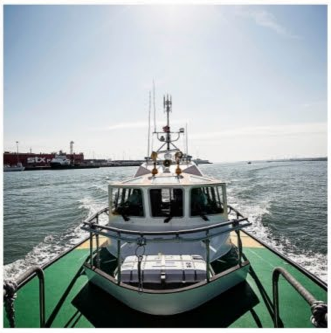
Port of Mostyn

Mostyn Energy Park Extension

Environmental Statement

Appendix 7.1 Water Framework Directive Compliance Assessment

January 2023



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		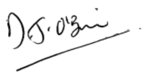

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Notice

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1 Introduction

1.1 Introduction

ABPmer was commissioned by the Port of Mostyn to undertake a Water Framework Directive (WFD) compliance assessment to determine whether the proposed Mostyn Energy Park Extension (MEPE) Project complies with the objectives of the WFD. The information presented in this appendix, together with the Environmental Statement (ES), will support the application for a marine licence. Figure 1 shows the location of the proposed development and surrounding WFD water bodies.

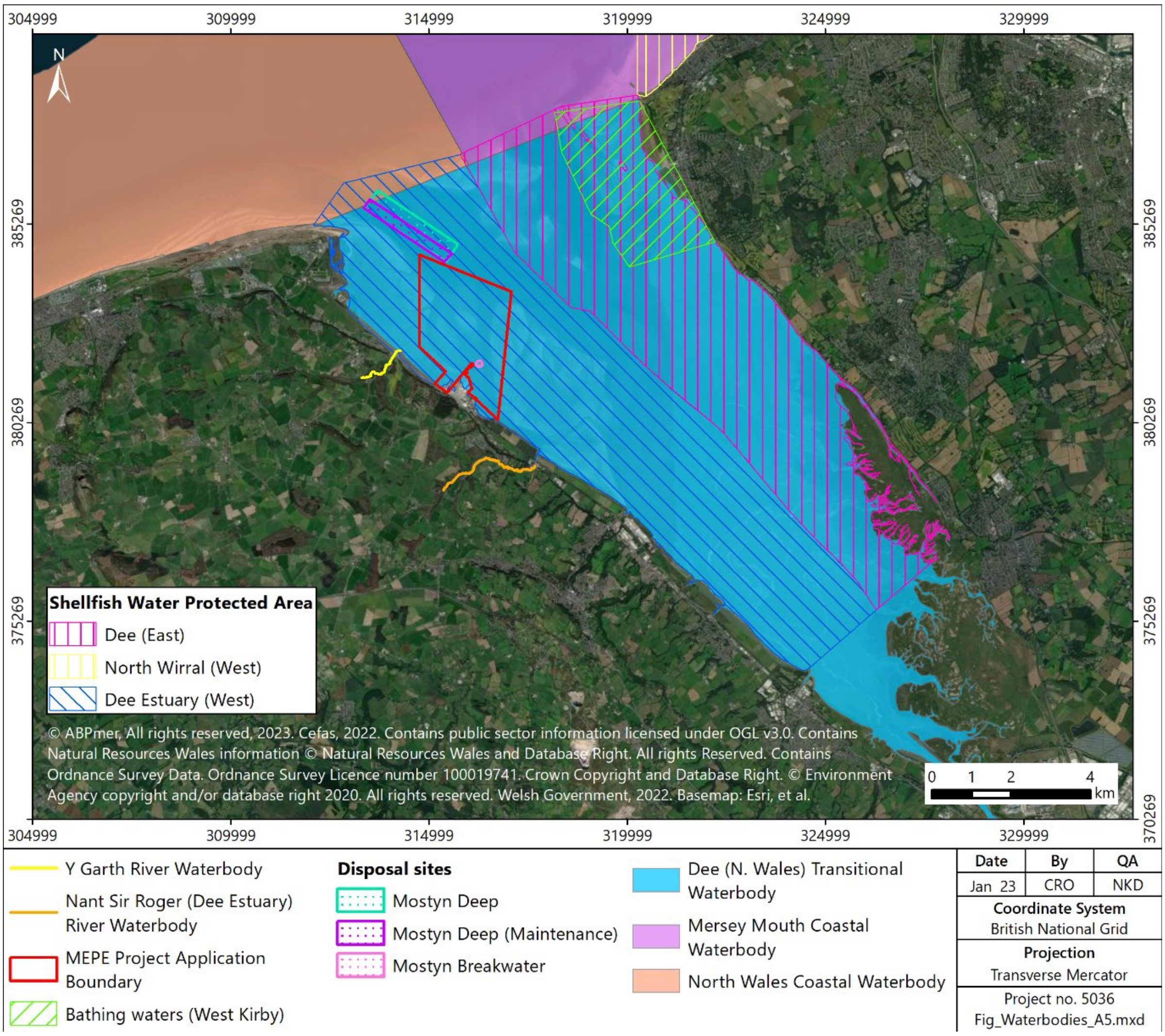

Figure 1. Water Framework Directive (WFD) waterbodies and WFD protected areas in vicinity of MEPE Project

1.2 Water Framework Directive

The WFD (2000/60/EC) came into force in 2000 and establishes a framework for the management and protection of Europe's water resources. It was implemented in England and Wales through the Water Environment (WFD) (England and Wales) Regulations 2003 (the Water Framework Regulations). These Regulations were revoked and replaced in April 2017 by the Water Environment (WFD) (England and Wales) Regulations 2017 .

The overall objective of the WFD is to achieve good status (GS) in all inland, transitional, coastal and ground waters by 2021, unless alternative objectives are set and there are appropriate reasons for time limited derogation.

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, the water body 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).

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.

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 environmental quality standards (EQS) for a specified list of 'priority' and 'priority hazardous' substances. These substances were first established by the Priority Substances Directive (PSD) (2008/105/EC) which came into force in January 2009.

The PSD sets objectives, amongst other things, for the reduction of these substances through the cessation of discharges or emissions. As required by the WFD and PSD, a proposal to revise the list of priority (hazardous) substances was submitted by the European Commission in 2012. Subsequently, an updated PSD (2013/39/EU) was published in 2013, identifying new priority substances, setting EQSs for those newly identified substances, revising the EQS for some existing substances in line with scientific progress and setting biota EQSs for some existing and newly identified priority substances. The updated PSD is transposed into UK legislation through the Water Environment (WFD) (England and Wales) (Amendment) Regulations 2015, which entered into force in September 2015, and explained in the WFD (Standards and Classification) Directions (England and Wales) 2015.

In addition to surface water bodies, the WFD also incorporates groundwater water bodies. Groundwaters are assessed against different criteria compared to surface water bodies since they do not support ecological communities (i.e., it is not appropriate to consider ecological status of a groundwater). Therefore, groundwater water bodies are classified as 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.

River Basin Management Plans (RBMPs) are a requirement of the WFD, setting out measures for each river basin district to maintain and improve quality in surface and groundwater water bodies where necessary. In 2009, the Environment Agency published the first cycle (2009 to 2015) of RBMPs for England and Wales, reporting the status and objectives of each individual water body. NRW subsequently published updated RBMPs for Wales as part of the second cycle (2015 to 2021), as well as providing water body classification results from 2015 and interim classifications via the Water Watch Wales website. The latest RBMPs cover the period from 2021 to 2027, reporting the status and objectives of each individual water body for cycle 3.

The MEPE Project is located within the Dee (N. Wales) transitional water body (see Figure 1). It is also located within the Dee Carboniferous Coal Measures groundwater water body. These water bodies are located within the Dee River Basin District which is reported in the Dee RBMP (NRW, 2022). A small portion of the Mostyn Deep disposal site (IS102) also overlaps with the North Wales coastal water body. This water body is located within the Western Wales River Basin District which is reported in the Western Wales RBMP (NRW, 2022).

Consideration of WFD requirements 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 proposed development to impact WFD water bodies, specifically referring to the following environmental objectives of the WFD:

- Prevent deterioration in status of all surface water bodies (Article 4.1 (a)(i));
- 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));
- 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));
- Reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances (Article 4.1 (a)(iv));
- Prevent or limit the input of pollutants into groundwater and prevent deterioration of the status of all groundwater water bodies (Article 4.1 (b)(i));
- Protect, enhance and restore all groundwater water bodies and ensure a balance between abstraction and recharge of groundwater (Article 4.1 (b)(ii));
- Ensure the achievement of objectives in other water bodies is not compromised (Article 4.8); and
- Ensure compliance with other community environmental legislation (Article 4.9).

The Environment Agency (2016b) 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:

- Screening: excludes any activities that do not need to go through the scoping or impact assessment stages;
- Scoping: identifies the receptors that are potentially at risk from an activity and need impact assessment; and
- 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.

NRW signposts applicants for marine licences in Wales to this guidance. This WFD Compliance Assessment for the proposed development follows the format specified in this guidance.

2 Screening

2.1 Project description

The proposed development will involve marine works and associated landside works.

Marine works – The marine works will comprise the construction of a new quay wall so as to provide, together with a retained section of existing quay, a continuous berthing frontage. This will involve undertaking a capital dredge to create a new berth pocket along the new quay wall and the dredging of the existing berth pocket along the existing quay wall. The existing main navigation channel will also need to be deepened as is currently permitted under the Port's existing maintenance dredge and disposal licence (DML1542v2) to provide access to vessels that will use the new berthing frontage. A proportion of the suitable capital dredge arisings is proposed to be reused as infill material for the landside works (see below) and the remainder disposed of at the existing marine disposal site. A Roll-on Roll-off (Ro-Ro) pontoon linkspan may need to be constructed and two alignment options are being considered, one set within the new quay wall and one along the existing harbour frontage. In addition, four existing dolphins (piles) at the Port may need to be relocated and installed within the harbour area to create a berth for Service Operation Vessels (SOVs) that provide operation and maintenance (O&M) requirements for the offshore wind sector. Once the constructed quay is operational, a maintenance dredging and disposal programme for the new berth, harbour area and navigation channel will be put in place. The maintenance dredge area comprises a polygon that shows where maintenance dredging of the navigation channel may take place in response to the natural movement of the existing channels in the area. The maintenance dredge material will be disposed of at the existing marine disposal sites and/or reused as is currently undertaken under the existing maintenance dredge and disposal licences.

Landside works – The landside works will involve an infill behind the newly created quay wall (i.e. a small reclamation of the harbour area). The reclaimed area will comprise hardstanding that will be used as a storage/laydown area. There is no requirement for any other associated landside infrastructure.

The consenting process will comprise the following:

i) The majority of the proposed development will take place below mean high water springs (MHWS) and within the Statutory Harbour Area (SHA), therefore, a marine licence will be required from the marine licensing authority (Natural Resources Wales (NRW)) under the Marine and Coastal Access Act 2009. This single marine licence will subsume the existing dredging related marine licences for ongoing maintenance dredge and disposal activities in the harbour and its approaches (DML1542v2 and DML2001). It will also replace the existing construction marine licence to build a new quay and extend the MEP development (CML1343v3); and

ii) As a Statutory Undertaker and under the Harbours Act 1964, the Port of Mostyn has Permitted Development Rights which allows it to undertake development associated with the movement of goods and passengers. As there are no non-marine activities being required for the MEPE Project (other than those covered by the permitted development rights), there is no need for a planning application to be submitted to the local planning authority.

2.2 Potentially affected water bodies

To determine which water bodies would potentially be affected by the proposed development, all surface and groundwater water bodies located within the Zone of Influence (ZoI) of the proposed development were recorded. The ZoI in relation to water and sediment quality impacts is considered to be the wider Dee Estuary (see Chapter 7 of the ES). Therefore, the following water bodies were initially screened in:

- Dee (N.Wales) transitional water body (ID: GB531106708200);
- North Wales coastal water body (ID: GB641011650000);
- Y Garth river water body (ID: GB111067057060);
- Nant Sir Roger (Dee estuary) river water body (ID: GB111067057050); and
- Dee Carboniferous Coal Measures groundwater water body (ID: GB41102G204800).

The Dee (N.Wales) transitional water body overlaps specifically with the proposed development (Figure 1). A small portion of the north west edge of the Mostyn Deep disposal site (IS102) also overlaps with the North Wales coastal water body, though the majority lies within the Dee (N. Wales) transitional water body. Both water bodies are screened into the assessment.

Given the nature and scale of activities (i.e., piling, dredging and disposal within transitional water body), it is considered unlikely that there would be a significant non-temporary effect on the Dee Carboniferous Coal Measures groundwater water body, which lie beneath the southern bank of the Dee Estuary. It is noted that this groundwater water body covers a large proportion of the Dee River Basin District, and thus the MEPE Project is considered unlikely to cause deterioration in status at the water body level. Therefore, groundwater water bodies have been screened out of the assessment and will not be discussed further.

Y Garth river water body and Nant Sir Roger (Dee estuary) river water bodies drain into the Dee Estuary. These water bodies are beyond the normal tidal limit (NTL) or behind a sluice/weir. Therefore, they have been screened out of this WFD compliance assessment as the proposed development is unlikely to result in adverse effects.

Table 1 provides a summary of the Dee (N. Wales) transitional water body, including current water body status (overall, ecological and chemical) and parameters currently failing to achieve good status.

Table 1. Dee (N.Wales) transitional water body summary table

Water Body Name	Dee (N.Wales)
Water Body ID	GB531106708200
Water Body Type	Transitional
Water Body Area	109.29 km^2
Hydromorphological Designation	HMWB
Protected Area Designations	Conservation of Wild Birds Directive (Special Protection Area, SPA), Habitats and Species Directive (Special Area of Conservation, SAC), Bathing Water Directive, Shellfish Water Directive
Overall Status	Moderate
Ecological Status/Potential	Good
Chemical Status	Moderate
Parameters Not At Good Status	Brominated dyphenylether (BDPE Calc.) (moderate); Polyaromatic Hydrocarbons (PAH) (moderate);
Higher Sensitivity Habitats	Mussel beds, including blue and horse mussel (36.77 ha); Polychaete reef (1.29 ha); Saltmarsh (2647.83 ha).
Lower Sensitivity Habitats	Cobbles, gravel, and shingle (4.29 ha); Intertidal soft sediment (8239.72 ha); Rocky shore (44.17 ha); Subtidal rocky reef (0.86 ha); Subtidal soft sediments (679.37 ha).
Phytoplankton Status	Good
History of Harmful Algae	Yes

It is recorded as a heavily modified waterbody (HMWB) due to navigation, ports and harbours use. This means 'ecological potential' is applied rather than 'ecological status'. The current (2021) overall status of the waterbody is 'moderate', with an ecological potential of 'good', and a chemical status of 'moderate'. The overall, ecological and chemical status/potential 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), then the status for that water body is reported at that level. The reason for the 'moderate' chemical status is based on priority hazardous substances, brominated diphenylethers (BDPE), and polyaromatic hydrocarbons (PAHs).

Table 2 provides a summary of the North Wales coastal water body, including current water body status (overall, ecological and chemical) and parameters currently failing to achieve good status. It is recorded as a HMWB due to coastal protection. This means 'ecological potential' is applied rather than 'ecological status'. The current (2021) overall status of the waterbody is 'moderate', with an ecological potential of 'moderate', and a chemical status of 'moderate'. The reason for the 'moderate' ecological status is based on the biological quality element phytoplankton, and the reason for the 'moderate' chemical status is based on priority hazardous substance mercury.

Table 2. North Wales coastal water body summary table

Water Body Name	North Wales
Water Body ID	GB641011650000
Water Body Type	Coastal
Water Body Area	146.28 km^2
Hydromorphological Designation	HMWB
Protected Area Designations	Conservation of Wild Birds Directive (Special Protection Area, SPA), Habitats and Species Directive (Special Area of Conservation, SAC), Bathing Water Directive, Shellfish Water Directive
Overall Status	Moderate
Ecological Status/Potential	Moderate
Chemical Status	Moderate
Parameters Not At Good Status	Phytoplankton and Mercury
Higher Sensitivity Habitats	-
Lower Sensitivity Habitats	Cobbles, gravel, and shingle (3,133 ha); Intertidal soft sediment (782 ha); Rocky shore (61 ha); Subtidal rocky reef (56 ha); Subtidla Boulder field (6 ha) Subtidal soft sediments (10,492 ha).
Phytoplankton Status	Moderate
History of Harmful Algae	History of harmful algae unknown

2.3 Protected areas

The WFD and Water Framework Regulations require that activities are also in compliance with other relevant retained EU legislation, such as the Habitats Directive (92/43/EEC as amended), Birds Directive (2009/147/EC), Ramsar Convention, Bathing Water Directive (2006/7/EC), Nitrates Directive (91/676/EEC), Urban Waste Water Treatment Directive (91/271/EEC) and the provisions of the Shellfish Waters Directive (2006/113/EC) (now repealed and integrated into the WFD).

2.3.1 Nature Conservation Designations

The Conservation of Habitats and Species Regulations 2017 (as amended) transpose the Habitats 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), Special Protection Areas (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.

The MEPE Project falls within the boundaries of the Dee Estuary SAC, SPA and Ramsar site (
Figure 2).

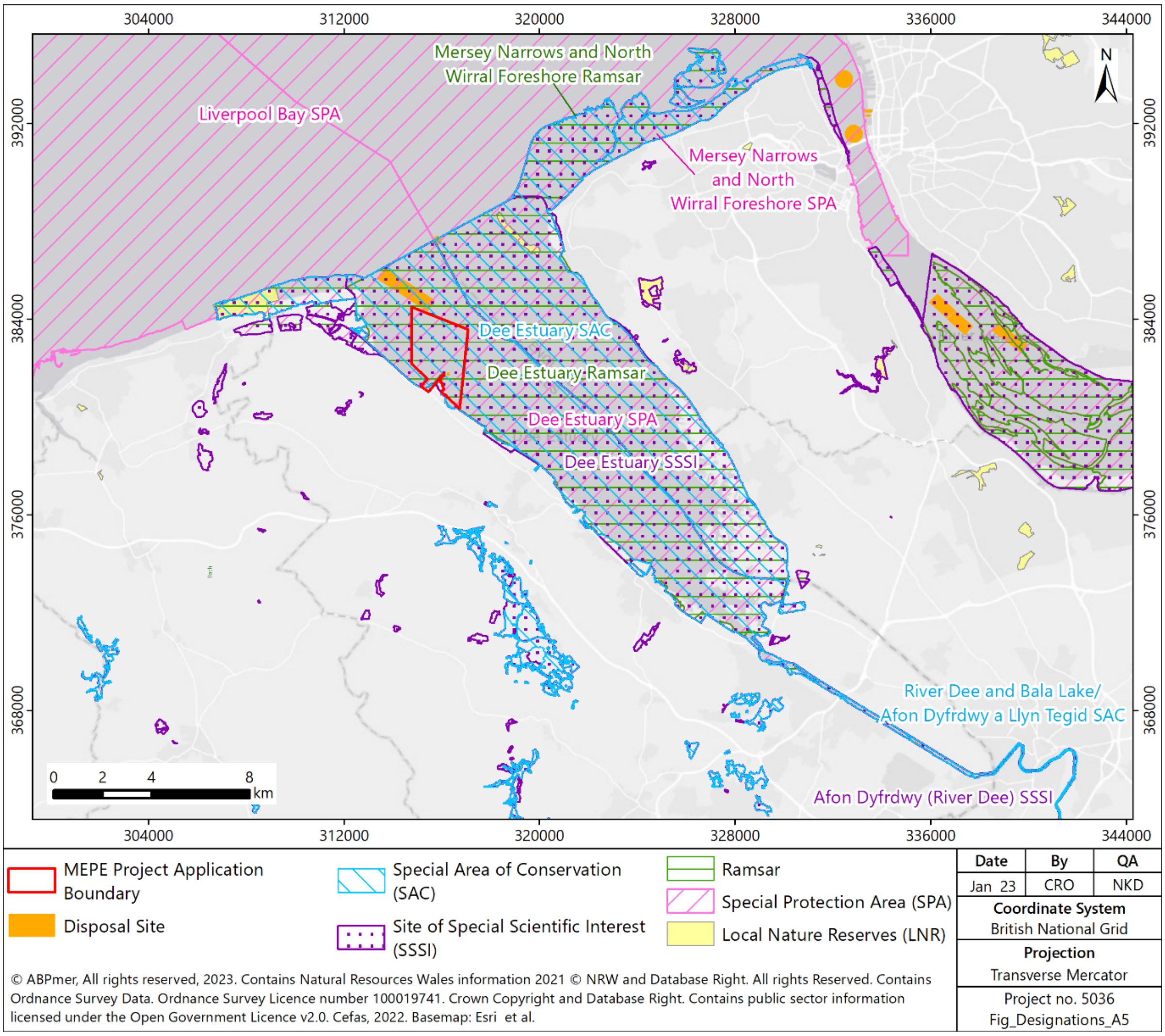

Figure 2 **European/Ramsar designated sites within the study area**

2.3.2 Bathing Water Directive

The revised Bathing Water Directive (2006/7/EC) came into force in 2006, updating the microbiological and physico-chemical standards set by the original Bathing Water Directive (76/160/EEC) and the process used to measure/monitor water quality at identified bathing waters. It is implemented in England and Wales under the Bathing Water Regulations 2013 (as amended). The revised Bathing Water

Directive focuses on fewer microbiological indicators, whilst setting higher standards, compared to those of the 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).

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[1] (as amended). 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.

The closest designated bathing water to the proposed development within the study area is West Kirby, located approximately 7 km north east of the proposed development (Figure 1). West Kirby was assessed as having 'excellent' bathing water quality between 2017 and 2021 (Environment Agency, 2022).

2.3.3 Shellfish Waters Directive

The Shellfish Waters Directive (2006/113/EC) was repealed in December 2013 and subsumed within the WFD. However, the Shellfish Water Protected Areas (England and Wales) Directions 2016 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 100 ml of shellfish flesh and intravalvular liquid.

The Directions also requires 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 Directions).

The proposed development and marine disposal sites overlap the Dee (West) Shellfish Water Protected Area (NRW, 2022; Figure 1).

2.3.4 Nitrates Directive

The Nitrates Directive (91/676/EEC) is implemented in Wales under the Nitrate Pollution Prevention Regulations 2013 (as amended). It 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). Under the Nitrates Directive, surface waters are identified if too much nitrogen has caused a change in plant growth which affects existing plants and animals and the use of the water body.

There are no Nitrate Vulnerable Zones (NVZs) in the vicinity of the proposed development and marine disposal sites.

2.3.5 Urban Waste Water Treatment Directive

The Urban Waste Water Treatment Directive (91/271/EEC) is implemented in England and Wales 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

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

of waters receiving the discharges. In general, the Urban Waste Water Treatment Directive 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 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.

There are no Sensitive Areas (Eutrophic) designated under the Urban Waste Water Treatment Directive in the vicinity of the proposed development and marine disposal sites.

3 Scoping

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

- Hydromorphology;
- Biology (habitats);
- Biology (fish);
- Water quality;
- Protected areas; and
- Invasive non-native species (INNS).

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.

3.1 Hydromorphology

Hydromorphology is the physical characteristics of 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 proposed development. As at least one hydromorphological consideration indicates that a risk could be associated with these works, this receptor has been scoped into the impact assessment (Section 4).

Table 3. Hydromorpholgy risk issues in the study area water bodies

Hydromorphology Considerations	Hydromorphology Risk Issue(s)	
	Dee (N. Wales)	North Wales
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 high'). Impact assessment not required.	No (morphology status 'not high'). 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 proposed development). Requires impact assessment.	Yes (potential changes to hydromorphology as a result of proposed development). Requires impact assessment.
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 (reason for hydromorphological designation is 'coastal protection'). No impact assessment required.

3.2 Biology (habitats)

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 (habitats) considerations and associated risk issues for the proposed development. As the biology (habitats) considerations indicate that a risk could be associated with this proposed development, this receptor has been scoped into the assessment (Section 4).

Table 4. Biology (Habitats) risk issues in the study area water bodies

Biology (Habitats) Considerations	Biology (Habitats) Risk Issue(s)	
	Dee (N. Wales)	North Wales
Is the footprint of the activity 0.5 km² or larger?	Yes. Requires impact assessment.	No. Impact assessment not required.
Is the footprint of the activity 1% or more of the water body's area?	Yes. Requires impact assessment.	No. Impact assessment not required.
Is the footprint of the activity within 500 m of any higher sensitivity habitat?	Yes (Mussel beds including blue and horse mussel, and Saltmarsh, within 500 m). Requires impact assessment.	No. Impact assessment not required.
Is the footprint of the activity 1% or more of any lower sensitivity habitat?	Yes. Requires impact assessment.	No. Impact assessment not required.

3.3 Biology (fish)

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 proposed development. As the biology (fish) considerations indicate that a risk could be associated with these works, this receptor has been scoped into the assessment (Section 4).

Table 5. Biology (fish) risk issues in the study area water bodies

Biology (Fish) Considerations	Biology (Fish) Risk Issue(s)	
	Dee (N. Wales)	North Wales
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".	No. Impact assessment not required.
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 (dredge and piling works will impact upon fish behaviour) Requires impact assessment.	N/A
Consider if your activity could cause entrainment or impingement of fish?	Yes (dredging works may cause entrainment or impingement of fish). Requires impact assessment.	N/A

3.4 Water quality

Consideration should be made regarding whether phytoplankton status and harmful algae could be affected by the proposed development, 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 for the proposed development. As at least one water quality consideration indicates that a risk could be associated with this proposed development, this receptor has been scoped into the impact assessment (Section 4).

Table 6. Water quality risk issues in the study area water bodies.

Water Quality Considerations	Water Quality Risk Issue(s)	
	Dee (N. Wales)	North Wales
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.
Consider if your activity is in a water body with a phytoplankton status of moderate, poor or bad?	No (phytoplankton classification is currently good). Impact assessment not required.	Yes. Requires impact assessment.
Consider if your activity is in a water body with a history of harmful algae?	Yes (the water body does have a history of harmful algae). Requires impact assessment.	No (harmful algae history unknown). 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, disposal and piling). Requires impact assessment.	Yes (potential for sediment-bound chemicals above Cefas AL1 to be disturbed and dispersed during dredge disposal). 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

Consideration should be made regarding whether WFD protected areas are at risk from your activity, including SACs and SPAs (European sites), as well as bathing waters, shellfish water protected areas, and nutrient sensitive areas. Table 7 presents a summary of protected area considerations and associated risk issues for the proposed development. As the protected areas considerations indicate that a risk could be associated with these works, this receptor has been scoped into the impact assessment (Section 4).

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

Protected Area Considerations	Protected Area Risk Issue(s)	
	Dee (N. Wales)	North Wales
Consider if your activity is within 2 km of any WFD protected area?	Yes (overlap with SPAs, SACs, Shellfish Water Protected Area). Impact assessment required.	Yes (overlap with SPAs, SACs, Shellfish Water Protected Area). Impact assessment required.

3.6 Invasive non-native species (INNS)

Consideration should be made regarding whether there is a risk the activity 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 development. As the INNS considerations indicate that a risk could be associated with these works, this receptor has been scoped into the impact assessment (Section 4).

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

INNS Considerations	INNS Risk Issue(s)	
	Dee (N. Wales)	North Wales
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

An impact assessment should be 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:

- Hydromorphology;
- Biology (habitats);
- Biology (fish);
- Water quality;
- Protected areas; and
- Invasive non-native species (INNS).

Each of these WFD parameters has been evaluated in order to determine whether the proposed activities might cause deterioration in 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.

4.1 Hydromorphology

Changes in hydromorphology may occur as a result of the capital and maintenance dredge, disposal of material, as well as the presence of the new quay wall and dredge pocket. A detailed physical processes assessment has been undertaken for the proposed development (Chapter 6 of the ES) and is briefly summarised here.

The greatest increase in suspended sediment concentrations (SSC) from the piling, dredging and disposal activities will occur during the 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). This is typically the same scenario that occurs for the existing maintenance dredging of the existing berths/approach channel, which is generally undertaken on a regular basis (on average, twice monthly).

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 berth and approach channel will be monitored.

Marginal changes to hydrodynamics (local flow speed) are likely to result from the MEPE facility within, and adjacent to, the proposed berth pocket and within the approach channel. Slight changes in flow speed are predicted to extend around 2 km up-estuary of the Port and down-estuary across the Mostyn Channel and Salisbury Bank. The largest predicted magnitude of change is anticipated within the berth pocket itself (particularly towards the northern end).

Hydrodynamic forcing within (and adjacent to) the proposed MEPE facility will only be marginally altered and, therefore, changes in the sediment pathways will be small. Predicted changes to future sediment transport are greatest within the proposed dredge pocket and deepened approach channel, which may require future maintenance dredging to ensure sufficient underkeel clearance for vessels on berth. Outside the proposed berth pocket and approach channel, the proposed development has limited impact on the baseline sediment transport pathways.

Marginal changes to significant wave height (Hs) are likely to result from the MEPE facility and approach channel deepening. The extent of impact is generally constrained to the areas within, and adjacent to, the dredge works. For the assessed extreme event, slight changes in wave height (typically less than ±5-10 % of baseline values) are predicted to extend around 500 m either side of the approach channel and around 200 m up-estuary of the proposed berth pocket. The largest predicted magnitude of change is within the reclamation area (as a result of the reclaim itself) and within the dredged berth pocket/ approach channel.

As a result of a less intensive dredge programme (and an overall lower predicted dredge volume), future maintenance dredging will result in smaller changes in SSC and sedimentation (within the dredge plumes and at the disposal site(s)) compared to the capital dredge (as described above). Furthermore, the predicted impacts from future maintenance dredging will be similar to that which already arises from the ongoing maintenance of the existing Port and channel areas.

Overall, the proposed development will not result in any significant changes in hydromorphology. The proposed development is, therefore, not expected to lead to a deterioration of the assessed hydromorphological elements within the Dee (N. Wales) transitional water body or North Wales coastal water body, nor prevent these water bodies from meeting their WFD objectives.

4.2 Biology (habitats)

A detailed assessment on benthic habitats has been undertaken for the proposed development (Chapter 8 of the ES) and is briefly summarised in the sub-sections below.

WFD higher sensitivity habitat 'mussel beds' are shown on the Magic Map Application[2] within the vicinity of the MEPE Project. The Phase 1 habitat survey (see Chapter 8 of this ES) recorded rock and boulder-sized slag waste deposits which were colonised by the bladder wrack *Fucus vesiculosus*, along with barnacles and patches of mussels *Mytilus edulis*. The lower shore consisted predominantly of barnacle covered rock-sized slag deposits with aggregations of mussels *Mytilus edulis*. WFD higher sensitivity habitat 'saltmarsh' is also shown on the Magic Map Application within the vicinity of the MEPE Project, however, saltmarsh was not recorded within the project-specific surveys.

4.2.1 Habitat loss

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

Both intertidal and subtidal habitats are sensitive to physical loss at locations where new structures are introduced onto the seabed (i.e., within the development 'footprint' of these structures). The significance of such losses will vary on a site-by-site basis in response to differences in the extent and duration of the losses as well as the relative value of the habitats in question. The value of the habitats

2 https://magic.defra.gov.uk/magicmap.aspx

is, in turn, reflected by the species that are present and level of statutory and non-statutory protection afforded to them.

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

The area to be reclaimed consists of the following habitats:

- Intertidal hard substrate habitat (0.27 ha): The eastern side of the breakwater comprises tipped slag waste deposits which have partly fragmented into hard substrate of varying sizes (rock, boulders and cobble-sized deposits) grading into sand and silt closer to the lower shore. This artificial habitat was colonised by algae (including wracks *Fucus* spp.), barnacles, blue mussel *Mytilus edulis* aggregations, periwinkles *Littorina littorea*, shore crabs *Carcinus maenas* and also the common starfish *Asterias rube*ns on the lower shore around the sublittoral fringe. This habitat provides a similar ecological function to the 'estuarine rocky habitats' Habitat of Principal Importance in Wales listed under the NERC Act 2006 Section 42 and is also considered to be of some functional value for feeding and roosting waterbirds such as Turnstone. Naturally formed rocky habitat is also relatively limited within the Dee Estuary;
- Intertidal mud habitat (2.57 ha): Intertidal habitat adjacent to the eastern side of the breakwater in the area of the ferry Ro-Ro terminal and old Airbus berthing facility consisted of sandy mud habitat which was fluid in nature and highly impoverished with a very low number of species recorded within it. Although this soft/fluid sandy mud habitat did not have the standard and more stable structure and form characteristic of intertidal mudflat, it should be noted that 'Intertidal mudflats' are a Habitat of Principal Importance in Wales listed under the NERC Act 2006 Section 42 and mudflat 'mudflats and sandflats not covered by seawater at low tide' is a qualifying feature of the Dee Estuary SAC and supporting habitat of the Dee SPA and Ramsar. However, all the species recorded in the samples are considered commonly occurring, not protected and typical of estuarine mudflat habitat. Furthermore, the number of species and abundance levels recorded in the samples are much lower than have been recorded in the ecologically richer and more stable mudflat habitats of the nearby local area such as on the Mostyn Bank. This soft/fluid sandy mud is, therefore, considered to comprise a poorer quality and more unstable habitat that is not representative of the ecological structure and function of intertidal mudflat found beyond the immediate area of the harbour. This mud habitat is also considered to be of limited functional value for coastal waterbirds; and
- Subtidal channel habitat (0.65 ha): The subtidal benthic samples from within the channel consisted predominantly of slightly gravelly sand or slightly gravelly muddy sand mud. Samples were typically impoverished and characterised by low numbers of the polychaete Nephtys sp. (particularly Nephtys hombergii), oligochaete *Tubificoides benedii*, nematodes and juvenile blue mussel *Mytilus edulis*. These characterising species dominated the assemblage and contributed almost entirely to the total abundances of organisms recorded at most of the sites. No subtidal species considered nationally rare or protected were recorded, with the assemblages observed considered characteristic of estuarine communities found more widely in the Dee Estuary.

Capital dredging will also cause a direct loss of 1.34 ha of intertidal habitat which will be changed to subtidal habitat as a result of the deepening of the berth pocket required for the new quay wall. The habitat in this area (which is known as 'Bug Bank') consists of low elevation and dynamic sandflat habitat. The project-specific intertidal benthic survey recorded a highly impoverished faunal assemblage characterised by very low numbers of mobile crustaceans (such as *Eurydice pulchra* and *Corophium volutator*), errant polychaetes (such as *Nephtys* spp.) and gastropods (such as the bivalve *Kurtiella* *bidentata*). These species are considered commonly occurring in the region and typical of tide swept sandflat habitat. The mobile sandflat habitat on Bug Bank is also considered highly disturbed as a result of tide swept nature of this area (causing a high degree of sediment mobility) and also due to ongoing maintenance dredging of Bug Bank. These factors prevent the establishment of a more species rich habitat in the area (Tillin, 2018). This habitat is, therefore, considered to be of limited functional value for species at higher trophic levels in terms of feeding resources (such as fish and coastal waterbirds).

In conclusion, habitat loss associated with the proposed development is not expected to lead to a deterioration of the assessed biological (habitat) elements within the Dee (N. Wales) transitional water body or North Wales coastal water body, nor prevent these water bodies from meeting their WFD objectives.

4.2.2 Changes to subtidal habitat as a result of removal of seabed

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

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

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

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

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

Recolonisation of the benthic habitat is expected to occur over a relatively short period of time based on an understanding of the benthic community present in the area and the life history strategies of the species. The project-specific subtidal survey (see Section 8.6.2 of Chapter 8 and Appendix 8.1) recorded an impoverished benthic community characterised by low numbers of the polychaete *Nephtys* sp.

(particularly *Nephtys hombergii)*, oligochaete *Tubificoides benedii*, nematodes and juvenile blue mussel *Mytilus edulis*. These characterising species dominated the assemblage and contributed almost entirely to the total abundances of organisms recorded at most of the sites. Other species recorded included the bivalve *Limecola balthica* and polychaete *Eteone longa*. These species are typically fast growing and/or have rapid reproductive rates which allow populations to fully re-establish in typically less than 1 to 2 years and for some species within a few months (De-Bastos, 2016b; Tillin and Mainwaring, 2016; Tillin and Ashley, 2018). The benthic communities would, therefore, be expected to recolonise the dredge footprint relatively quickly. All the species recorded are also considered commonly occurring and not protected, with the faunal assemblage recorded also considered characteristic of subtidal habitats found more widely in this section of the Dee Estuary (GoBe Consultants Ltd., 2011; ERM, 2009).

Maintenance dredging, however, will cause an ongoing source of seabed disturbance, albeit in the localised areas that require regular dredging. Benthic data suggests that the shallow sandy channel habitats in the Dee Estuary are generally relatively impoverished which is likely to reflect the existing high levels of natural physical disturbance in the area due to strong near bed tidal currents and sediment transport (see Section 8.6.2 in Chapter 8 of the ES).

In conclusion, the removal of seabed during dredging associated with the proposed development is not expected to lead to a deterioration of the assessed biological (habitat) elements within the Dee (N. Wales) transitional water body or North Wales coastal water body, nor prevent these water bodies from meeting their WFD objectives.

4.2.3 Changes to habitats as a result of sedimentation

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

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

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

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

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

The majority of habitat located in close proximity to the proposed dredge footprint on Salisbury Bank (adjacent to the Port of Mostyn) consists of tide-swept sandflat habitat which consists of a clean sand substratum with a relatively species poor, macrofaunal community comprising low numbers of mobile crustaceans (such as *Bathyporeia pilosa* and *Eurydice pulchra*) and polychaetes (such as *Nephtys* spp.). Mudflat habitat in the local area is characterised by typical mud dwelling species such as the bivalves (peppery furrow shell *Scrobicularia plana*, common cockle *Cerastoderma edule*, Baltic tellin *Limecola balthica*), polychaetes (such as *Hediste diversicolor*), mud snail Peringia ulvae, mud shrimp *Corophium volutator*, and the oligochaete *Tubificoides* spp. (see Section 8.6.2 of Chapter 8).

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

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

An assessment of the sediment changes that are predicted to occur as a result of the disposal of capital dredged material is presented in more detail in the physical processes assessment (Chapter 6 of the ES). In summary, peak sedimentation depths within the disposal site are predicted around 50-60 mm, reducing to around 4-6 mm within a distance of approximately 1 km from the disposal site. Future maintenance dredging will result in smaller changes in sedimentation within the disposal site(s)) compared to the capital dredge. Furthermore, the predicted impacts from future maintenance dredging will be similar to that which already arises from the ongoing maintenance of the existing Port and channel areas.

The existing Mostyn Deep disposal site (IS102) and Mostyn Breakwater disposal site (IS103) are located in areas that are subject to regular natural physical disturbance (and associated scouring) as a result of very strong tidal flows. The current use of the disposal site(s) will also cause some disturbance due to sediment deposition. The Port of Mostyn is currently able to deposit up to a maximum of 900,000 tonnes (approximately 600,000 m^3) of material per annum at Mostyn Deep (IS102) under its existing capital and maintenance dredge disposal licence for the main navigation channel (DML1542v2). Since the renewed maintenance dredge and disposal licence was granted in December 2019, the total disposal quantity has been approximately 100,000 m^3 and the annual average disposal quantity has been around 50,000 m^3, indicating some spare capacity. No material has been disposed of at the Mostyn Breakwater disposal site (IS103) since the licence was granted in October 2020, indicating some spare capacity. The regular disturbance caused by natural processes, and to less of an extent by the intermittent disposal activity, is reflected in a generally impoverished assemblage in the vicinity of the disposal site.

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

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

In conclusion, sedimentation associated with the proposed development is not expected to lead to a deterioration of the assessed biological (habitat) elements within the Dee (N. Wales) transitional water body or North Wales coastal water body, nor prevent these water bodies from meeting their WFD objectives.

4.3 Biology (fish)

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

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

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

There is a wide diversity in hearing structures in fish which leads to different auditory capabilities across species (Webb *et al*., 2008). All fish can sense the particle motion[3] component of an acoustic field via the inner ear as a result of whole-body accelerations (Radford *et al*., 2012), and noise detection ('hearing') becomes more specialised with the addition of further hearing structures. Particle motion is especially important for locating sound sources through directional hearing (Popper *et al*., 2014; Hawkins *et al.,* 2015; Nedelec *et al*., 2016). Although many fish are also likely to detect sound pressure[4], particle motion is considered equally or potentially more important (Hawkins and Popper, 2017).

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

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

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

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

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

4.3.1 Piling

The predicted range (R) at which the Popper et al. (2014) quantitative instantaneous peak Sound Pressure Level (SPL) thresholds for pile driving are reached indicates that there is a risk of mortality, potential mortal injury or recoverable injury within 151 m from the source of impact piling in fish with a swim bladder (such as herring, Atlantic salmon and European eel) and within 70 m in fish with no swim bladder (such as lamprey and flatfish). For vibro-piling, there is a risk of mortality, potential mortal injury or recoverable injury within 3 m from the source in fish with a swim bladder and within 1 m in fish with no swim bladder.

The calculator developed by the United States National Marine Fisheries Service (NMFS) (NMFS, 2021) as a tool for assessing the potential effects to fish exposed to elevated levels of underwater sound produced during pile driving was used to calculate the range at which the cumulative Sound Exposure Levels (SEL) thresholds for pile driving (Popper et al., 2014) are reached. Based on the assumptions highlighted in Appendix 8.4, there is predicted to be a risk of mortality and potential mortal injury within

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3 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.

4 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.

385 m from the source of impact piling in fish with a swim bladder involved in hearing (such as herring), within 262 m from the source in fish with a swim bladder not involved in hearing (such as European eel) and within 82 m in fish with no swim bladder (such as sole). The distance at which the received level of noise is within the limits of the recoverable injury threshold is within 644 m in fish with a swim bladder and 121 m in fish without a swim bladder. For vibro-piling, there is predicted to be a risk of mortality and potential mortal injury within 26 m from the source in fish with a swim bladder involved in hearing, within 18 m from the source in fish with a swim bladder not involved in hearing and within 6 m in fish with no swim bladder. The distance at which the received level of noise is within the limits of the recoverable injury threshold is within 43 m in fish with a swim bladder and 8 m in fish without a swim bladder.

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

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

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

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

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

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

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

In conclusion, the proposed piling activities are not expected to lead to a deterioration of the assessed fish elements within the Dee (N. Wales) transitional water body or North Wales coastal water body, nor prevent these water bodies from meeting their WFD objectives.

4.3.2 Dredging and disposal

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

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

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

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

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

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

In conclusion, the proposed dredging and disposal activities are not expected to lead to a deterioration of the assessed fish elements within the Dee (N. Wales) transitional water body or North Wales coastal water body, nor prevent these water bodies from meeting their WFD objectives.

4.4 Water quality

Changes in water quality may occur as a result of the capital and maintenance dredge, piling and disposal of material. A detailed assessment has been undertaken for the proposed development (Chapter 7 of the ES) and is briefly summarised here.

4.4.1 Baseline

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 (MMO, 2014).

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.

In August 2021, a sample plan (SP2106) was provided by NRW, prepared in consultation with Cefas. In September 2022, sediment samples were collected from eight borehole stations (A to H) across the proposed dredge area comprising the proposed development, including subsurface samples (Figure 3).

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

- Particle size analysis (PSA);
- Trace metals;
- Organotins;
- Polycyclic aromatic hydrocarbons (PAHs);
- Total hydrocarbon content (THC); and
- Organochlorine pesticides (OCPs).

The PSA results are presented in Table 9. Sediments from most sampling locations were dominated by sand material. Site F (Sample ID: BH502 (ES1) 0.00m) contained the most silt material of any sample comprising approximately 73 %. Site B (Sample ID: EB2 (ES4) 6.00m), Site C (Sample ID: EB3 (ES3) 4.00m), Site H (Sample ID: BH504 (ES1) 0.00m), Site E (Sample ID: BH501 (ES1) 0.00m), Site F (Sample ID: BH502 (ES4) 6.00m and Sample ID: BH502 (ES5) 8.00m), and Site A (Sample ID: EB1 (ES2) 2.00m and Sample ID: EB1 (ES4) 6.00m) comprised < 4% gravel, with all other samples containing no gravel.

A summary of sediment quality (chemical analysis) of samples from the dredge areas is provided in Table 10 to Table 14. Concentrations above or below Cefas Guideline Action Levels are highlighted to provide an indication of sediment quality. Contaminant concentrations were low, with most values below the respective AL1. There were no instances where the concentration exceeded the respective AL2 (or a sample concentration was close to exceeding this threshold).

Trace metal concentrations were below AL1 in most samples. AL1 for nickel, cadmium, and mercury was only marginally exceeded in one sample at Site C (Sample ID: EB3 (ES5) 8.00 m), Site G (Sample ID: BH503 (ES4) 6.00 m), and Site H (Sample ID: BH504 (ES4) 6.00 m), respectively. AL1 for zinc was exceeded in three samples: Site B (Sample ID: EB2 (ES4) 6.00 m), and Site F (Sample ID: BH502 (ES5) 8.00m and Sample ID: BH502 (ES6) 10.00m). Organotins in all samples were below the respective AL1.

Some individual PAHs were found to be marginally above AL1 (there is currently no AL2 for individual or total PAHs), primarily at Site H (Sample ID: BH504 (ES4) 6.00 m) and Site F (Sample ID: BH502 (ES1) 0.00m and Sample ID: BH502 (ES2) 2.00m). OCP concentrations were often below the limit of detection (LOD) in most samples.

The full results of the sediment analysis undertaken on the samples that were collected in accordance with the sediment sample plan are provided in the required NRW results template and included in Appendix 7.2 of the ES.

Figure 3. Sediment sampling location for MEPE Project.

Table 9. Particle size analysis (PSA) results from sediment samples collected in September 2022

Site	Sample ID	Visual Appearance	Particle Size Distribution (%)		
			Gravel (>2 mm)	Sand (2 mm – 63 µm)	Silt (<63 µm)
Site B	EB2 (ES1) 0.00m	Odourless Brown Muddy Sand	0.00	93.96	6.04
	EB2 (ES2) 2.00m	Odourless Brown Muddy Sand	0.00	80.89	19.11
	EB2 (ES3) 4.00m	Odourless Brown Muddy Sand	0.00	86.01	13.99
	EB2 (ES4) 6.00m	Brown Gravelly Muddy Sand with Shell Fragments and a Peat Odour	0.34	89.59	10.08
Site D	EB4 (ES1) 0.00m	Odourless Brown Muddy Sand	0.00	89.24	10.76
	EB4 (ES2) 2.00m	Odourless Brown Muddy Sand	0.00	82.73	17.27
	EB4 (ES3) 4.00m	Odourless Brown Muddy Sand	0.00	76.79	23.21
	EB4 (ES4) 6.00m	Odourless Brown Muddy Sand	0.00	85.17	14.83
	EB4 (ES5) 8.00m	Odourless Brown Muddy Sand	0.00	88.70	11.30
Site C	EB3 (ES1) 0.00m	Odourless Brown Sand	0.00	96.92	3.08
	EB3 (ES2) 2.00m	Odourless Brown Muddy Sand	0.00	92.15	7.85
	EB3 (ES3) 4.00m	Brown-Black Gravelly Muddy Sand with Shell Fragments and a Hydrocarbons Odour	1.38	66.04	32.58
	EB3 (ES4) 6.00m	Odourless Brown Muddy Sand	0.00	71.43	28.57
	EB3 (ES5) 8.00m	Brown Sandy Mud with a Peat Odour	0.00	80.24	19.76
Site H	BH504 (ES1) 0.00m	Brown Muddy Sand with Shell Fragments and Organic Matter and a Peat Odour	0.20	48.62	51.19
	BH504 (ES2) 2.00m	Brown Muddy Sand with a Peat Odour	0.00	85.21	14.79
	BH504 (ES3) 4.00m	Odourless Brown Muddy Sand with Organic Matter	0.00	58.16	41.84
	BH504 (ES4) 6.00m	Brown Muddy Sand with Shell Fragments and a Peat Odour	0.00	70.49	29.51
	BH504 (ES5) 8.00m	Odourless Brown Muddy Sand with Shell Fragments	0.00	95.63	4.37
Site G	BH503 (ES1) 0.00m	Odourless Brown Muddy Sand with Organic Matter	0.00	64.54	35.46
	BH503 (ES2) 2.00m	Odourless Brown Muddy Sand	0.00	74.29	25.71
	BH503 (ES3) 4.00m	Odourless Brown Muddy Sand	0.00	83.25	16.75
	BH503 (ES4) 6.00m	Brown Muddy Sand with an Earthy Odour	0.00	93.54	6.46
	BH503 (ES5) 8.00m	Brown Muddy Sand with a Hydrocarbons Odour	0.00	89.70	10.30

Site	Sample ID	Visual Appearance	Particle Size Distribution (%)		
			Gravel (>2 mm)	Sand (2 mm – 63 µm)	Silt (<63 µm)
Site E	BH501 (ES1) 0.00m	Odourless Brown Gravelly Sandy Mud with Shell Fragments and Organic Matter.	4.11	58.68	37.21
	BH501 (ES2) 2.00m	Odourless Brown Muddy Sand.	0.00	89.74	10.26
	BH501 (ES3) 4.00m	Odourless Brown Muddy Sand.	0.00	93.61	6.39
	BH501 (ES4) 6.00m	Odourless Brown Muddy Sand.	0.00	37.70	62.30
Site F	BH502 (ES1) 0.00m	Brown Sandy Mud with Organic Matter and a Peat Odour.	0.00	27.26	72.74
	BH502 (ES2) 2.00m	Odourless Brown Muddy Sand.	0.00	74.99	25.01
	BH502 (ES3) 4.00m	Odourless Brown Muddy Sand.	0.00	70.82	29.18
	BH502 (ES4) 6.00m	Odourless Brown Muddy Sand with Organic Matter.	0.64	86.56	12.80
	BH502 (ES5) 8.00m	Brown Gravelly Muddy Sand with Shell Fragments and Organic Matter and an Earthy Odour.	0.92	41.88	57.20
	BH502 (ES6) 10.00m	Odourless Brown Muddy Sand.	0.00	41.88	58.12
Site A	EB1 (ES1) 0.00m	Odourless Brown Muddy Sand.	0.00	93.97	6.03
	EB1 (ES2) 2.00m	Odourless Brown Muddy Sand with Shell Fragments.	0.03	75.95	24.03
	EB1 (ES3) 4.00m	Odourless Brown Muddy Sand.	0.00	96.20	3.80
	EB1 (ES4) 6.00m	Odourless Brown Gravelly Muddy Sand with Shell Fragments.	2.39	74.71	22.90
	EB1 (ES5) 8.00m	Odourless Brown Muddy Sand.	0.00	89.69	10.31

Table 10. Sediment contamination data collected in September 2022 (1 of 5)

Contaminant	Units	Cefas Action Level		Sample Concentration								
		AL1	AL2	Site B				Site D				
				EB2 (ES1) 0.00m	EB2 (ES2) 2.00m	EB2 (ES3) 4.00m	EB2 (ES4) 6.00m	EB4 (ES1) 0.00m	EB4 (ES2) 2.00m	EB4 (ES3) 4.00m	EB4 (ES4) 6.00m	EB4 (ES5) 8.00m
Arsenic	mg/kg	20	100	4.4	7.2	6.9	8.7	4.8	4.9	5.8	6	5
Cadmium	mg/kg	0.4	5	0.15	0.21	0.21	0.18	0.11	0.1	0.13	0.13	0.1
Chromium	mg/kg	40	400	7.8	19.1	14	15.2	8.2	8.9	13.1	14.2	14.1
Copper	mg/kg	40	400	4.4	9.3	8.2	10.3	4.4	4.2	7	11.3	5.2
Mercury	mg/kg	0.3	3	<0.01	0.07	0.05	0.14	<0.01	<0.01	0.03	0.02	0.02
Nickel	mg/kg	20	200	8	17.1	13.4	14.5	7.4	9.5	11.6	14.2	14.8
Lead	mg/kg	50	500	4.4	18.6	16.3	20.1	6.3	7.1	12.3	11.7	7.9
Zinc	mg/kg	130	800	29.5	88.8	80	130	35.8	40.4	70.4	58.6	50.4
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.001	<0.005	<0.005	<0.005	<0.005	<LOD
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.001	<0.005	<0.005	<0.005	<0.005	<LOD
Acenaphthene	µg/kg	100	-	<5	4.74	6.78	2.49	<1	2.35	3.57	1.44	<LOD
Acenaphthylene	µg/kg	100	-	<5	5.4	7.25	4.21	<1	2.53	2.59	2.91	3.06
Anthracene	µg/kg	100	-	<5	8.12	15.3	6.31	1.68	6.25	4.82	3.32	3.97
Benzo[a]anthracene	µg/kg	100	-	<5	22.2	35.1	15.2	3.5	17	9.55	10.7	10.2
Benzo[a]pyrene	µg/kg	100	-	1.05	27.2	48	24.6	3.81	18.3	12.3	11.1	9.44
Benzo[b]fluoranthene	µg/kg	100	-	1.72	37	66.2	31.3	5.47	21	18.3	10.4	10.1
Benzo[ghi]perylene	µg/kg	100	-	1.04	23.1	38.4	20	2.89	13.4	9.88	6.7	6.58
Benzo[e]pyrene	µg/kg	100		1.29	29	47.4	22.1	4.43	16.4	13.2	10.2	8.79
Benzo[k]fluoranthene	µg/kg	100	-	<5	29.1	38.8	23.5	3.88	14.6	11.3	10.6	6.59
C1-naphthalenes	µg/kg	100	-	4.43	62.3	81.4	31.9	13.4	26.6	44.8	14.9	15.8
C1-phenanthrene	µg/kg	100	-	3.65	72.4	76.8	29.2	10.6	33.7	24	22.5	19.7
C2-naphthalenes	µg/kg	100	-	9.29	91.9	62.2	26.8	14.7	26.6	31	16.7	19.8
C3-naphthalenes	µg/kg	100	-	3.28	86.4	62.4	24.2	12.1	25.1	20.6	20.7	25.8
Chrysene	µg/kg	100	-	1.14	29.7	44.5	19.7	4.89	20.3	13.3	13.9	11.6
Dibenzo[ah]anthracene	µg/kg	100	-	<5	4.7	8.18	3.87	<1	2.62	1.72	1.15	1.03

Contaminant	Units	Cefas Action Level		Sample Concentration								
		AL1	AL2	Site B				Site D				
				EB2 (ES1) 0.00m	EB2 (ES2) 2.00m	EB2 (ES3) 4.00m	EB2 (ES4) 6.00m	EB4 (ES1) 0.00m	EB4 (ES2) 2.00m	EB4 (ES3) 4.00m	EB4 (ES4) 6.00m	EB4 (ES5) 8.00m
Fluoranthene	µg/kg	100	-	1.5	37.1	65.9	25.9	6.16	25.6	19.6	15.9	14.6
Fluorene	µg/kg	100	-	<5	9.92	12.4	4.79	1.5	4.28	5.56	3.5	3.07
Indeno[1,2,3-cd]pyrene	µg/kg	100	-	1.12	25.8	42.6	22.5	2.88	13	9.49	6.27	5.41
Naphthalene	µg/kg	100	-	<5	15	38.8	11	3.8	9.66	9.51	5.81	6.69
Perylene	µg/kg	100	-	<5	10.3	16.5	6.7	1.36	5.72	3.85	3.58	2.34
Phenanthrene	µg/kg	100	-	1.83	51.9	55.7	22.8	7.89	24.7	19.1	13.9	16.6
Pyrene	µg/kg	100	-	1.7	40.4	67.5	29.5	6.51	28.5	20.4	18.5	17.2
Total Hydrocarbon Content (THC)	mg/kg	-	-	2.13	18.3	18.2	31.6	15.9	14.9	23.1	11	12.8
AHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<LOD
BHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<LOD
GHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<LOD
Dieldrin	mg/kg	0.005	-	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0003	<LOD
HCB	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<LOD
PPTDE	mg/kg	-	-	<0.0001	0.0003	<0.0001	0.0003	<0.0001	<0.0001	0.0002	0.0002	<LOD
PPDDE	mg/kg	-	-	<0.0001	0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<LOD
PPDDT	mg/kg	0.001	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<LOD
Key	Below AL1											
	Above AL1, Below AL2											
	Above AL2											

Table 11. Sediment contamination data collected in September 2022 (2 of 5)

Contaminant	Units	Cefas Action Level		Sample Concentration						
				Site C					Site H	
		AL1	AL2	EB3 (ES1) 0.00m	EB3 (ES2) 2.00m	EB3 (ES3) 4.00m	EB3 (ES4) 6.00m	EB3 (ES5) 8.00m	BH504 (ES1) 0.00m	BH504 (ES2) 2.00m
Arsenic	mg/kg	20	100	4.1	4.7	7.1	5.3	8.7	10.8	6.7
Cadmium	mg/kg	0.4	5	0.14	0.05	0.1	0.04	0.23	0.19	0.06
Chromium	mg/kg	40	400	7.7	13.7	19.5	11.6	28.5	22	12.8
Copper	mg/kg	40	400	3.5	5.5	8.8	3.8	14.5	11.8	6.8
Mercury	mg/kg	0.3	3	<0.01	<0.01	0.06	<0.01	0.14	0.11	0.05
Nickel	mg/kg	20	200	7.8	9.7	15	8.8	22.5	15.6	10.1
Lead	mg/kg	50	500	4.9	6.4	17.8	6.7	26.8	24.2	13.2
Zinc	mg/kg	130	800	31.9	38	81.2	50.9	124	106	71.6
Dibutyltin (DBT)	mg/kg	0.1	1	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Tributyltin (TBT)	mg/kg	0.1	1	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Acenaphthene	µg/kg	100	-	<LOD	<LOD	3.84	9.32	<LOD	2.36	2.57
Acenaphthylene	µg/kg	100	-	<LOD	<LOD	4.22	6.35	<LOD	2.6	1.75
Anthracene	µg/kg	100	-	<LOD	<LOD	8.23	15.4	<LOD	5.14	2.93
Benzo[a]anthracene	µg/kg	100	-	1.3	<LOD	17.8	38.2	1.1	12.6	6.96
Benzo[a]pyrene	µg/kg	100	-	1.28	<LOD	22.1	50.3	<LOD	16.7	7.21
Benzo[b]fluoranthene	µg/kg	100	-	1.71	<LOD	35.3	66.1	<LOD	24.1	10.1
Benzo[ghi]perylene	µg/kg	100	-	1.12	<LOD	19.7	43	<LOD	16	5.47
Benzo[e]pyrene	µg/kg	100		1.69	<LOD	25.3	53.7	<LOD	17.2	7.88
Benzo[k]fluoranthene	µg/kg	100	-	1.37	<LOD	22.6	47.5	<LOD	15.9	8.49
C1-naphthalenes	µg/kg	100	-	7.94	1.37	43.3	91.2	1.96	27.6	15.6
C1-phenanthrene	µg/kg	100	-	9.44	1.52	39.5	136	1.93	29.8	15.6
C2-naphthalenes	µg/kg	100	-	9.24	1.87	38.8	99.7	2.5	25.3	36.3
C3-naphthalenes	µg/kg	100	-	10.6	1.48	36.2	104	1.95	17.2	11.1
Chrysene	µg/kg	100	-	1.95	<LOD	25.4	54	1.23	17.2	9.23
Dibenzo[ah]anthracene	µg/kg	100	-	<LOD	<LOD	3.2	8.12	<LOD	2.59	<LOD
Fluoranthene	µg/kg	100	-	2.32	<LOD	36.7	75.8	2.03	24	15.8

Contaminant	Units	Cefas Action Level		Sample Concentration						
				Site C					Site H	
		AL1	AL2	EB3 (ES1) 0.00m	EB3 (ES2) 2.00m	EB3 (ES3) 4.00m	EB3 (ES4) 6.00m	EB3 (ES5) 8.00m	BH504 (ES1) 0.00m	BH504 (ES2) 2.00m
Fluorene	µg/kg	100	-	<LOD	<LOD	9.14	16.7	<LOD	4.69	3.05
Indeno[1,2,3-cd]pyrene	µg/kg	100	-	<LOD	<LOD	19.3	44.9	<LOD	15.8	4.45
Naphthalene	µg/kg	100	-	1.31	<LOD	15.9	30.7	<LOD	10.3	6.98
Perylene	µg/kg	100	-	<LOD	<LOD	7.52	16.5	<LOD	5.58	2.41
Phenanthrene	µg/kg	100	-	5.46	1.09	33.4	99.3	1.38	21.5	14
Pyrene	µg/kg	100	-	2.67	1.12	37.4	82.3	2.43	23.4	16.7
Total Hydrocarbon Content (THC)	mg/kg	-	-	2.2	4.49	16.7	19.8	6.16	43.2	24.7
AHCH	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
BHCH	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
GHCH	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Dieldrin	mg/kg	0.005	-	0.0001	<LOD	0.0001	0.0002	<LOD	<LOD	<LOD
HCB	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
PPTDE	mg/kg	-	-	<LOD	<LOD	0.0002	0.0003	<LOD	0.0004	<LOD
PPDDE	mg/kg	-	-	<LOD	<LOD	<LOD	0.0002	<LOD	0.0001	<LOD
PPDDT	mg/kg	0.001	-	<LOD	<LOD	<LOD	0.0002	<LOD	<LOD	<LOD
Key	Below AL1									
	Above AL1, Below AL2									
	Above AL2									

Table 12. Sediment contamination data collected in September 2022 (3 of 5)

Contaminant	Units	Cefas Action Level		Sample Concentration							
				Site H			Site G				
		AL1	AL2	BH504 (ES3) 4.00m	BH504 (ES4) 6.00m	BH504 (ES5) 8.00m	BH503 (ES1) 0.00m	BH503 (ES2) 2.00m	BH503 (ES3) 4.00m	BH503 (ES4) 6.00m	BH503 (ES5) 8.00m
Arsenic	mg/kg	20	100	5.8	15.9	8.3	5.6	7.8	6	6.3	5.4
Cadmium	mg/kg	0.4	5	0.15	0.32	0.2	0.08	0.05	<LOD	0.43	0.33
Chromium	mg/kg	40	400	10.2	23.3	17.4	9.3	16.2	12.1	8.7	7.7
Copper	mg/kg	40	400	7.9	17.3	14.7	5.7	8.8	5.6	6.2	4.6
Mercury	mg/kg	0.3	3	0.03	0.33	0.11	0.03	0.08	0.02	0.07	0.01
Nickel	mg/kg	20	200	9.8	15	16.6	7.3	11.6	8.8	7.7	8.5
Lead	mg/kg	50	500	11.4	45.6	23.9	12.8	20	12	9.8	7.3
Zinc	mg/kg	130	800	67.2	219	97.6	60.2	89.4	64.6	65.2	56.1
Dibutyltin (DBT)	mg/kg	0.1	1	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Tributyltin (TBT)	mg/kg	0.1	1	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Acenaphthene	µg/kg	100	-	3.93	14.8	5.37	<LOD	2.92	8.59	2.13	<LOD
Acenaphthylene	µg/kg	100	-	2.68	18.3	5.95	1.25	3.52	3.56	1.54	1.27
Anthracene	µg/kg	100	-	9.98	41.1	13.8	1.36	7.17	7.84	4.18	3.41
Benzo[a]anthracene	µg/kg	100	-	34.5	93.4	51.7	2.16	12.5	25.2	5.92	5.36
Benzo[a]pyrene	µg/kg	100	-	39.4	136	74.7	2.65	13.3	25	6.94	4.47
Benzo[b]fluoranthene	µg/kg	100	-	39.6	204	85.1	4.02	21	34	10.3	7.72
Benzo[ghi]perylene	µg/kg	100	-	31	129	62.9	2.62	16.8	21.1	6.9	4.7
Benzo[e]pyrene	µg/kg	100		33.4	136	76.4	3.36	19.6	27.2	9.85	7.15
Benzo[k]fluoranthene	µg/kg	100	-	36.9	131	66	3.19	15.7	28.4	7.81	7.08
C1-naphthalenes	µg/kg	100	-	21.7	120	60.1	11.4	31.5	34	15.8	12.7
C1-phenanthrene	µg/kg	100	-	35.4	153	78.6	12.8	34.4	41.1	17.4	15.3
C2-naphthalenes	µg/kg	100	-	25.8	119	64.5	11.2	34.6	36.2	18.3	14.6
C3-naphthalenes	µg/kg	100	-	22.1	116	68.3	6.19	28.2	34.7	13.8	13.2
Chrysene	µg/kg	100	-	39.3	118	68.4	2.94	19.1	32.9	8.69	7.33
Dibenzo[ah]anthracene	µg/kg	100	-	5.76	17.7	14.8	<LOD	2.36	3.49	<LOD	<LOD
Fluoranthene	µg/kg	100	-	62.8	169	94.6	4.41	28.7	56.6	13.4	10.2

Contaminant	Units	Cefas Action Level		Sample Concentration							
				Site H			Site G				
		AL1	AL2	BH504 (ES3) 4.00m	BH504 (ES4) 6.00m	BH504 (ES5) 8.00m	BH503 (ES1) 0.00m	BH503 (ES2) 2.00m	BH503 (ES3) 4.00m	BH503 (ES4) 6.00m	BH503 (ES5) 8.00m
Fluorene	µg/kg	100	-	5.67	25.5	12.8	1.72	6.78	10.3	2.98	1.77
Indeno[1,2,3-cd]pyrene	µg/kg	100	-	40.3	127	85.1	2.22	14.1	20.1	5.36	4.08
Naphthalene	µg/kg	100	-	9.49	56.5	24.4	3.39	13.9	13.4	7.53	5.46
Perylene	µg/kg	100	-	14.8	43.2	46	1.53	7.05	8.97	2.32	1.23
Phenanthrene	µg/kg	100	-	33.1	132	57.3	4.34	27.3	37.5	12.8	10.5
Pyrene	µg/kg	100	-	60.2	184	93.9	5.38	29.5	52.2	14.5	14.7
Total Hydrocarbon Content (THC)	mg/kg	-	-	8.68	12.2	25.8	12.7	18.5	26.6	8.73	11.8
AHCH	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
BHCH	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
GHCH	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Dieldrin	mg/kg	0.005	-	<LOD	<LOD	<LOD	0.0002	0.0001	<LOD	<LOD	<LOD
HCB	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
PPTDE	mg/kg	-	-	<LOD	0.0007	0.0003	<LOD	0.0003	0.0002	<LOD	0.0002
PPDDE	mg/kg	-	-	<LOD	0.0001	<LOD	<LOD	0.0001	<LOD	<LOD	<LOD
PPDDT	mg/kg	0.001	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Key	Below AL1										
	Above AL1, Below AL2										
	Above AL2										

Table 13. Sediment contamination data collected in September 2022 (4 of 5)

Contaminant	Units	Cefas Action Level		Sample Concentration							
				Site E				Site F			
		AL1	AL2	BH501 (ES1) 0.00m	BH501 (ES2) 2.00m	BH501 (ES3) 4.00m	BH501 (ES4) 6.00m	BH502 (ES1) 0.00m	BH502 (ES2) 2.00m	BH502 (ES3) 4.00m	BH502 (ES4) 6.00m
Arsenic	mg/kg	20	100	5.3	5.2	4.4	9.4	9.7	15.5	6	5.6
Cadmium	mg/kg	0.4	5	0.11	<LOD	<LOD	0.07	0.2	0.2	0.06	<LOD
Chromium	mg/kg	40	400	11.2	11.6	9.6	25.2	25.9	17.1	10.9	10.1
Copper	mg/kg	40	400	16	21.8	9.4	22.3	21.3	19.3	16.4	11
Mercury	mg/kg	0.3	3	0.04	0.02	<LOD	0.17	0.22	0.1	0.06	0.03
Nickel	mg/kg	20	200	10	10.7	8	19.8	19	13.6	9.8	8.9
Lead	mg/kg	50	500	16.1	14.1	6.2	33.3	35.8	22.5	12.9	10
Zinc	mg/kg	130	800	92.4	51.5	52.5	118	122	97.3	71.8	65.4
Dibutyltin (DBT)	mg/kg	0.1	1	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Tributyltin (TBT)	mg/kg	0.1	1	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Acenaphthene	µg/kg	100	-	4.76	1.99	<LOD	8.81	11.4	61.2	4.09	3.75
Acenaphthylene	µg/kg	100	-	4.16	2.19	<LOD	8.35	11.4	7.29	7.81	3.44
Anthracene	µg/kg	100	-	6.82	2.21	<LOD	22.4	28	83.5	10.2	11.4
Benzo[a]anthracene	µg/kg	100	-	16.5	5.49	<LOD	52.1	62.8	156	25.4	34.3
Benzo[a]pyrene	µg/kg	100	-	26.5	6.82	1.23	88.3	105	199	30.1	46
Benzo[b]fluoranthene	µg/kg	100	-	29.1	6.65	1.47	112	119	179	27.7	46.9
Benzo[ghi]perylene	µg/kg	100	-	24.6	6.55	1.13	95.9	119	154	24.7	43.4
Benzo[e]pyrene	µg/kg	100		26.6	6.62	1.44	87	103	133	26.1	36.7
Benzo[k]fluoranthene	µg/kg	100	-	24.9	5.73	1.24	92.7	79.7	158	31.1	42.4
C1-naphthalenes	µg/kg	100	-	100	17.2	4.7	103	117	89.8	31.2	24.7
C1-phenanthrene	µg/kg	100	-	85.8	20.7	3.22	97.6	123	184	46.2	41.1
C2-naphthalenes	µg/kg	100	-	130	22	3.39	101	113	88.9	30.9	24.7
C3-naphthalenes	µg/kg	100	-	97.1	15.8	2.62	80.2	98.5	95.1	35.1	27.8
Chrysene	µg/kg	100	-	26.7	8.17	1.17	78.3	90.1	186	32.2	42.4
Dibenzo[ah]anthracene	µg/kg	100	-	5.04	1.24	<LOD	15.9	21.6	24.1	5.24	7.37
Fluoranthene	µg/kg	100	-	26.3	9.14	1.24	97.2	118	462	42	76.8

Contaminant	Units	Cefas Action Level		Sample Concentration							
				Site E				Site F			
		AL1	AL2	BH501 (ES1) 0.00m	BH501 (ES2) 2.00m	BH501 (ES3) 4.00m	BH501 (ES4) 6.00m	BH502 (ES1) 0.00m	BH502 (ES2) 2.00m	BH502 (ES3) 4.00m	BH502 (ES4) 6.00m
Fluorene	µg/kg	100	-	7.99	3.03	<LOD	19	22	42.8	7.27	6.47
Indeno[1,2,3-cd]pyrene	µg/kg	100	-	29.8	6.2	<LOD	104	122	159	27.2	46.7
Naphthalene	µg/kg	100	-	19.4	5.93	1.65	43.6	48.4	37.3	10.5	10
Perylene	µg/kg	100	-	9.59	2.53	<LOD	42.7	57.3	73.9	11.2	17.3
Phenanthrene	µg/kg	100	-	56	11.9	2.22	90.7	112	457	33.4	42.1
Pyrene	µg/kg	100	-	29.2	10.2	1.82	96.9	118	425	42.3	73.7
Total Hydrocarbon Content (THC)	mg/kg	-	-	9.75	7.69	1.04	10.2	9.76	154	105	7.2
AHCH	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
BHCH	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.0002	<LOD
GHCH	mg/kg	-	-	0.0001	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Dieldrin	mg/kg	0.005	-	0.0009	<LOD	<LOD	0.0002	<LOD	<LOD	0.0001	<LOD
HCB	mg/kg	-	-	<LOD	<LOD	<LOD	0.0001	0.0001	<LOD	<LOD	<LOD
PPTDE	mg/kg	-	-	0.0002	0.0041	<LOD	0.0006	0.0008	0.0003	0.0004	<LOD
PPDDE	mg/kg	-	-	0.0002	0.0002	<LOD	0.0002	0.0003	0.0001	0.0002	<LOD
PPDDT	mg/kg	0.001	-	0.0001	0.0017	<LOD	<LOD	<LOD	<LOD	0.0002	<LOD
Key	Below AL1										
	Above AL1, Below AL2										
	Above AL2										

Table 14. Sediment contamination data collected in September 2022 (5 of 5)

Contaminant	Units	Cefas Action Level		Sample Concentration						
				Site F		Site A				
		AL1	AL2	BH502 (ES5) 8.00m	BH502 (ES6) 10.00m	EB1 (ES1) 0.00m	EB1 (ES2) 2.00m	EB1 (ES3) 4.00m	EB1 (ES4) 6.00m	EB1 (ES5) 8.00m
Arsenic	mg/kg	20	100	11.8	6.8	4.7	5.8	4.8	5.1	5.8
Cadmium	mg/kg	0.4	5	0.24	0.28	<LOD	<LOD	<LOD	<LOD	0.07
Chromium	mg/kg	40	400	27	24	9.9	12.5	7.8	8.8	11.9
Copper	mg/kg	40	400	22.8	21.4	9.3	9.4	6.9	7	9.3
Mercury	mg/kg	0.3	3	0.26	0.22	<LOD	0.04	0.01	<LOD	0.04
Nickel	mg/kg	20	200	18.7	17.3	7.9	10.1	8	8.2	10
Lead	mg/kg	50	500	43.8	32.4	7.2	15.2	7.7	8.2	11.9
Zinc	mg/kg	130	800	170	137	39.8	66.1	64.2	56.6	65.5
Dibutyltin (DBT)	mg/kg	0.1	1	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Tributyltin (TBT)	mg/kg	0.1	1	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Acenaphthene	µg/kg	100	-	7.89	9.9	<LOD	2.56	1.33	<LOD	5.84
Acenaphthylene	µg/kg	100	-	7.8	11.9	<LOD	3.19	1.37	1.67	3.9
Anthracene	µg/kg	100	-	18.4	21.1	1.15	5.64	3.56	3.86	11
Benzo[a]anthracene	µg/kg	100	-	47.6	60.2	2.83	20.2	8.68	9.87	29.9
Benzo[a]pyrene	µg/kg	100	-	87.5	92.4	3.37	24.3	13.7	8.4	31.5
Benzo[b]fluoranthene	µg/kg	100	-	102	106	2.71	30.3	15	8.84	46.8
Benzo[ghi]perylene	µg/kg	100	-	94.9	99.1	3.14	27.8	13.5	7.02	47.8
Benzo[e]pyrene	µg/kg	100		81.7	83.1	2.8	26.6	11.7	7.77	45.6
Benzo[k]fluoranthene	µg/kg	100	-	88.9	89	2.76	31.6	14.4	12.3	41.3
C1-naphthalenes	µg/kg	100	-	64.6	97.4	2.93	28.7	9.01	6.91	191
C1-phenanthrene	µg/kg	100	-	70.1	90.2	6.77	32.4	9.79	13.3	115
C2-naphthalenes	µg/kg	100	-	68.1	88.8	4.61	37.6	8.14	10.3	223
C3-naphthalenes	µg/kg	100	-	64.6	67.2	3.47	33.6	8.28	6.53	211
Chrysene	µg/kg	100	-	67.6	81.8	3.75	27.4	11.5	13.5	44.6
Dibenzo[ah]anthracene	µg/kg	100	-	14.1	19	<LOD	6.06	2.16	1.24	7.61
Fluoranthene	µg/kg	100	-	84.4	108	6.25	34.2	16.3	15.3	48.7

Contaminant	Units	Cefas Action Level		Sample Concentration						
				Site F		Site A				
		AL1	AL2	BH502 (ES5) 8.00m	BH502 (ES6) 10.00m	EB1 (ES1) 0.00m	EB1 (ES2) 2.00m	EB1 (ES3) 4.00m	EB1 (ES4) 6.00m	EB1 (ES5) 8.00m
Fluorene	µg/kg	100	-	14.4	17.2	<LOD	5.19	2.06	2.12	14.6
Indeno[1,2,3-cd]pyrene	µg/kg	100	-	96.2	109	3.02	31.2	13.7	6.21	38.9
Naphthalene	µg/kg	100	-	27.1	40.4	1.24	12.8	4.26	3.32	75.9
Perylene	µg/kg	100	-	29	23	1	8.55	3.61	2.72	14.1
Phenanthrene	µg/kg	100	-	59.9	75.6	3.91	24.7	9.69	6.37	73.2
Pyrene	µg/kg	100	-	93.6	110	5.87	35.7	19	14.2	58.7
Total Hydrocarbon Content (THC)	mg/kg	-	-	44.9	10.3	3.18	13.8	7.16	8.01	29.4
AHCH	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
BHCH	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
GHCH	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Dieldrin	mg/kg	0.005	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
HCB	mg/kg	-	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
PPTDE	mg/kg	-	-	0.0004	0.0004	<LOD	0.0002	0.0001	0.0001	0.0003
PPDDE	mg/kg	-	-	0.0003	0.0002	<LOD	0.0001	<LOD	<LOD	0.0001
PPDDT	mg/kg	0.001	-	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Key	Below AL1									
	Above AL1, Below AL2									
	Above AL2									

4.4.2 Capital and maintenance dredging

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) (Luoma, 1983). 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) (Eggleton and Thomas, 2004). Due to the variability in environmental conditions, a wide range of partition coefficients are reported in the literature.

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 or cutter head). As noted in Physical Processes Chapter 6, 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 2,000 mg/l (at the point of release) at the Mostyn Deep (IS102) disposal site (for material not used as engineering fill material for the reclamation, see Project Methodology Chapter 3). 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.

A Microsoft Excel Spreadsheet tool developed by APEM Ltd, referred to as SeDiChem, is provided by the Environment Agency to support consideration of potential uplift in contaminant concentrations following disturbance of contaminated sediments in estuarine and marine waters. This tool has been used to assess risks from chemical contamination associated with dredging for the MEPE Project.

Table 15 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 3,024,000 m^3/day based on an average for the River Dee of 35 m^3/second which is considered a conservative estimate at this location of the Dee Estuary, however, it has been used in this assessment on a pre-cautionary basis (CH2M Hill, 2013)), maximum incremental SSC (2,000 mg/l), worst case (or precautionary) partition coefficients from suggested literature and sediment quality from samples collected within the proposed dredge area.

Overall, the 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 bodies (e.g., PAHs), any disturbance of sediments during dredging activities will result in an uplift exacerbating the failure. However, the scale of this deterioration is considered to be small and highly localised. As a percentage increase of EQS, the increased concentration due to dredging is likely to be less than 1 % for benzo(a)pyrene, benzo(b) fluoranthene, benzo(k) fluoranthene, and fluoranthene, and around 3 % for benzo(g,h,i) perylene. For TBT, the uplift in concentration is likely to be around 20 % of the EQS. For metals, concentration increases as a percentage of the EQS range from less than 1 % to around 7 %. 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.

Table 15. Potential contaminant concentrations as a result of the proposed development in the Dee (N. Wales) transitional water body based on SeDiChem tool outputs

Parameter	Max. Sediment Concentration (mg/kg)	Partition Coefficient (l/kg)	EQS (µg/l)	Additional Dissolved Concentration (Dredging) (µg/l)	Concentration Increase as % of EQS
Arsenic	15.90	40	25 (dissolved)	1.334	5.34 %
Cadmium	0.43	100	0.2 (dissolved)	0.015	7.42 %
Chromium	28.50	79	32 (dissolved)	1.171	3.66 %
Copper	22.80	3,162	3.76 (dissolved)	0.024	0.65 %
Lead	45.60	35,481	14 (dissolved)	0.004	0.03 %
Mercury	0.33	6,310	0.07 (dissolved)	0.000	0.25 %
Nickel	22.50	500	34 (dissolved)	0.147	0.43 %
Zinc	170.00	12,589	8.8 (dissolved)	0.045	0.57 %
Benzo(a)pyrene	0.20	9,120	0.027 (total)	0.00007	0.27 %
Benzo(b) fluoranthene	0.20	20,795	0.017 (total)	0.00003	0.19 %
Benzo(g,h,i) perylene	0.15	18,904	0.00082 (total)	0.00003	3.17 %
Benzo(k) fluoranthene	0.16	19,859	0.017 (total)	0.00003	0.16 %
Fluoranthene	0.17	1,396	0.12 (total)	0.0004	0.34 %
Tributyltin (TBT)	0.005	49	0.0015 (total)	0.0003	21.95 %
Hexachloro-benzene	0.0001	5,978	0.05 (total)	0.000	0.00 %

Furthermore, the proposed development will not directly introduce contaminants to the marine environment and good practice measures (Defra and Environment Agency, 2019), will be used to prevent/reduce the potential for accidental spillages throughout the dredging process.

The amount of nutrients introduced into the water column by dredging will be small relative to other sources in the estuary, such as from agricultural surface run-off. The scale of temporary increases in nutrient levels during dredging is therefore likely to be small. Any change will be short-lived (in the order of days) and within the range of natural variability in the study area, as has previously been seen in other dredge research studies (Lohrer and Wetz, 2003). The potential for much higher rates of nutrients to be added from other sources suggests that the estuary is unlikely to be sensitive to dredge induced nutrient release, except if these occurred during other conditions that have induced algal blooms in the past. Therefore, potential changes to nutrient concentrations in the water column during dredging are considered unlikely to result in algal blooms.

In conclusion the proposed dredging activities are not expected to lead to a deterioration of the assessed water quality elements within the Dee (N. Wales) transitional water body or North Wales coastal water body, nor prevent these water bodies from meeting their WFD objectives.

4.4.3 Piling

As discussed for dredging above, maximum SSCs are associated with the disposal activities. Peak excess SSC levels resulting from the disposal activities are predicted to be around 2,000 mg/l (at the point of release) at the Mostyn Deep (IS102) disposal site (for material not used as engineering fill material for the reclamation, see Project methodology Chapter 3 of the ES). The anticipated increased SSC concentration related to piling will be less than that of dredging and disposal, as compaction will occur in the sediment rather than complete disturbance.

Table 15 calculates the potential for sediment-bound contaminants to increase the concentration of in-water contaminants and, even when applying SSCs of 2,000 mg/l, the proposed piling works are considered unlikely to result in significant water quality impacts.

In conclusion the proposed piling activities are not expected to lead to a deterioration of the assessed water quality elements within the Dee (N. Wales) transitional water body or North Wales coastal water body, nor prevent these water bodies from meeting their WFD objectives.

4.4.4 Disposal activities

As discussed for dredging above, maximum SSCs are associated with the disposal activities. Peak excess SSC levels resulting from the disposal activities are predicted to be around 2,000 mg/l (at the point of release) at the Mostyn Deep (IS102) disposal site (for material not used as engineering fill material for the reclamation, see Project Methodology Chapter 3 of the ES).

Table 15 calculates the potential for sediment-bound contaminants to increase the concentration of in-water contaminants and, when applying SSCs of 2,000 mg/l, the proposed disposal activities are considered unlikely to result in significant water quality impacts.

With respect to nutrient levels, these will be increased temporarily in the water column during the disposal of fine-grained sediments. In the dynamic environment of the Dee Estuary, suspended sediments will be rapidly dispersed, and nutrients diluted rapidly to background levels.

In conclusion the proposed disposal activities are not expected to lead to a deterioration of the assessed water quality elements within the Dee (N. Wales) transitional water body or North Wales coastal water body, nor prevent these water bodies from meeting their WFD objectives.

4.5 Protected areas

The proposed development is located within the Dee Estuary/ Aber Dyfrdwy SAC, and the Dee Estuary SPA and Ramsar site. As the proposed development 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.

The potential impact pathways on these sites and interest features have been assessed in the Habitat Regulations Assessment (HRA) (Appendix 8.5 of the ES) in the context of the nature and scale of the construction and operational activities associated with the proposed development. 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 suggested mitigation measures outlined in the HRA and Chapter 8 of the ES, 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.

The proposed development is also located within the Dee (West) Shellfish Water Protected Area. Any sediment-bound pathogens that are released into the water column during construction could potentially affect the classification of the shellfish beds and result in additional treatment being required. However, it should be noted that the majority of material disturbed during capital dredging works will be sucked from the bed to the hopper/barge or directly into the reclamation area via a floating pipeline, with only a small proportion raised into suspension and remaining in the water column (i.e., through abrasion pressure from the draghead/cutter head).

The level of pathogens in the material that will be disturbed during construction is anticipated to be negligible given that there are no nearby sources of contamination. Only a small proportion of disturbed material during construction is expected to be raised into suspension and this material will be rapidly dispersed by strong tidal currents in the area. Some degree of bacterial die-off can also be expected to occur during dredging and disposal of contaminated material as the sediment is dispersed in the water column. Although this is not quantified specifically for this assessment, many studies have found the potential for 90% of bacteria to become inactive within less than a few hours in seawater (Sinton *et al.*, 1999; Yukselen *et al.,* 2003). Significant elevations of contamination in the water column are, therefore, not anticipated.

Furthermore, ongoing existing dredging and disposal activity has never raised an issue in terms of the classification of nearby shellfish beds, and the estuary is dynamic and surficial sediments are regularly disturbed by tidal action.

In conclusion, the proposed development is not expected to lead to a deterioration of the assessed protected area designations within the Dee (N. Wales) transitional water body or North Wales coastal water body, nor prevent these water bodies from meeting their WFD objectives.

4.6 Invasive non-native species (INNS)

As with most activities which occur in the marine environment, there is potential risk that the proposed development 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 proposed development, the ballast water exchange requirements expected to have been carried out as described under the Ballast Water Management Convention[5] and the fact that potential biosecurity risks are managed through existing biosecurity management procedures, the risk in terms of introducing or transferring INNS is considered to be insignificant. Biosecurity control measures during construction will also be detailed within a Construction Environmental Management Plan (CEMP). This will be provided to NRW prior to works commencing and will set out the mitigation measures needed to manage environmental effects. It is noted that the installation of the new quay wall will introduce a new 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 Mostyn.

Consequently, the probability of the introduction and spread of INNS from dredging is considered low and it is not expected to lead to a deterioration in status of the Dee (N. Wales) transitional water body or North Wales coastal water body, nor prevent these water bodies from meeting their WFD objectives.

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5 Noting, the UK has not yet ratified the Convention; however, the UK regulatory package has been drafted and the Government remains committed to acceding to the Convention and implementing it into UK law. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/949792/Ballast_water_Rev_3._01.21.pdf

5 Conclusion

Based upon the information presented within this WFD compliance assessment, it is concluded that the proposed development is not likely to have a permanent (i.e., non-temporary) effect on the status of WFD parameters that are significant at water body level. Therefore, deterioration to the current status of the Dee (N. Wales) transitional water body and North Wales coastal water body is not predicted, nor will the proposed development prevent these water bodies from achieving their WFD status objectives.

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7 Abbreviations/Acronyms

AA	Annual Average
ABP	Associated British Ports
AEOI	Adverse Effect on Integrity
AL1	Cefas Guideline Action Level 1
AL2	Cefas Guideline Action Level 2
AWB	Artificial Water Body
BDPE	Brominated Diphenylethers
Cefas	Centre for Environment, Fisheries and Aquaculture Science
COVID	Coronavirus
DBT	Dibutyltin
Defra	Department for Environment, Food and Rural Affairs
DO	Dissolved Oxygen
EC	European Commission
EEC	European Economic Community
EQS	Environmental Quality Standard
EQSD	Environmental Quality Standards Directive
EU	European Union
GCS	Good Chemical Status
GEP	Good Ecological Potential
GES	Good Ecological Status
GS	Good Status
HMS	Her Majesty's Ship
HMWB	Heavily Modified Water Body
HRA	Habitat Regulations Assessment
ID	Identity
ID	Identity
IECS	International Estuarine and Coastal Specialists Ltd
INNS	Invasive Non-Native Species
LNG	Liquefied Natural Gas
LT	Long-term
MAC	Maximum Allowable Concentration
MarESA	Marine Evidence based Sensitivity Assessment
MDP	Maintenance Dredge Protocol
MEP	Mostyn Energy Park
MEPE	Mostyn Energy Park Extension
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
NRW	Natural Resources Wales
NTL	Normal Tidal Limit
NVZ	Nitrate Vulnerable Zone
O&M	Operation and Maintenance
OCP	Organochlorine pesticide
OJEU	Official Journal of the European Union
PAH	Poly Aromatic Hydrocarbons
PBDE	Polybrominated Diphenyl Ether
PCB	Polychlorinated Biphenyl
PSD	Priority Substances Directive

Ramsar	Wetlands of international importance designated under the Ramsar Convention
RBMP	River Basin Management Plan
SAC	Special Area of Conservation
SeDiChem	Sediment Chemistry Data
SI	Statutory Instruments
SOVs	Service Operation Vessels
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
TBT	Tributyltin
TECFO	Thames Estuary Cockle Fishery Order
THC	Total Hydrocarbon Content
TSHD	Trailing Suction Hopper Dredging
UK	United Kingdom
WFD	Water Framework Directive
WID	Water Injection Dredging
ZoI	Zone of Influence

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

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