/kg	-	-	0.0048	0.0069	0.0039	<0.0001	<0.0001
PPDDE	mg/kg	-	-	0.0010	0.0015	0.0008	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	0.0014	0.0034	0.0002	<0.0001	0.0002
Key	Below AL1							
	Above AL1, Below AL2							
	Above AL2							

Table 16: Sediment contamination data for Sample 7 collected in March 2023

Contaminant	Units	Cefas Action Level		Sample Concentration		
		AL1	AL2	Sample 7 (0m)	Sample 7 (1.0m)	Sample 7 (1.4m)
Arsenic	mg/kg	20	100	15.3	5.5	1.3
Cadmium	mg/kg	0.4	5	0.67	0.28	0.43
Chromium	mg/kg	40	400	16.6	16.0	4.40
Copper	mg/kg	40	400	10.1	14.1	4.90
Lead	mg/kg	50	500	14.8	8.9	2.80
Mercury	mg/kg	0.3	3	0.02	<0.01	<0.01
Nickel	mg/kg	20	200	23.6	20.1	12.6
Zinc	mg/kg	130	800	68.2	34.3	15.4
Dibutyltin (DBT)	mg/kg	0.1	1	<0.001	<0.001	<0.001
Tributyltin (TBT)	mg/kg	0.1	1	<0.001	<0.001	<0.001
Acenaphthene	µg/kg	100	-	<5	<5	<1
Acenaphthylene	µg/kg	100	-	<5	<5	<1
Anthracene	µg/kg	100	-	3.3	<5	<1

Contaminant	Units	Cefas Action Level		Sample Concentration		
		AL1	AL2	Sample 7 (0m)	Sample 7 (1.0m)	Sample 7 (1.4m)
Benzo[a]anthracene	µg/kg	100	-	8.1	<5	<1
Benzo[a]pyrene	µg/kg	100	-	6.9	<5	<1
Benzo[b]fluoranthene	µg/kg	100	-	9.1	<5	<1
Benzo[e]pyrene	µg/kg	100	-	13.9	68.4	1.2
Benzo[ghi]perylene	µg/kg	100	-	13.4	<5	<1
Benzo[k]fluoranthene	µg/kg	100	-	5.7	<5	<1
C1-naphthalenes	µg/kg	100	-	50.6	227.0	3.3
C1-phenanthrene	µg/kg	100	-	47.8	191.0	3.5
C2-naphthalenes	µg/kg	100	-	46.4	182.0	2.6
C3-naphthalenes	µg/kg	100	-	56.8	179.0	2.7
Chrysene	µg/kg	100	-	14.6	64.0	1.3
Dibenzo[ah]anthracene	µg/kg	100	-	<5	<5	<1
Fluoranthene	µg/kg	100	-	15.1	<5	<1
Fluorene	µg/kg	100	-	<5	<5	<1

Contaminant	Units	Cefas Action Level		Sample Concentration		
		AL1	AL2	Sample 7 (0m)	Sample 7 (1.0m)	Sample 7 (1.4m)
<5	<5	<1	-			
13.9	<5	<1	-			
<5	<5	<1	-			
<5	159.0	2.5	-			
21.7	65.3	1.4	-			
20.2	8.58	3.81	-			
0.00056	0.00056	0.00056	0.01			
0.002	0.002	0.002	-			
<0.0001	<0.0001	<0.0001	-			
<0.0001	<0.0001	<0.0001	-			
<0.0001	<0.0001	<0.0001	-			
<0.0001	<0.0001	<0.0001	-			
<0.0001	<0.0001	<0.0001	-			
PPTDE	mg/kg	-	-	<0.0001	<0.0001	<0.0001

Contaminant	Units	Cefas Action Level		Sample Concentration		
		AL1	AL2	Sample 7 (0m)	Sample 7 (1.0m)	Sample 7 (1.4m)
PPDDE	mg/kg	-	-	<0.0001	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	0.0014	<0.0001	0.0002
Key	Below AL1					
	Above AL1, Below AL2					
	Above AL2					

Table 17: Sediment contamination data for Sample 8 collected in March 2023

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 8 (0m)	Sample 8 (1.0m)	Sample 8 (2.0m)	Sample 8 (2.9m)
Arsenic	mg/kg	20	100	10.8	5.9	1	<0.5
Cadmium	mg/kg	0.4	5	0.44	0.11	0.26	0.15
Chromium	mg/kg	40	400	20.2	18.9	0.90	1.00
Copper	mg/kg	40	400	13.6	13.9	3.90	5.10
Lead	mg/kg	50	500	14.1	9.10	1.40	1.50
Mercury	mg/kg	0.3	3	0.03	0.03	0.01	<0.01
Nickel	mg/kg	20	200	26.1	23.8	8.30	6.60
Zinc	mg/kg	130	800	58.4	43.9	18.0	14.6
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	<0.001	<0.001	<0.001
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.001	<0.001	<0.001
Acenaphthene	µg/kg	100	-	5.3	<1	<1	<1
Acenaphthylene	µg/kg	100	-	1.7	<1	<1	<1
Anthracene	µg/kg	100	-	7.0	<1	<1	<1

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 8 (0m)	Sample 8 (1.0m)	Sample 8 (2.0m)	Sample 8 (2.9m)
Benzo[a]anthracene	µg/kg	100	-	23.7	<1	<1	<1
Benzo[a]pyrene	µg/kg	100	-	31.1	<1	<1	<1
Benzo[b]fluoranthene	µg/kg	100	-	36.4	<1	<1	<1
Benzo[e]pyrene	µg/kg	100	-	48.3	<1	<1	<1
Benzo[ghi]perylene	µg/kg	100	-	65.0	<1	<1	<1
Benzo[k]fluoranthene	µg/kg	100	-	20.0	<1	<1	<1
C1-naphthalenes	µg/kg	100	-	116.0	<1	<1	1.3
C1-phenanthrene	µg/kg	100	-	137.0	<1	<1	<1
C2-naphthalenes	µg/kg	100	-	108.0	<1	<1	<1
C3-naphthalenes	µg/kg	100	-	111.0	<1	<1	<1
Chrysene	µg/kg	100	-	48.6	<1	<1	<1
Dibenzo[ah]anthracene	µg/kg	100	-	5.8	<1	<1	<1
Fluoranthene	µg/kg	100	-	38.4	<1	<1	<1
Fluorene	µg/kg	100	-	15.0	<1	<1	<1

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 8 (0m)	Sample 8 (1.0m)	Sample 8 (2.0m)	Sample 8 (2.9m)
Indeno[1,2,3-cd]pyrene	µg/kg	100	-	18.0	<1	<1	<1
Naphthalene	µg/kg	100	-	24.9	<1	<1	<1
Perylene	µg/kg	100	-	13.4	<1	<1	<1
Phenanthrene	µg/kg	100	-	92.8	<1	<1	<1
Pyrene	µg/kg	100	-	58.6	<1	<1	<1
Total Hydrocarbon Content (THC)	mg/kg	-	-	5.14	10.9	<1	<1
PCBs – Sum of ICES 7	mg/kg	0.02	0.01	0.00056	0.00056	0.00056	0.00056
PCBs – Sum of 25 Congeners	mg/kg	0.2	-	0.0	0.0	0.0	0.0
AHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	<0.0001	<0.0001	0.0001	<0.0001
HCB	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 8 (0m)	Sample 8 (1.0m)	Sample 8 (2.0m)	Sample 8 (2.9m)
PPTDE	mg/kg	-	-	0.0003	<0.0001	<0.0001	<0.0001
PPDDE	mg/kg	-	-	0.0001	<0.0001	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	<0.0001	<0.0001	<0.0001	<0.0001
Key	Below AL1						
	Above AL1, Below AL2						
	Above AL2						

Table 18: WFD Assessment of the water quality results taken on 31 of March 2023 and 18 May 2023

	Units	The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015	Environmental Quality Standards (EQS)	SW1	SW2	SW3	SW1	SW2	SW3
Sampled Date				**31 March 2023**			**18 May 2023**		
Sample Code					27786434	27786435	28018759	28018758	28018760
National Grid Reference (NGR)				TA 20679 15370	TA 19948 14978	TA 21315 14966	TA 20679 15370	TA 19948 14978	TA 21315 14966
Weather				Overcast	Overcast	Overcast	Clear skies	Clear skies	Clear skies
Notes				Unable to sample[7]					

[7] SW1 water quality sampling was not possible during the first round, due to access issues as the bridge on the Applicants land was too high for sample collection using a telescopic sampling pole.

	Units	The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015	Environmental Quality Standards (EQS)	SW1	SW2	SW3	SW1	SW2	SW3
Sampled Date				**31 March 2023**			**18 May 2023**		
Inorganics									
Nitrate as N	mg/l				12.1	8.55	2.38	0.588	4.57
Nitrite as NO_2	mg/l				0.111	0.15	0.197	0.178	0.203
Phosphate (Ortho as P) (Filtered)	mg/l	0.064			0.093	0.453	0.0852	0.0274	0.354
Alkalinity, Total as $CaCO_3$	mg/l				223	243	255	177	268
BOD (Unfiltered) (Biochemical Oxygen Demand)	mg/l	5 (90^{th} Percentile)			<1	<1	<1	<1	<1
COD (Chemical Oxygen Demand)	mg/l				16.1	14.6	22.7	638	28.2

	Units	The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015	Environmental Quality Standards (EQS)	SW1	SW2	SW3	SW1	SW2	SW3
Sampled Date				**31 March 2023**			**18 May 2023**		
Electrical conductivity *(lab)	uS/cm				896	914	1070	2400	1260
pH by Meter	pH units	<=9 (95th Percentile)			8.32	8.2	8.28	7.92	8.15
Turbidity	NTU				25.1	8.12	7.32	73.7	13.3
Ammoniacal Nitrogen as N	mg/l	0.6			<0.2	<0.2	0.314	1.3	0.202
Metals									
Dissolved Calcium (Filtered)	mg/l				133	148	140	244	148
Dissolved Arsenic (Filtered)	ug/l	50 long term average	25		0.642	0.796	1.15	2.02	1.26

	Units	The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015	Environmental Quality Standards (EQS)	SW1	SW2	SW3	SW1	SW2	SW3
Sampled Date				**31 March 2023**			**18 May 2023**		
Dissolved Boron (Filtered)	ug/l				105	75.2	169	1870	202
Dissolved Cadmium (Filtered) (depending on water hardness classes) [8]	ug/l	0.25 (Class 5)			<0.08	<0.08	<0.08	0.272	<0.08
Dissolved Copper (Filtered)	ug/l	1 bioavailable	3.76 µg/l dissolved, where DOC ≤1mg		2.58	1.32	2.41	3.53	2.61
Dissolved Iron (Filtered)3	ug/l	1					0.0367	<0.019	0.0204

[8] For cadmium and its compounds (No 6) the EQS values vary depending on the hardness of the water as specified in five class categories (≤ 0.08 ug/l Class 1: < 40 mg $CaCO_3$/l, 0.08 ug/l Class 2: 40 to < 50 mg $CaCO_3$/l, 0.09 ug/l Class 3: 50 to < 100 mg CaCO3/l, 0.15 ug/l Class 4: 100 to < 200 mg $CaCO_3$/l and 0.25 ug/l Class 5: ≥ 200 mg $CaCO_3$/l)
[3]Further analysis was required due to change in river conditions

	Units	The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015	Environmental Quality Standards (EQS)	SW1	SW2	SW3	SW1	SW2	SW3
Sampled Date				**31 March 2023**			**18 May 2023**		
Dissolved Lead (Filtered)	ug/l	1.2 (bioavailable)			<0.2	0.264	<0.2	<0.2	0.318
Dissolved Mercury	ug/l	0.07			<0.01	<0.01	<0.01	<0.01	<0.01
Dissolved Nickel	ug/l	4 (bioavailable)			2.12	2.07	1.95	2.42	4.1
Dissolved Selenium (Filtered)	ug/l				<1	<1	<1	<1	<1
Dissolved Zinc (Filtered)	ug/l	10.9	6.8		5.92	6.38	4.24	16.7	10.7
Total Arsenic	ug/l	50	25		<2	<2	<2	3.41	<2
Total Boron	ug/l				117	70.7	176	1900	213
Total Cadmium (depending on water hardness classes)	ug/l	0.25 (Class 5)			<0.5	<0.5	<0.5	<0.5	<0.5

	Units	The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015	Environmental Quality Standards (EQS)	SW1	SW2	SW3	SW1	SW2	SW3
Sampled Date				**31 March 2023**			**18 May 2023**		
Total Chromium	ug/l	3.4 (Cr VI)			<3	<3	7.62	10.3	12.7
Total Copper	ug/l	1 bioavailable			3.97	2.02	2.37	5.62	3.37
Total Iron	ug/l	1					0.45	1.92	0.603
Total Lead	ug/l	1.2 (dissolved = 1.2 bioavailable			1.63	1.61	<1	6.27	3.15
Total Mercury	ug/l	0.07 (dissolved, 0.07 bioavailable)			<0.02	<0.02	<0.02	<0.02	<0.02
Total Nickel	ug/l	4 (dissolved, 4ug/l bioavailable)			3.3	1.94	2.64	4.29	3.91
Total Phosphorus	ug/l	196			183	333	118	263	468
Total Selenium	ug/l				<1	<1	<1	<1	<1

	Units	The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015	Environmental Quality Standards (EQS)	SW1	SW2	SW3	SW1	SW2	SW3
Sampled Date				**31 March 2023**			**18 May 2023**		
Total Zinc	ug/l	10.9 (bioavailable)			13.7	7.66	8.05	33.3	22.3
Polycyclic Aromatic Hydrocarbon (PAH) Mass Spectrometry (MS)									
Acenaphthylene	ug/l				<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthene	ug/l				<0.005	<0.005	<0.005	<0.005	<0.005
Fluorene	ug/l				<0.005	<0.005	<0.005	<0.005	<0.005
Phenanthrene	ug/l				0.0135	0.00639	<0.005	0.012	<0.005
Anthracene	ug/l	0.1			<0.005	<0.005	<0.005	<0.005	<0.005
Fluoranthene	ug/l	0.0063			0.0309	0.0244	0.0124	0.0263	0.0202

	Units	The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015	Environmental Quality Standards (EQS)	SW1	SW2	SW3	SW1	SW2	SW3
Sampled Date				**31 March 2023**			**18 May 2023**		
Pyrene	ug/l				0.0484	0.0347	<0.005	0.0287	0.0291
Benzo(a)anthracene	ug/l				0.0206	0.013	<0.005	0.0129	<0.005
Chrysene	ug/l				0.0373	0.0243	<0.005	0.0179	<0.005
Benzo(a)pyrene	ug/l	0.00017*			<0.002	0.0212	<0.002	0.0197	<0.002
Indeno(1,2,3-cd)pyrene	ug/l				0.0154	0.0121	<0.005	0.0114	<0.005
Dibenzo(a,h)anthracene	ug/l				<0.005	<0.005	<0.005	<0.005	<0.005
PAH 16 Total	ug/l				0.216	0.192	<0.082	0.169	<0.082
Benzo(b)fluoranthene	ug/l	0.017			0.0348	0.0279	<0.005	0.0239	0.0194
Benzo(g,h,i)perylene	Ug/l	0.0082			<0.005	0.014	<0.005	0.0084	<0.005

	Units	The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015	Environmental Quality Standards (EQS)	SW1	SW2	SW3	SW1	SW2	SW3
Sampled Date				31 March 2023			18 May 2023		
Benzo(k)fluoranthene	ug/l	0.017			0.0152	0.0143	<0.005	0.0079	<0.005
Napthalene	ug/l				<0.01	<0.01	<0.01	<0.01	<0.01
Non Metals									
Total Organic Carbon	mg/l				6.53	3.9	5.71	<3	5.33
Sulphate as SO_4	mg/l	400,000 (ug/l) = 400 mg/l			151	160	210	1250	270
Chloride	mg/l	250,000 ug/l = 200 mg/l			66.2	70.8	105	8280	133
Total Cyanide	mg/l	1ug/l = 0.001 mg/l			<5	<5	<5	<5	<5

	Units	The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015	Environmental Quality Standards (EQS)	SW1	SW2	SW3	SW1	SW2	SW3
Sampled Date				**31 March 2023**			**18 May 2023**		
EPH (Extractable Petroleum Hydrocarbons)									
EPH (DRO) (C10-C40) (diss.filt)	µg/l				108	107	<100	107	126
EPH Range >C10 - C40 (aq)	µg/l				<100	<100	119	<100	173
Miscellaneous Organics									
Branched PFOS	µg/l				0.0265	0.000906	0.0468	0.0277	0.00214
Linear PFOS (1763-23-1)	µg/l				0.0566	0.00126	0.082	0.049	0.00303
PFOA (335-67-1) (Perfluorooctanoic acid)	µg/l				0.00748	0.00198	0.0114	>0.0065	0.00353

	Units	The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015	Environmental Quality Standards (EQS)	SW1	SW2	SW3	SW1	SW2	SW3
Sampled Date				**31 March 2023**			**18 May 2023**		
Total PFOS (Perfluorooctane sulfonic acid)	µg/l	36			0.0831	0.00216	0.129	0.0767	0.00517
Aliphatics >C16-C35 Aqueous	µg/l				<10	<10	<10	<10	<10

4.4.19. The Environment Agency’s ‘Catchment Data Explorer (Ref 1-10) provides data on water quality measurements taken at sampling points around England. These can be from coastal or estuarine waters, rivers, lakes, ponds, canals or groundwaters. They are taken for a number of purposes including compliance assessment against discharge permits, investigation of pollution incidents or environmental monitoring.

4.4.20. The nearest saline water sampling point to the Project (with adequate temporal coverage and a reasonable amount of determinands measured) is Clean Site - Ti02 Monitoring Point, 1985 (sampling ID: AN-CLNMON1). This is shown on Plate 4. Contaminant concentrations measured in the water at this location are shown in **Table 19**. These are compared against EQS as described under The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015, specifically annual average (“AA”) concentrations and/or maximum allowable concentrations (“MAC”) to provide an indication of the water quality measured at the sampling point.

4.4.21. As indicated in **Table 18**, metal concentrations reported between 2015 and 2023 were typically below respective EQSs. There were some exceedances related to the AA EQS for tributyl tin (“TBT”) and the Humber Estuary transitional water body was failing chemical status due to excessive concentrations of TBT in 2019. Benzo(a)pyrene and benzo(g,h,i)perylene were failing their respective MAC EQSs between 2015 and 2023 (with the exception of 2022 for benzo(a)pyrene). Benzo(b)fluoranthene and benzo(k)fluoranthene were also failing their MAC EQSs in 2015 to 2023 (with the exception 2019). The Humber Lower transitional water body was failing chemical status due to benzo(a)pyrene, benzo(b)fluoranthene and benzo(g-h-i)perylene in 2019.

Table 19: Concentration range, mean and number of water samples collected between 2015 and 2023 by the Environment Agency for contaminants measured near the Project

Parameter	Unit	EQS	Results	2015	2016	2017	2018	2019	2020	2021	2022	2023
Arsenic	µg/l	25 (AA)	Range	1.9 - 2.39	2.32 - 2.32		1.94 - 2.59	1.95 - 1.95				2.2 - 2.2
			Average	2.10	2.32	-	2.28	1.95	-	-	-	2.20
			n	3	1		3	1				1
Cadmium	µg/l	0.2 (AA)	Range	0.044 - 0.101	0.041 - 0.066	0.062 - 0.063	0.0461 - 0.144	0.0408 - 0.0706		0.058 - 0.12	0.051 - 0.08	0.045 - 0.081
			Average	0.08	0.05	0.06	0.09	0.06	-	0.08	0.07	0.06
			n	9	4	2	9	3		8	12	4
Chromium (VI)	µg/l	0.6 (AA); 32 (MAC)	Range	<0.3	<0.3		<0.3	<0.3				
			Average	0.3	0.3	-	0.3	0.3	-	-	-	-
			n	1	1		3	1				
Copper	µg/l	3.76 (AA)	Range	1.7 - 2.62	2.5 - 3.2	2.35 - 2.96	1.99 - 2.52	1.59 - 1.59		1.7 - 3.2	1.7 - 3.7	1.8 - 4.2
			Average	2.01	2.85	2.66	2.20	1.59	-	2.19	2.28	2.93
			n	3	2	2	3	1		8	12	4

Parameter	Unit	EQS	Results	2015	2016	2017	2018	2019	2020	2021	2022	2023
Lead	µg/l	1.3 (AA); 14 (MAC)	Range	<0.04 - 0.074	0.04 - 0.098	-	<0.04 - 0.0876	0.0656 - 0.108	-	0.046 - 0.12	<0.04 - 0.088	0.054 - 0.09
			Average	0.06	0.07		0.05	0.08		0.07	0.07	0.08
			n	9	3		9	3		8	12	4
Mercury	µg/l	0.07 (MAC)	Range	<0.01 - 0.01	<0.01 - 0.01	-	<0.01 - 0.01	<0.01 - 0.01	-	-	-	0.013 - 0.013
			Average	0.01	0.01		0.01	0.01				0.013
			n	9	3		9	3				1
Nickel	µg/l	8.6 (AA); 34 (MAC)	Range	1.25 - 2.29	1.14 - 2.11	1.79 - 2.11	1.4 - 2.48	1.35 - 1.8	-	1.4 - 7.8	1.3 - 7.2	1.3 - 2
			Average	1.69	1.61	1.95	1.80	1.54		2.43	2.05	1.73
			n	9	4	2	9	3		8	12	4
Zinc	µg/l	7.9 (AA)	Range	2.2 - 4.7	3.47 - 4.86	4.22 - 4.86	2.21 - 4.32	4.05 - 4.05	-	1.9 - 5.7	1.9 - 4.6	3 - 4.1
			Average	3.79	4.17	4.54	3.15	4.05		3.29	3.16	3.68
			n	3	2	2	3	1		8	12	4
Tributyltin (TBT)	µg/l	0.0002 (AA);	Range	0.00021 - 0.00096	<0.0002 - 0.0008	0.00029 - 0.00092	<0.0002 - 0.00081	0.00025 - 0.00032	-	<0.0002 - 0.00023	<0.0002 - 0.00042	<0.0002 - 0.00026

Parameter	Unit	EQS	Results	2015	2016	2017	2018	2019	2020	2021	2022	2023
		0.0015 (MAC)	Average	0.0004	0.0004	0.0005	0.0003	0.0003		0.0002	0.0003	0.0002
			n	9	12	3	10	2		8	12	4
Benzo(a)-pyrene	µg/l	0.00017 (AA); 0.0027 (MAC)	Range	>0.002 - <0.01	>0.002 - 0.22	0.00055 - >0.05	<0.0004 - 0.0874	0.0146 - 0.017	-	<0.0004 - 0.033	<0.0004 - 0.026	0.00077 - >0.05
			Average	0.01	0.04	0.03	0.03	0.02		0.01	0.01	0.02
			n	12	12	3	8	3		8	12	4
Benzo(g,h,i)-perylene	µg/l	0.00082 (MAC)	Range	>0.002 - <0.01	0.002 - 0.239	0.00063 - 0.05	0.00057 - 0.0911	0.0149 - 0.0183	-	0.0004 - 0.03	<0.0004 - 0.024	0.00054 - >0.05
			Average	0.01	0.04	0.02	0.03	0.02		0.01	0.01	0.02
			n	12	12	3	8	2		8	12	4
Benzo(b)-fluoranthene	µg/l	0.017 (MAC)	Range	>0.002 - <0.01	>0.002 - 0.196	0.00056 - >0.05	0.00045 - 0.0743	0.013 - 0.0139	-	0.00052 - 0.03	<0.0004 - 0.021	0.00071 - 0.048
			Average	0.01	0.04	0.02	0.03	0.01		0.01	0.01	0.02
			n	12	12	3	8	2		8	12	4
Benzo(k)-fluoranthene	µg/l	0.0063 (AA); 0.017 (MAC)	Range	>0.002 - <0.01	>0.002 - 0.111	<0.0004 - >0.05	0.0004 - 0.0379	0.00701 - 0.00746	-	<0.0004 - 0.016	<0.0004 - 0.012	<0.0004 - 0.028
			Average	0.01	0.02	0.02	0.01	0.01		0.01	0.00	0.01

Parameter	Unit	EQS	Results	2015	2016	2017	2018	2019	2020	2021	2022	2023
			n	12	12	3	8	2		8	12	4
Fluoranthene	µg/l	0.12 (MAC)	Range	>0.002 - <0.01	>0.002 - 0.142	0.00103 - >0.05	<0.0004 - 0.0953	0.0163 - 0.0185	-	0.0015 - 0.026	0.0012 - 0.023	0.0015 - 0.03
			Average	0.01	0.04	0.03	0.03	0.02		0.01	0.01	0.02
			n	12	12	3	8	3		8	12	4
Hexa-chlorobenzene	µg/l	0.05 (MAC)	Range	<0.001 - 0.001	<0.0001 - 0.001	<0.0001 - 0.005	-	-	-	-	-	-
			Average	0.001	0.0005	0.002						
			n	12	7	3						
Hexa-chlorobutadiene	µg/l	0.6 (MAC)	Range	<0.003 - 0.003	<0.0001 - <0.003	<0.0001 - <0.005	-	-	-	-	-	-
			Average	0.003	0.001	0.002						
			n	12	7	3						
BDE 28	µg/l	-	Range	<0.00006 - <0.00006	<0.00006 - <0.00006	<0.00006 - <0.00006	-	-	-	-	-	-
			Average	0.00006	0.00006	0.00006						
			n	7	7	3						

Parameter	Unit	EQS	Results	2015	2016	2017	2018	2019	2020	2021	2022	2023
BDE 47	µg/l	-	Range	<0.00006 - 0.0001	<0.00006 - <0.00006	<0.00006 - <0.00006	-	-	-	-	-	-
			Average	0.0001	0.00006	0.00006						
			n	7	7	3						
BDE 99	µg/l	-	Range	<0.00006 - 0.00017	<0.00006 - <0.00006	<0.00006 - <0.00006	-	-	-	-	-	-
			Average	0.0001	0.00006	0.00006						
			n	7	7	3						
BDE 100	µg/l	-	Range	<0.00006 - 0.00017	<0.00006 - <0.00006	<0.00006 - <0.00006	-	-	-	-	-	-
			Average	0.0001	0.00006	0.00006						
			n	7	7	3						
BDE 153	µg/l	-	Range	<0.00006 - 0.00007	<0.00006 - <0.00006	<0.00006 - <0.00006	-	-	-	-	-	-

Parameter	Unit	EQS	Results	2015	2016	2017	2018	2019	2020	2021	2022	2023
			Average	0.0001	0.00006	0.00006						
			n	7	7	3						
BDE 154	µg/l	-	Range	<0.00006 - <0.00006	<0.00006 - <0.00006	<0.00006 - <0.00006	-	-	-	-	-	-
			Average	0.00006	0.00006	0.00006						
			n	7	7	3						
Data from sampling point 'Clean Site - Ti02 Monitoring Point, 1985, ID: AN-CLNMON1)' in the Humber Estuary, obtained from the Environment Agency's 'Water Quality Archive' (Ref 1-39)												

Capital and maintenance dredging

4.4.22. As sediment is disturbed and re-distributed into the water column, any sediment-bound contaminants may be partitioned from the solid phase (i.e., bound to sediments or suspended matter), to the dissolved or aqueous phase (i.e. dissolved in pore water or overlying water) (Ref 1-40). To determine the maximum dissolved fraction of contaminants released into the water column, it is necessary to consider the relative potential for each contaminant to change from one phase to another (i.e. contaminant adsorbed to sediment surfaces to dissolved in the water), referred to as the partition coefficient. Partition coefficients describe the ratio between the freely dissolved concentration in water and another environmental phase (e.g. sediment-bound) at equilibrium. It should be noted that desorption rates of contaminants from suspended sediments into the water column are highly regulated by hydrodynamics, biogeochemical processes, and environmental conditions (redox, pH, salinity, and temperature) (Ref 1-41). Due to the variability in environmental conditions, a wide range of partition coefficients are reported in the literature.

4.4.23. There is potential for sediment-bound contaminants to be re-mobilised in the water column following an increase in SSC during the proposed capital and maintenance dredging. Sediment disturbance will be caused at the bed by abrasion pressure from the dredging equipment (i.e. bucket). As noted in **Chapter 16: Physical Processes [TR030008/APP/6.2]**, maximum SSCs are associated with the disposal activities (with relatively small increases in SSC arising from the dredging itself). Peak excess SSC levels resulting from the disposal activities are predicted to be around 600 to 800 mg/l at HU060 licensed disposal site (this site is likely to receive the vast majority of the more unconsolidated dredged material, whereas HU056 will be used for any consolidated boulder/glacial clay, see **Chapter 2: The Project [TR030008/APP/6.2]**). Increased SSCs arising from the dredge operations will be of lower magnitude and persist for a shorter distance (and time) than that from the disposal. Therefore, while a different activity, the estimated maximum incremental SSC for disposal activities is used in the calculations below on a precautionary basis.

4.4.24. A Microsoft Excel Spreadsheet tool developed by APEM Ltd, referred to as SeDiChem (short for Sediment Disturbance on Chemical status), was provided by the Environment Agency to support consideration of potential uplift in contaminant concentrations following disturbance of contaminated sediments in estuarine and marine waters.

4.4.25. **Table 20** provides a summary of the SeDiChem tool outputs, with empirical calculations based on a number of simple assumptions. This includes general site parameters (e.g., net flow rate of 20,736,000m^3/day based on an average for the Humber of 240m^3/second (Ref 1-42)), maximum incremental SSC (800mg/l), worst case (or precautionary) partition coefficients from suggested literature and sediment quality from samples collected within the proposed dredge area. In addition, background water quality concentrations have been inputted based on Environment Agency monitoring data from nearby monitoring station Clean Site - Ti02 Monitoring Point, 1985 (sampling ID: AN-CLNMON1) (see **Table 20**), averaged across the most recent five years of data.

4.4.26. Overall, the potential uplift in contaminant concentrations is anticipated to be minimal, and unlikely to present a significant issue at the water body level. Where contaminants are already reported to be failing within the water body (e.g., PBDEs, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g-h-i)perylene, mercury and its compounds and TBT compounds), any disturbance of sediments during dredging activities will result in an uplift effectively causing a ‘worse failure’. However, the scale of this deterioration is considered to be small and highly localised. As a percentage increase of EQS headroom (i.e., the capacity for the concentration to increase whilst still remaining below the environmental threshold), the increased concentration due to dredging is likely to be less than 1% for mercury, and 70% for TBT. For benzo(a)pyrene, benzo(b)fluoranthene, benzo(g-h-i)perylene, and benzo(k)fluoranthene, the background dissolved concentration is above the EQS, therefore no headroom is available according to the SeDiChem tool. However, as a percentage increase of background concentrations, the increase in concentration of these contaminants as a result of dredging is calculated as <1%. Furthermore, these calculations are based on a maximum sediment concentration and worst-case partition coefficients. It is, therefore, considered unlikely that the proposed dredging activity would cause even a short-term deterioration in water quality with regards to contaminants.

4.4.27. Furthermore, the proposed works will not directly introduce contaminants to the marine environment and standard practice measures (Ref 1-43), will be used to prevent/reduce the potential for accidental spillages throughout the dredging process.

4.4.28. In conclusion, dredging activities are not expected to lead to a deterioration of the assessed water quality elements within the Humber Lower transitional water body, nor prevent this water body from meeting its WFD objectives.

Table 20: Potential contaminant concentrations as a result of the Project in the Humber Lower transitional water body based on SeDiChem tool outputs

Parameter	Max. Sediment Concentration (mg/kg)	Current WFD Status	Partition Coefficient (l/kg)	EQS (µg/l)	Dissolved Concentration (Background* and Dredging) (µg/l)	Concentration Increase due to Dredging (% of Background)	Concentration Increase as % of EQS Headroom
Arsenic	31.40	High	40	25 (dissolved)	3.374	45.42%	4.65%
Cadmium	0.67	Good	100	0.2 (dissolved)	0.099	10.28%	8.41%
Chromium	59.20	High	79	32 (dissolved)	1.273	324.34%	3.07%
Copper	37.90	High	3,162	3.76 (dissolved)	2.946	0.56%	1.96%
Lead	75.30	Good	35,481	14 (dissolved)	0.083	3.56%	0.02%
Mercury	0.25	Fail	6,310	0.07 (dissolved)	0.013	0.40%	0.09%
Nickel	45.50	Good	500	34 (dissolved)	2.549	4.91%	0.38%
Zinc	189.00	High	12,589	8.8 (dissolved)	4.560	0.44%	0.60%
Benzo(a)pyrene	0.51	Fail	9,120	0.027 (total)	0.040	0.18%	No headroom
Benzo(b) fluoranthene	0.43	Fail	20,795	0.017 (total)	0.040	0.07%	No headroom
Benzo(g,h,i) perylene	0.40	Fail	18,904	0.00082 (total)	0.040	0.07%	No headroom

Parameter	Max. Sediment Concentration (mg/kg)	Current WFD Status	Partition Coefficient (l/kg)	EQS (µg/l)	Dissolved Concentration (Background* and Dredging) (µg/l)	Concentration Increase due to Dredging (% of Background)	Concentration Increase as % of EQS Headroom
Benzo(k) fluoranthene	0.42	Good	19,859	0.017 (total)	0.02	0.14%	No headroom
Fluoranthene	0.88	Good	1,396	0.12 (total)	0.041	2.10%	1.05%
Tributyltin (TBT)	0.03	Fail	49	0.0015 (total)	0.001	190.94%	69.43%
Hexachloro-benzene	0.001	Good	5,978	0.05 (total)	0.002	0.011%	0.00%
* Maximum annual average between 2015 and 2023							

Marine Piling

4.4.29. As discussed for dredging above and in **Chapter 16: Physical Processes [TR030008/APP/6.2]**, maximum SSCs are associated with the disposal activities. Peak excess SSC levels resulting from the disposal activities are around 600-800 mg/l at the HU060 licensed disposal site. Increased SSCs arising from the dredge operations will be of lower magnitude and persist for a shorter distance (and time) than that from the disposal. The anticipated increased SSC concentration related to piling will be less than that that of dredging and disposal, as compaction will occur in the sediment rather than complete disturbance. **Table 20** calculates the potential for sediment-bound contaminants to increase the concentration of in-water contaminants and, even when applying SSCs of 800 mg/l, the proposed piling works are considered unlikely to result in significant water quality impacts.

4.4.30. In conclusion, piling is not expected to lead to a deterioration of the assessed water quality elements within the Humber Lower transitional water body, nor prevent this water body from meeting its WFD objectives.

Disposal

4.4.31. As discussed for dredging above and in **Chapter 16: Physical Processes [TR030008/APP/6.2]**, maximum SSCs are associated with the disposal activities. Peak excess SSC levels resulting from the disposal activities are around 600-800 mg/l at the HU060 licensed disposal site. **Table 20** calculates the potential for sediment-bound contaminants to increase the concentration of in-water contaminants and, when applying SSCs of 800 mg/l, the proposed disposal activities are considered unlikely to result in significant water quality impacts.

4.4.32. In conclusion, disposal activities are not expected to lead to a deterioration of the assessed water quality elements within the Humber Lower transitional water body, nor prevent this water body from meeting its WFD objectives.

Surface water run-off

4.4.33. Potential effects could arise from migration, caused by site works, of potential contaminants into the Humber Estuary, North Beck Drain or Habrough Marsh Drain.

4.4.34. Accidental leaks of fuels and oils from vehicular plant equipment, stored liquids, and other polluting materials have the potential to be mobilised to groundwaters and surface water via vertical and lateral migration or surface run-off. These risks will be mitigated, however, by the adoption of good practice as set in the guidance document Construction Industry Research and Information Association ("CIRIA") C741 and to be secured through the implementation of the site-specific **Outline Construction Environmental Management Plan ("CEMP")** (**[TR030008/APP/6.5]**).

4.4.35. Disturbance and/or removal of ground materials could potentially remove, relocate or mobilise potential contaminants, e.g. during foundation construction, earthworks and excavations. Soil samples from Made Ground with recorded exceedances of the human health Generic Assessment Criteria ("GAC") for Commercial Land Use indicating potential sources of contamination within Made Ground. Exceedances were also identified in leachate samples from Made Ground and reworked natural strata, indicating further sources of contamination that could be mobilised during foundation works, earthworks and excavations. These exceedances are the same, or within one order of magnitude of the GAC, EQS Freshwater and Drinking Water Standards ("DWS") criteria and hence are considered to present a low risk. However, exceedances of chromium ("VI"), thiocyanate and ammoniacal nitrogen were two orders of magnitude above the DWS and EQS Freshwater criteria.

4.4.36. There is potential for creation of new terrestrial Source-Pathway-Receptor linkages (e.g. pile foundation construction through existing Made Ground into underlying natural soils or bedrock) into an aquifer (comprised of coarse or sandy soils (superficial deposits) or Chalk (bedrock)). With regards to piling for foundation purposes, no dewatering of the Chalk aquifer is expected, however it is anticipated that appropriate piling risk assessment will be undertaken prior to commencement of the works as outlined within the **Outline Construction Environmental Management Plan (CEMP)** (**[TR030008/APP/6.5]**).

4.4.37. The creation of new potential contaminant linkages or mobilisation of existing contaminants may result from exposure of soils/increases in rainwater infiltration through changes in ground cover/in excavations or bulk earthworks. Leachate exceedances of ammoniacal nitrogen, copper and nickel were identified in Made Ground and reworked natural deposits within the same exploratory hole location, indicating a potential pathway from Made Ground to reworked natural deposits.

4.4.38. A Remediation Strategy (**Appendix 21C: Outline Remediation Strategy [TR030008/APP/6.4]**) will be put in place for the relevant landside parts of the Project which will set out the measures required to mitigate any significant/unacceptable contaminant linkages (risks) and how the earthworks stage of construction will be undertaken during the landside works (see the **Chapter 12: Ground Conditions and Land Quality [TR030008/APP/6.2]** for further detail).

4.4.39. Impacts to water quality could also potentially occur during operation as a result of accidental spills from the handling or leakage of fuels, lubricants, stored chemicals and process liquids. Standard industry practices will be adopted to mitigate these potential impacts and controlled by the conditions attached to the Environmental Permit which would need to be granted by the Environment Agency. Such procedures and monitoring are also likely to form part of the processes defined in the Environmental Management System.

4.4.40. In conclusion, surface-water run-off is not expected to lead to a deterioration of the assessed water quality elements within the Humber Lower transitional water body and/or the North Beck Drain river water body, nor prevent these water bodies from meeting their WFD objectives.

4.5. Protected Areas

4.5.1. The Project, specifically the marine element of the works and the dredge disposal sites, overlaps with the Humber Estuary SAC, SPA and Ramsar site (collectively forming the Humber European Marine Site). The Wash and North Norfolk Coast Special Area of Conservation is also located outside the Humber Estuary. As the Project is neither directly connected with nor necessary to the management of these sites, it is considered to have the potential to result in a likely significant effect ("LSE") on these European sites.

4.5.2. The potential impact pathways on these sites and interest features have been assessed in the **Habitat Regulations Assessment [TR030008/APP/7.6]** ("HRA") in the context of the nature and scale of the construction and operational activities associated with the Project. The geographic location of the Project activities relative to the interest features and the sensitivities of the interest features to these environmental pressures/changes have also been taken into account. Based on available evidence and the mitigation measures outlined in the HRA and **Chapter 9: Nature Conservation (Marine Ecology) [TR030008/APP/6.2]**, there is considered to be no potential for an adverse effect on integrity ("AEOI") of the interest features or conservation objectives of European sites either alone and/or in-combination with other plans and projects.

4.5.3. The Project will not introduce nitrates to the marine environment (such inputs are typically associated with wastewater discharges and agricultural activities) and, therefore, will not impact nearby surface and groundwater NVZs.

4.5.4. In conclusion, the Project is not expected to lead to a deterioration of the assessed protected area designations within the Humber Lower transitional water body and/or North Beck Drain river water body, nor prevent these water bodies from meeting respective WFD objectives.

4.6. Invasive Non-native Species

4.6.1. As with most activities which occur in the marine environment, there is potential risk that the Project could result in the introduction or spread of INNS. Non-native species have the potential to be transported into the local area on the hulls of the vessels if they have operated in other water bodies, as well as ballast water which can transfer organisms from one water body to another. Nevertheless, given the nature of the Project, the ballast water exchange requirements expected to have been carried out as described under the Ballast Water Management Convention[9] and the fact that potential biosecurity risks are managed through ABP's existing biosecurity management procedures, the risk in terms of introducing or transferring INNS is considered to be insignificant. Biosecurity control measures during construction have also been detailed within the **Outline Construction Environmental Management Plan [TR030008/APP/6.5]**). It is noted that the installation of piles will introduce a new

[9] The UK has ratified this convention and it is domestically implemented under the Merchant Shipping (Control and Management of Ships' Ballast Water and Sediments) Regulations 2022. The MCA has also issued guidance on the regulations - MGN 675 (M+F) The merchant shipping (control and management of ships' ballast water and sediments) regulations 2022 - GOV.UK.(www.gov.uk).

hard surface which could be colonised by INNS, although this does not present a new opportunity for introduction/spread of INNS given the abundance of similar habitat types/surfaces at the Port of Immingham.

4.6.2. Consequently, the probability of the introduction and spread of INNS from the Project is considered low and it is not expected to lead to a deterioration in status of the Humber Lower transitional water body and/or North Beck Drain river water body, nor prevent these water bodies from meeting respective WFD objectives.

5. Conclusion

5.1.1. Based upon the information presented within this WFD Compliance Assessment, and considering the additional information presented in **Chapter 16: Physical Processes**, **Chapter 17: Marine Water and Sediment Quality**, **Chapter 9: Nature Conservation (Marine Ecology)**, and **Chapter 18: Water Quality, Coastal Protection, Flood Risk and Drainage [TR030008/APP/6.2]**, it is concluded that the Project is not likely to have a permanent effect on the status of WFD parameters that are significant at water body level. Therefore, deterioration to the current status of the Humber Lower transitional water body and/or North Beck Drain river water body is not predicted. Itis also not predicted that these water bodies will be prevented from achieving future WFD status objectives.

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