Planning Act 2008
Infrastructure Planning (Changes to, and Revocation of, Development Consent Orders) Regulations 2011
Document reference: TR030006/APP/8

Able Marine Energy Park

Material Change 2

Water Framework Directive Assessment

June 2021
Revision 1
BDB Pitmans

Humber Marine Energy Park

Water Framework Directive Assessment

DER6453-RT004-R03-00

June 2021

Document information

Document permissions	Confidential - client
Project number	DER6453
Project name	Humber Marine Energy Park
Report title	Water Framework Directive Assessment
Report number	RT004
Release number	R03-00
Report date	June 2021
Client	Able UK Ltd
Client representative	Richard Cram
Project manager	Graham Siggers
Project director	Mike Dearnaley

Document history

Date	Release	Prepared	Approved	Authorised	Notes
24 Jun 2021	03-00	JBL	TJM	TJM	
21 Jun 2021	02-00	JBL	TJM	TJM	
12 Apr 2021	01-00	JBL	TJM	TJM	

Document authorisation

Prepared	Approved	Authorised
[redacted]	[redacted]	[redacted]

Contents

Figures

Tables

1. Introduction

Able UK Ltd. The Applicant, received consent for a Development Consent Order (DCO) which approved the construction of a Marine Energy Park (AMEP) near Immingham on the southern bank of the Humber estuary. The AMEP will provide a facility for the marine energy sector, initially for the construction of offshore wind turbines and other activities associated with renewable energy generation. The project is referred to as the 'Proposed Development' within this report.

This WFD assessment should be read in conjunction with the following documents:

- Sediment plume dispersion from dredging (Updated ES Appendix UES8-1);
- Water and sediment quality ES Chapter 9 (SLR, 2021),
- Aquatic Ecology ES Chapter 10 (SLR, 2021);
- Hydro and sediment dynamics ES Chapter 8 (SLR, 2021);
- Updated dredging strategy (Updated ES Appendix UES4-2);
- MEP Impact of underwater piling noise on migratory Fish (TR030001-000383-10.3)[1];
- Sediment sampling plan (MMO Letter Ref SAM/2020/00052: letter dated 20 Jan 2021, Updated ES Appendix UES 9-4); and,
- sediment sample laboratory analysis results – Appendix B.

Environmental Impact Assessments (EIA) have been carried out and an Environmental Statement (the original ES) prepared for both the Proposed Development and the habitat compensation scheme (Able UK Ltd and Black & Veatch, 2012), formed part of the DCO application in 2011. A WFD assessment (HR Wallingford, 2012) (the original WFD assessment) also formed part of the application.

Able is proposing a material change to the DCO. Consequently, Able has produced the updated ES and supplementary documentation as part of the proposed material change application. The full details of the proposed material change is described in Chapter 4 of the updated ES (UES) (SLR, 2021).

The WFD assessments within this report are informed by the updated assessment of impacts following the proposed material change in design (SLR, 2021).

2. Project components

The consented DCO for the site, approved a harbour development with the associated land development to serve the renewable energy sector. The harbour comprises a quay of 1,279 m frontage, of which 1,200 m is solid quay and 79 m is a specialist berth formed by the reclamation of intertidal and subtidal land within the Humber Estuary. The key features of the Proposed Development that require consideration within the WFD assessment are:

- Reclamation;
- Quay construction;

[1] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR030001/TR030001-000383-10.3%20-%20MEP%20Impact%20of%20Underwater%20Piling%20Noise%20on%20Migratory%20Fish.pdf

- Capital dredging;
- Disposal of dredged material;
- Habitat compensation scheme; and,
- Maintenance dredging (operational).

The material differences caused by the proposed material change that require consideration for the updated WFD assessment are:

- Changes to the proposed quay layout to reclaim the specialist berth at the southern end of the quay, and to set back the quay line at the northern end of the quay to create a barge berth;
- A change to the consented deposit location for dredge arisings from the berthing pocket, to permit its disposal at Disposal Site HU081 if required, in addition to HU080 and HU082; and,
- An increase in the amount of sediment to be deposited in the estuary.

2.1. Reclamation

The reclamation area is located within the footprint of the quay and will affect both intertidal and sub-tidal estuary habitat. It is anticipated that the total dredge quantity for the reclamation area will be 605,000 wet tonnes. The material change will result in a slightly smaller reclamation area as compared to that consented in the DCO (see Table 2.2).

2.2. Quay construction

The Proposed Development will require the construction of a quay wall which will entail piling which will introduce underwater noise into the marine environment. The presence of the quay wall may also alter morphological aspects of the Humber Estuary. The material change means that the proposed quay layout to reclaim the specialist berth at the southern end of the quay, and to set back the quay line at the northern end of the quay to create a barge berth.

2.3. Capital dredging

Capital dredging will be carried out to create a berth pocket, approach channel and manoeuvring area. Dredging will affect sub-tidal estuary habitat. The total capital dredge will be approximately 1,970,000 m^3 (Updated ES Appendix UES4-2, Able, 2021). The anticipated capital dredge quantities for various dredge areas are presented in Table 2.1.

Table 2.1: Volume of capital dredging for the Proposed Development

Activity	Consented in DCO (wet tonnes)	Revised Quantity (wet tonnes)
Reclamation area	725,000	605,000
Dredging of berthing pocket	1,835,000	1,835,000
Dredging of approach channel	1,650,000	1,650,000
Dredging of turning area	250,000	250,000
The pumping Station outfall	8,000	8,000
Cherry Cobb Sands Breach	10,000	10,000
TOTAL	4,478,000	4,358,000

2.4. Disposal of dredged material

The proposed dredging works will be changed to comprise all mechanically dredged arisings from the berthing pocket being deposited at the HU081 or HU082 disposal sites in the Humber Estuary, instead of some having to be deposited on ‘terrestrial areas landward of the existing Killingholme Marshes flood defence wall’ (DCO Schedule 8, paragraph 11(2)).

This change is needed because the landside reclamation areas have already been substantially raised with engineered fill, and the remaining undeveloped part of the site is likely to be developed concurrently with the reclamation works and before the main capital dredging works are undertaken. Given this anticipated sequence, it is now unlikely that there will be anywhere to deposit the clay material within the Proposed Development site by the time the arisings are actually available. The Applicant will still seek options for beneficial use of the clay elsewhere but needs to modify the consented works to ensure that an alternative disposal site is available if no such use is identified at the material time.

The disposal of 2.218M wet tonnes of erodible material and 1M tonnes of inerodible arisings is consented as part of the Proposed Development under Schedule 8, Part 4, para 46 of the DCO at existing disposal sites within the Humber Estuary.

The recalculation of quantities undertaken to support the material change application has identified a need to dispose of up to 2.218M wet tonnes of erodible material and up to 1.254M wet tonnes of non-erodible material at each of sites HU081 and HU082, but no more than 4.358M wet tonnes in total to all three sites. This equates to the tonnage presented in Table 2.1 of 4.358M wet tonnes. It is anticipated the inerodible material will be placed at HU081 and HU082 and the erodible material at HU080.

2.5. Areas affected

Table 2.2 provides the areas (in m^2) that will be affected by each of the activities presented above. It should be noted that these figures represent the total areas affected during construction activities and do not represent a permanent loss of habitat in all cases.

The proposed changes to the quay layout will lead to a slight reduction in the area of intertidal and shallow subtidal habitat lost under the quay footprint, from approximately 45.0ha to 43.6ha, out of a total of 26,180ha of the available intertidal and subtidal area in the lower and middle estuary (Chapter 10 Aquatic Ecology, SLR, 2021).

Table 2.2: Areas affected by Proposed Development

Activity	A. Area affected (m^2) original WFD	B. Area affected (m^2) updated WFD	B-A. Change m^2
Reclamation	450,000	436,014	-13,986
Dredging of berthing pocket	87,883	80,687	-7,196
Dredging of approach channel	329,177	425,918	96,741
Dredging of turning area	208,720	138,297	-70,423
Disposal of dredged material at site HU082	total area of site HU082 is 1,073,872 m^2. Disposal of dredged material will not take place over the entire site		
Disposal of Dredged material at site HU081	total area of site HU081 is 526,796 m^2. Disposal of dredged material will not take place over the entire site		
Disposal of dredged material at site HU080	The total area of site HU080 is 1,973,234 m^2. Disposal of dredged material will not take place over the entire site		
TOTAL reclamation + dredging	1,075,780 + disposal area	1,080,916 + disposal area	5,136
TOTAL dredging only	625,780	644,902	19,122

*Source: *From AME-006-00140 B Dredge Operation Areas 18/06/21*

2.6. Habitat Compensation Scheme

The habitat compensation scheme that is a requirement of the DCO, comprises three parts:

- managed realignment and regulated tidal exchange to create an intertidal area (Cherry Cobb Sands);
- wet grassland; and,
- overcompensation site (East Halton).

These three components are described further in the sections below.

2.6.1. Cherry Cobb Sands

An intertidal compensation site, Cherry Cobb Sands (see Figure 2.1) will be developed into an intertidal area providing 102.4 ha of intertidal habitat, located on the north bank of the Humber Estuary. Cherry Cobb Sands is opposite the Proposed Development, approximately 4 km south-west of Keyingham and north of Stone Creek. The site currently comprises Grade 2 arable fields bounded by drainage ditches and a flood defence embankment.

2.6.2. Cherry Cobb Sands wet grassland site

As partial compensation for the loss of Special Protection Area (SPA) bird habitat associated with the construction of the Proposed Development, it is proposed to create wet grassland immediately adjacent to the Cherry Cobb Sands managed realignment site (Black & Veatch, 2011), as shown on Figure 2.1. This would provide a foraging resource during the construction and development of the Cherry Cobb Sands compensation site. It may be that this additional site will only be required for a few years while the main Cherry Cobb Sands compensation site and creek system is developing, although it will be maintained until monitoring of the new intertidal habitat at the Cherry Cobb Sands compensation site indicates the site is providing effective compensation for the Proposed Development. This wet grassland site is approximately 38.5 ha and is known as the Cherry Cobb Sands Wet Grassland Site. The site currently comprises arable farmland on reclaimed saltmarsh or other intertidal habitat.

2.6.3. East Halton overcompensation site

The HRA for the original application deemed it necessary to provide overcompensation. The overcompensation site has been successfully developed at Halton Marshes in 2019 and involved the conversion of an arable field to pasture, with a range of different degrees of wetness providing a mosaic of different ecological functionalities.

As such this component of the original WFD assessment (HR Wallingford, 2012) is not considered further within this current assessment.

2.7. Maintenance dredging

An overview of anticipated maintenance dredging requirements as a result of the proposed material change and the implications for WFD compliance is presented in Section 5.3.8.

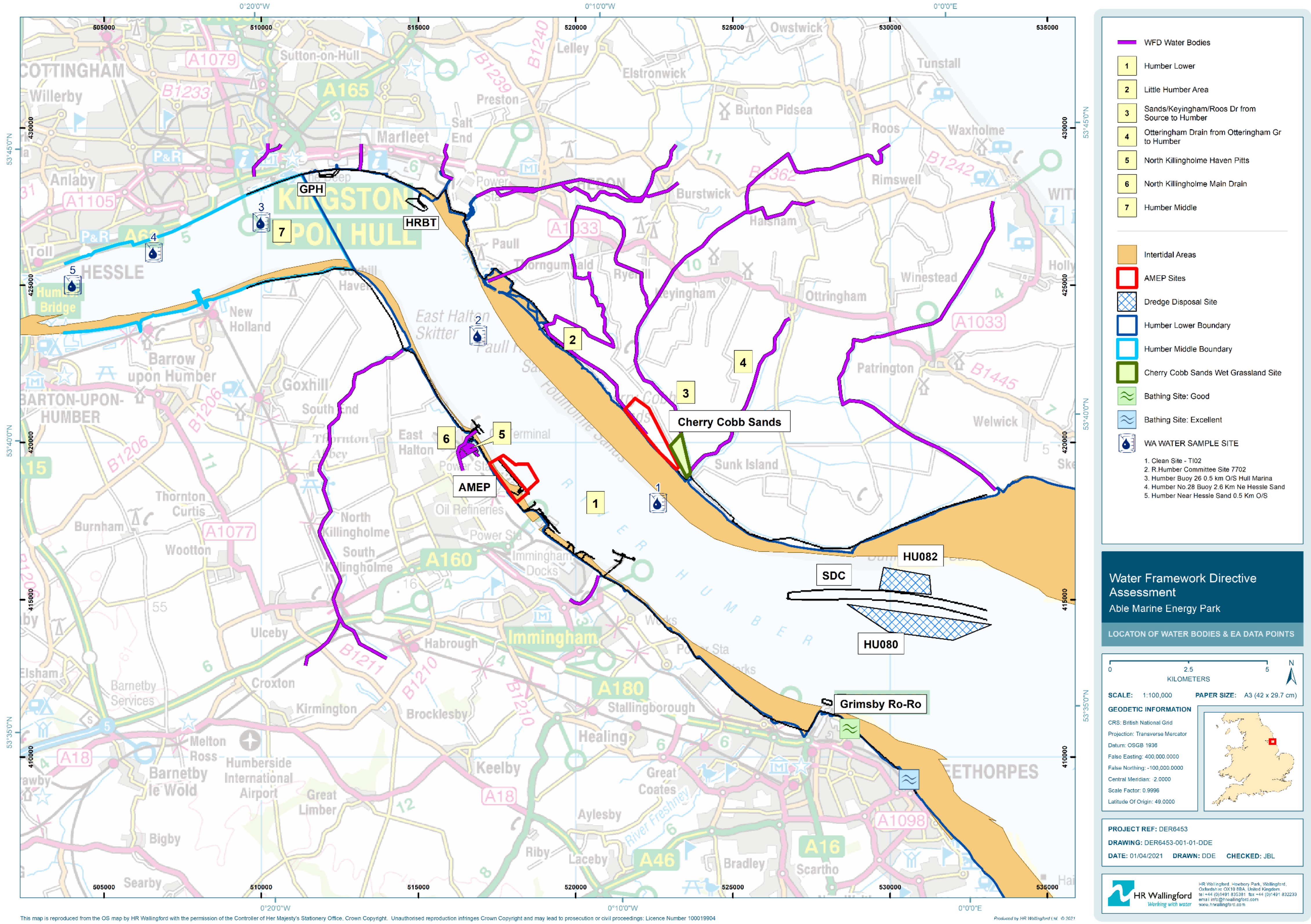


Figure 2.1: Proposed Development site (AMEP), compensation sites, WFD water bodies and Environment Agency water quality sampling locations in the vicinity of the Proposed Development

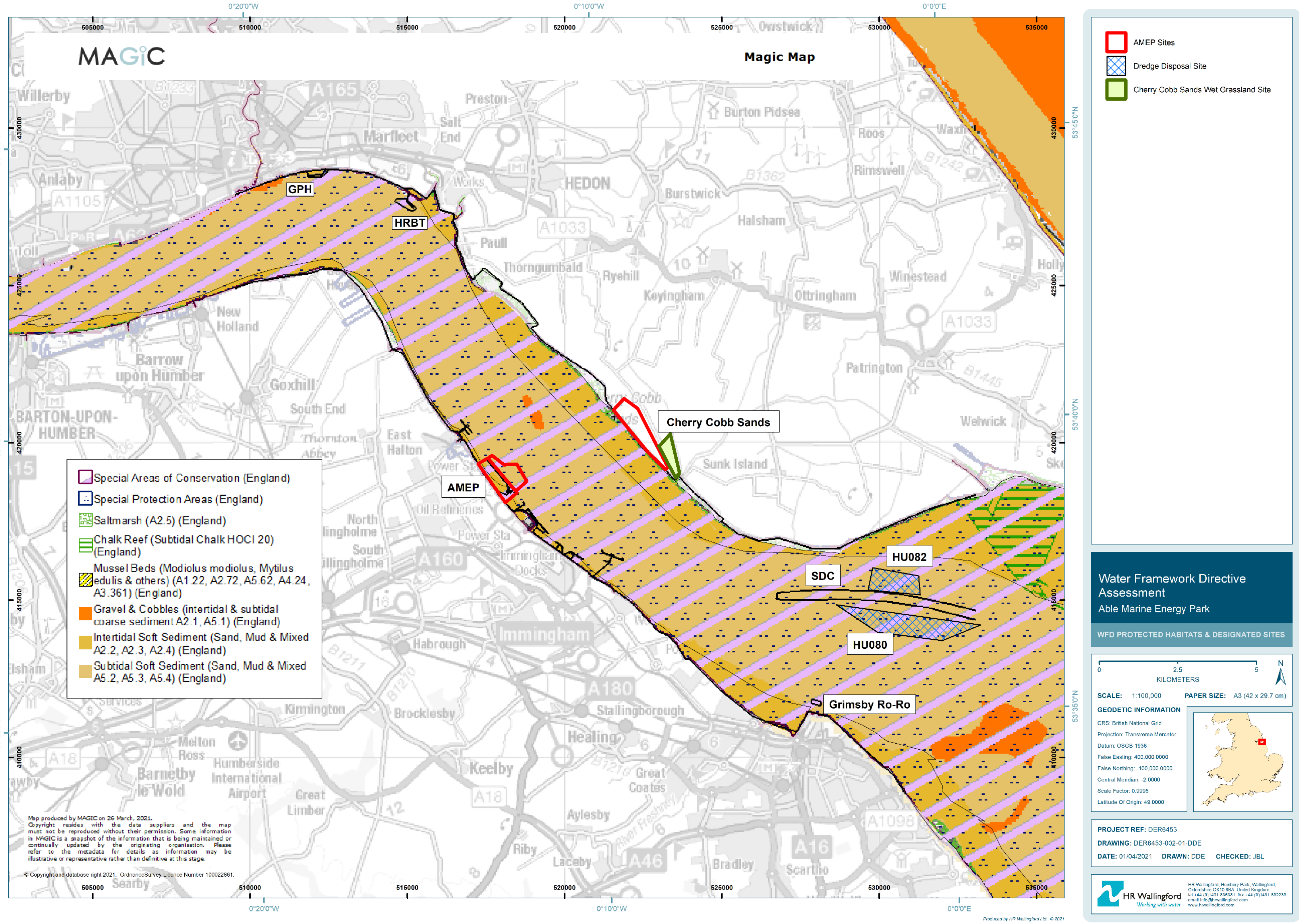


Figure 2.2: Protected areas, higher and lower sensitivity habitats and disposal grounds in the vicinity of the Proposed Development.

Source: Base map from MagicMap [Defra: Accessed April 2021] https://magic.defra.gov.uk/

2.8. Water bodies

A preliminary review of the Proposed Development was conducted, at the start of the updated WFD assessment, of the potential zone of influence of the Proposed Development and has identified the following water bodies:

- Humber Lower (transitional water body);
- Humber Middle (transitional water body);
- Keyingham Drain (part of Sands/Keyingham/Roos Drain from Source to Humber artificial water body);
- Otteringham Drain (from Ottringham Grange to Humber);
- Burstwick Drain (from source to Humber);
- North Killingholme Main Drain (freshwater artificial water body); and,
- Hull and East Riding Chalk (ground water body).

Figure 2.1 indicates the location of various areas associated with the Proposed Development and the proximal WFD water bodies that have been identified above.

This report presents the updated WFD assessment for the Proposed Development, including the proposed material change, considering the water bodies listed above and builds upon the original WFD assessment (HR Wallingford, 2012, R05).

Figure 2.2 indicates the location of various WFD habitats associated with the Proposed Development, and a number of the associated protected sites that require consideration in the updated WFD assessment.

This report provides an update to the WFD assessment as a result of the material changes to the project, and takes account of any updated baseline since the original assessment, as well as guidance for the completion of a WFD assessment in transitional water bodies (‘Clearing the Waters For All’, Environment Agency, 2017) provided after the original WFD assessment was prepared.

The ‘Clearing the Waters for All’ guidance relates to the assessment of transitional water bodies, and the relevant transitional water body is assessed in Section 5. The WFD assessment considers separately non-transitional water bodies that are classified as artificial water bodies (AWB) in Section 6. The assessment of the AWB considers if there is any interactions between the Proposed Development, including the proposed material change, and the AWBs and any subsequent effect on the status of any water body.

3. WFD assessment methodology

3.1. The 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 superseded 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, unless alternative objectives are set and there are appropriate reasons for time limited derogation.

The ecological status 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.

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. The Environment Agency subsequently published updated RBMPs for England as part of the second cycle (2015 to 2021), as well as providing water body classification results from 2015 to 2019 classifications via the Catchment Data Explorer (https://environment.data.gov.uk/catchment-planning).

The Proposed Development is located within the Humber Lower transitional water body (see Figure 2.1) in the Humber river basin district which is reported in the Humber River Basin Management Plan (RBMP) (Environment Agency, 2015). The status of this water body is discussed further in Section 4.

3.2. WFD assessment

Activities that disturb the seabed have the potential to either cause deterioration in the ecological or chemical status of a water body, or to compromise improvements which might otherwise lead to a water body meeting its WFD objectives. The Environment Agency's 'Clearing the Waters For All' guidance (updated 2017) sets out the process for ensuring that the effects of activities are compliant with the WFD. The guidance comprises four stages:

- Stage one: Screening;
- Stage two: Scoping;
- Stage three: Impact Assessment; and,
- Stage four: Identification of Measures.

The 'Clearing the Waters for All' guidance relates to the assessment of transitional water bodies. These are assessed in Section 5. This WFD assessment considers separately non-transitional water bodies in Section 6.

3.2.1. Stage one: Screening

Within the screening stage, some activities can be 'screened out' due to the nature, frequency or intensity of the activity. This thereby excludes activities that do not need to go through the scoping, impact assessment and measures stages.

The Environment Agency's guidance states that: *you do not need to carry out scoping if your activity is low risk. Your activity is low risk if it is a 'self-service marine licence activity' or an 'accelerated marine licence activity' that meets specific conditions* (https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters).

If the Proposed Development does not meet the self-service or accelerated marine licence criteria, the assessment should proceed to stage two: Scoping.

3.2.2. Stage two: Scoping

If an activity is not screened-out during stage one, the scoping stage identifies any activities that have a potential risk/s to each of the five WFD receptors. The receptors are:

- Hydromorphology;
- biology – habitats;
- biology – fish;
- water quality; and,
- protected areas.

These receptors are based on the water body's quality elements. Consideration is also required for invasive non-native species (INNS) at the scoping stage.

3.2.3. Stage three and four: Assessment and identification of measures

If there are any activities scoped in at stage two (above), the assessment stage considers the potential impacts of the activity, identifies ways to avoid or minimise impacts, and shows if the activity may cause deterioration or jeopardise the water body achieving good status.

4. Potentially affected water bodies

4.1. Water bodies

4.1.1. Introduction

The water bodies in the vicinity of the Proposed Development are listed in Section 2.8 and shown on Figure 2.1. Of these water bodies, a detailed assessment of WFD compliance, in relation to the proposed material change, has been carried out for Humber Lower transitional water body (Section 5), the Keyingham Drain (part of Sands/Keyingham/Roos Drain from Source to Humber artificial water body) and the Otteringham Drain water body (Section 6).

The other adjacent water bodies were excluded from the original WFD assessment (HR Wallingford, 2012) for the reasons given in Section 4.1.2.

Following the submission of the original WFD assessment (HR Wallingford, 2012), a monitoring and management strategy was required (under DCO Schedule 11 Requirement 15a) to show how compliance with the WFD was to be monitored during the Proposed Development. The management strategy (Niras, 2017) was approved by the Environment Agency (EA ref AN/2015/122049/05-L01, letter dated 03 April 2017) as adequate to discharge Requirement 15 of Schedule 11 of the DCO.

4.1.2. Adjacent water bodies

Humber Middle and Yorkshire South and Lincolnshire coastal water body

The Humber Lower water body becomes the Humber Middle water body upriver (See Figure 2.1), whilst to seaward it becomes the Yorkshire South and Lincolnshire coastal water body. The closest part of the project to the boundary with the Humber Middle water body to the Proposed Development is approximately 7 km.

The Humber Middle water body is considered to be sufficiently distant that it should not form a part of this updated WFD assessment.

Seaward, the disposal sites are located closest to the coastal water body at a distance of approximately 7 km. The coastal water body, is a very large water body extending from Flamborough Head in the north to the Wash. This water body is heavily modified and at moderate ecological potential with nitrogen and phytoplankton being identified as the cause of the failure to meet good ecological potential. There is no indication that the sediment from the AMEP that will be placed at the disposal sites has a high nitrogen content. It can be concluded, therefore, that the use of these existing disposal sites is not considered likely to cause deterioration in the Yorkshire South/Lincolnshire water body or affect its ability to move towards good potential.

The approach taken in the WFD assessment is, therefore, to assume that as long as there are no effects on the Humber Lower water body that are considered significant at water body level then there will equally not be any significant effects on these adjacent water bodies. This working assumption is reviewed in the overall conclusions (Section 7).

North Killingholme Main Drain

The North Killingholme main drain (ID GB104029067580) is a freshwater/river water body located to the north west of the Proposed Development. This is an artificial water body and designated for land drainage; it is currently at moderate ecological status due to the failure of ammonia to achieve good status and is at good chemical status. Section 13.6.7 of Chapter 13 Drainage and Flood Risk of the original ES notes that foul water from the operation of the Proposed Development will be discharged to this waste water treatment works (WWTW) and notes that Anglian Water will carry out a feasibility study and identify any necessary improvement works. Any potential effects of the (after the Proposed Development) discharge from the WWTW to the receiving water body will be controlled by consents to be obtained by Anglian Water as part of their upgrading of the WWTW. A separate consenting process thus applies. It is further noted that as the Environment Agency is the WFD competent authority it is considered unlikely that Anglian Water would be given authorisation from the Environment Agency for a discharge which could lead to deterioration in the chemical status of the water body.

The site is currently drained by a network of open watercourses (the Killingholme Marshes Drainage System under the control of the North East Lindsey Drainage Board - NELDB) that discharge into the Humber Estuary via a flapped gravity outfall on the coast in the middle of the Proposed Development frontage (Section 13.5.16 of the original ES). The existing tidal outfall is located within the footprint of the proposed quay. The outfall therefore needs to be relocated to accommodate the development and will be located to the south of the site and will discharge into the Lower Humber water body. This does not constitute a change to the current surface water discharge situation for North Killingholme main drain.

Taking into account the above, it is concluded that no further assessment of the North Killingholme main drain water body is required at this stage.

North Killingholme Haven Pits

The North Killingholme Haven Pits transitional water body (ID GB560402916700) (see Figure 2.1) is located in the vicinity of the Proposed Development. There is occasional direct hydraulic connectivity via a sluice between the Humber Lower and the North Killingholme Pits water bodies; however, this sluice is opened only at certain periods during the year. If the water in the lagoon is too high then the sluice is opened at low tide to allow water to flow from the lagoon to the Humber. If the water in the lagoon is too low then at high tide the sluice is opened to allow water to flow from the Humber to the lagoon. The location of the sluice gate itself is on the Humber side of the seawall in the north-west corner of the area, just outside the site. The water from the Humber already contains a high suspended sediment load: the increases in suspended solids associated with the dredging activity will be temporary and within the envelope of normal background levels (HR Wallingford, 2021), so this is unlikely to alter the composition of the water of the North Killingholme Haven Pitts. Therefore, it is considered that no further assessment of the North Killingholme Haven Pitts is required at this stage.

Burstwick Drain

This water body lies outside the boundaries of the habitat compensation sites and will not be directly affected by any of the works to create the new habitats. However, the drain discharges to the Humber Lower water body. The potential for an effect is therefore related to construction activities at the Cherry Cobb Sands site resulting in sediment-laden or contaminated water entering the drains. Burstwick Drain discharges into the Humber via a sluice that only opens at low tide. As the sluice is closed, except for at low tide, this prevents any estuarine water from entering this water body, thus there is no mechanism for potential impacts associated with temporary increased suspended sediment concentrations sourced from the artificial water body entering the adjacent Humber Lower transitional water body.

The Environment Agency is, however, concerned that siltation may occur in front of the sluice that could prevent the water body from discharging to the Humber Lower water body. This could lead to additional deposition in areas of reduced velocity behind the sluice gate which could in time affect the status of the artificial water body. This issue is recognised in the original ES. Section 36.6.1 refers to ‘construction activities’ being ‘managed to ensure drainage of surrounding land is not compromised at any time’. This assessment therefore assumes that this includes ensuring that the current deposition levels in front of the sluice gates are not exacerbated, and as such the Burstwick Drain is not assessed further within this WFD assessment. The proposed material change will have no impact on the Burstwick Drain water body.

Hull and East Riding Chalk ground water body

Section 33 of the habitat compensation scheme in the original ES concludes that there will be no impact from the habitat compensation scheme on the Hull and East Riding Chalk ground water body, in part because of the depth of this primary chalk aquifer which is overlain by around 20 to 25 m of marine and estuarine alluvium and 1 to 5 m of more recent deposits (Able UK Ltd and Black & Veatch, 2011). The ES further concludes that there are no source protection zones within 2 km of the proposed compensation site and it is therefore considered that no source protection zones will be affected by the works at either Cherry Cobb Sands compensation site or wet grassland site. Based on the conclusions of the ES, no further consideration of ground water is included in this WFD assessment. The proposed material change will have no impact on the Hull and East Riding Chalk ground water body.

4.2. Humber Lower Water Body

The dredging, reclamation and disposal will all take place in the same water body – the Humber Lower transitional water body (ID GB530402609201). The proposed Cherry Cobb Sands compensation site will, once the sea wall is breached, become part of the Humber Lower transitional water body (ID GB530402609201).

The ‘Clearing the Waters for All’ guidance relates to the assessment of transitional water bodies, which is followed for the Humber Lower water body with the current status later in this Section 4 and assessment in Section 5. The WFD assessment for the Keyingham Drain and Otteringham Drain water bodies is presented separately in Section 6, as they are not transitional water bodies and the assessment process is considered separately.

4.2.1. Humber River Basin Management Plan

As the Humber Lower water body are classified as being heavily modified for the purposes of navigation, ports and harbours which is the same as the purpose of the Proposed Development, it is necessary to indicate that the proposed activities will not affect any mitigation measures implemented in relation to the heavily modified water body (HMWB) status of the Humber Lower water body. The Humber river basin management plan (Environment Agency, 2015) identifies a number of priority river basin management issues to tackle within the Humber Estuary catchment. These include:

- coastal squeeze and intertidal habitat loss;
- tributyltin contamination in the inner estuary; and,
- dissolved oxygen levels in the inner estuary during summer months.

This management issues identified above fit well with the requirement under the Water Framework Directive for the Humber to reach 'good ecological potential'. Mitigation measures specified in the Humber RBMP (Environment Agency, 2015) to address physical modification include:

- improvement to condition of channel/bed and/or banks/shoreline;
- removal or easement of barriers to fish migration;
- improvement to condition of riparian zone and/or wetland habitats;
- change to operations and maintenance;
- removal or modification of engineering structure; and,
- vegetation management.

Future aims of the Humber Estuary catchment within the Humber RBMP (EA, 2015) are to:

- extend existing programmes of data collection to fill gaps and ensure that high quality physical, biological and chemical data and evidence exists to support decision making;
- work with landowners and businesses adjacent to the estuary to identify and work towards addressing issues that may be causing water quality problems; and,
- raise awareness of the effects of actions both on the estuary and upstream on the water quality in the Humber Estuary.

4.3. Current status: Humber Lower transitional water body

Table 4.1 provides a summary of the Humber Lower transitional water body (GB530603911401), within which the Proposed Development is located (see Figure 2.1). Details include current water body status (overall, ecological and chemical) and parameters currently failing to achieve good status.

Table 4.1: Humber Lower transitional water body summary

WFD water body name	Humber Lower
WFD water body ID	GB530603911401
River basin district name	GB530402609201
Water body type	Estuarine
Water body total area (ha)	24786.211
Overall water body status	Moderate
Ecological status	Moderate
Chemical status	Fail
Target water body status	Reaching good ecological potential (GEP) by 2027 Reaching good chemical status (GCS) by 2015
Hydro-morphology status	Not assessed
Parameters not at Good Status (2019)	Biological: Angiosperms and Invertebrates; Physio-chemical: Dissolved inorganic nitrogen; Chemical: Cypermethrin, Dichlorvos, Polybrominated diphenyl ethers (PBDE), Perfluorooctane sulphonate (PFOS), Benzo(b)fluoranthene, Benzo(g-h-i)perylene, Mercury and Its Compounds and Tributyltin Compounds.
Is the water body heavily modified (HMWB)?	Yes
Use: Coastal protection	Yes
Use: flood protection	Yes
Use: navigation, ports and harbours	Yes
Chalk reef (ha) (high-sensitivity habitat)	689.36
Saltmarsh (ha) (high-sensitivity habitat)	1072.31
Cobbles, gravel and shingle (ha) (low sensitivity habitat)	280.54
Intertidal soft sediment (ha) (low sensitivity habitat)	8788.69
Rocky shore (ha) (low sensitivity habitat)	0.46
Subtidal soft sediments (ha) (low sensitivity habitat)	11286.66
Magic map link for each water body	Humber Lower
Bivalve mollusc production area name	Humber
WFD phyto-plankton classification	High
History of harmful algae	No

Source: Water body summary table – EA.gov.uk and EA Catchment data explorer at: https://environment.data.gov.uk/catchment-planning/WaterBody/GB530402609201 [Accessed March 2021]

4.4. Status of Humber Lower transitional water body

The Humber Lower transitional water body currently has an overall moderate status, based on moderate ecological potential and fail chemical status. 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. Moderate ecological potential is due to the biological quality elements 'Angiosperms' and 'invertebrates' (moderate) and the physiochemical quality elements 'Dissolved inorganic nitrogen' (moderate).

5. WFD Assessment – Humber Lower transitional water body

5.1. Stage One: Screening

The first stage of a WFD assessment allows activities that do not require further assessment to be screened out. The Proposed Development does not meet the MMO criteria for 'low risk' activities.

As such, it is considered that the Proposed Development would need to progress to the WFD scoping stage.

5.2. Stage Two: Scoping

As the Proposed Development has not been screened out at stage one, consideration is required for the interaction of the Proposed Development with WFD receptors. A list of WFD receptors groups is shown in Section 3.2.2.

Environment Agency WFD guidance (2017) recommends the use of a scoping template to record the scoping stage findings (https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters) for estuarine and coastal waters. The template can then be sent to the regulator as part of the WFD assessment. The populated scoping template for the Proposed Development, including the proposed material change, can be found at Appendix A. A summary of the scoping stage for the Humber Lower water body is shown in the Table 5.1 below.

Table 5.1: Summery of WFD Scoping assessment

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	Yes	The Proposed Development includes: (i) dredging; (ii) land reclamation; (iii) construction of a quay; and, (iv) disposal of sediments at the disposal site. Each of these activities has the potential to impact the hydromorphology of the Humber Lower. The Humber Lower is a HMWB for the same use as the Proposed Development of: Flood protection and navigation, ports and harbours.
Biology: habitats	Yes	Location of the Proposed Development and size of works is above risk thresholds.
Biology: fish	Yes	The Proposed Development is in an estuary that is important for migratory fish. The construction activities may potentially cause a barrier that is physical (sediment plume) chemical (chemical plume) or noise barrier to fish migrations.
Water quality	Yes	The Proposed Development construction activities could affect water quality for longer than a neap tidal cycle (about 14 days). There are chemicals within the sediments that are above CAL1 which will be disturbed during the Proposed Development.
Protected areas	Yes	The Proposed Development is within part of the Humber SAC and Humber SPA.
Invasive non-native species	Yes	Introduction or spread of INNS is a potential risk from construction activities that requires assessment.

Source: Full WFD scoping assessment can be seen in Appendix A

5.3. Stage three and four: Assessment and identification of measures

The issues requiring further assessment in Stage two are considered further below.

5.3.1. Hydromorphology

Creation of new intertidal

During the majority of the construction process, the creation of the Cherry Cobb Sands site will not have an impact on the intertidal zone structure as the new embankments will be built behind the existing flood embankments. The potential implications of the construction on the Keyingham Drain and Otteringham Drain artificial water bodies are discussed in Section 6. The creation of the breach site will initiate an effect on the hydrodynamic and sediment regime along the frontage of the site as foreshore levels will be lower (Section 32.6.2 of the original ES). A maximum velocity of 2.4-2.6 m/s has been predicted (Section 32.6.7 of the original ES) within the first two weeks after the breach. Any saltmarsh remaining near the mouth of the breach will be eroded by the high velocity flows.

Local erosion is expected to be approximately 0.5 m over a 5 year period close to the breach (Section 32.6.19 of the original ES). Additional work has compared the predicted erosion for the regulated tidal exchange (RTE) scheme with the results of the original ES and suggests that erosion will be approximately 20 % greater during the first years following breaching when the RTE fields warp up. After this period the erosion will be less than that predicted in the original ES. The cross section of Cherry Cobb Sands Creek downstream of the breach will enlarge following breaching of the site and will stabilise over time as the RTE fields and the realignment area of the site accrete to their new equilibrium.

In itself the process described above represents a change to the morphology of the intertidal zone of the north bank of the Humber Lower water body, however this will not be significant at the water body scale.

Capital dredge and quay wall construction

Capital dredging is required to construct the berth pockets and turning area at the proposed AMEP. The sediments to be dredged consists of alluviums, soft clays, sand and gravels and glacial till. These are likely to require a combination of hydraulic dredging methods (cutter suction dredgers (CSD) or trailing suction hopper dredgers (TSHD)) and mechanical, backhoe (BHD) dredging to remove the stiffer glacial till. Table 5.2 presents the likely volumes of sediment to be removed by each method, though the actual split may vary.

Table 5.2: Maximum Quantities of Dredge Material and Proposed Dredging Methods

Material Type	Volume (m3)	Dredge Method
Alluvium, Clays, Sands and Gravels	1,440,000	Hydraulic (CSD or TSHD)
Glacial Till	590,000	BHD or CSD

Source: Updated ES Chapter 8 Hydrodynamic and Sedimentary Regime

Any effects of the material change in the Proposed Development have been assessed in relation to hydro- and sediment dynamics (updated ES: Chapter 8 Hydrodynamic and Sedimentary Regime). The original WFD assessment considered potential for hydromorphological impacts as a result of the Proposed Development. HR Wallingford 2021a assesses any changes to the original assessment in the context of hydro and sediment dynamics. The assessment concludes there are no significant changes when compared to the original consented development. The findings are summarised below (updated ES: Chapter 8 Hydrodynamic and Sedimentary Regime):

- The Proposed Development amended quay leads to no significant change in assessed impacts on water levels compared to the consented layout;
- The proposed AMEP Amended Quay layout leads to no significant change in assessed impacts to flood tide flows compared to the consented layout. During the ebb tide, a localised region of flow acceleration is predicted off the downstream end of the quay. This initial change may diminish with time but should be noted;
- Similar patterns of bed shear stress are presented for the proposed AMEP Amended Quay layout as for the consented layout;
- The proposed AMEP Amended Quay layout leads to no significant change in assessed impacts on waves compared to the consented layout;

- The Amended Quay layout is predicted to slightly reduce by 29,000 wet tonnes per year (or <6% of the average annual disposal quantity of 503,000 wet tonnes for the period 2016 to 2019) of the HST/C.Ro berths and approaches, due to a reduction in settlement predicted within these areas. For the downstream Immingham Riverside berths, the Amended Quay is predicted to slightly reduce the annual siltation by about 26,000 wet tonnes per year (or ~1% of the average annual disposal quantity of 3,447,000 wet tonnes for the period 2016 to 2019).
- The change to maintenance dredging requirements at the proposed AMEP Amended Quay layout when compared to the consented scheme is predicted to be an increase of up to 41,000 m^3/year muddy sediments and a decrease of 34,000 m^3/year for sandy sediments into the AMEP Berth Pockets. Significant localised sand deposition onto the dredged slopes of the proposed turning area / approach channel is predicted but the degree to which sandy infill occurs will be influenced by the availability of sand on the seabed. Presently material dredged from the area is described as silt.
- To the northwest of AMEP, bed level rising is likely to be at a slightly lower rate with the proposed AMEP Amended Quay layout. To the southeast there is likely to be no significant change from that predicted, other than to note that significant accretion has taken place since the original assessment (as a result of HIT) which leads to less further accretionary effect possible by AMEP.

Disposal of arisings

Disposal of dredged material to sites HU081 and HU082 by barge will result in localised changes to the tidal currents and wave action in proximity to the site. These changes to the hydrodynamics will have no effect on the ongoing coastal erosion to the north east of Hawkins Point or to the proposed site for managed realignment further to the east (Chapter 8 Hydrodynamic and Sedimentary Regime).

The material placed at sites HU081 and HU082 will be eroded by the action of the tidal currents and waves and the silt and clay sized material arising will disperse rapidly from the sites. Sands and gravel sized material arising from the placement will tend to accumulate in undulations on the seabed at the disposal site. Any material dredged by BHD or CSD and placed by barge at HU081 or HU082 will slowly be eroded by the action of tidal currents and waves. Sands and gravel sized material at the disposal sites and arising from the erosion of the glacial till will reduce the overall rate of erosion of the placed till. It is expected that the majority of the glacial till placed at either site will erode within a few years of placement.

This is considered to be a localised minor impact that is not significant at water body level.

Conclusion

The WFD assessment concludes that there is not likely to be a non-temporary effect on hydromorphology WFD parameters of the Humber Lower water body at water body level as a result of the proposed material change.

5.3.2. Biology habitats

Intertidal zone structure

The construction of the reclamation and capital dredging will result in a direct loss of intertidal habitat as well as the conversion of mudflat to saltmarsh. These effects are in a Natura 2000 site and are significant in the context of the Habitats Directive. Following the submission of a shadow HRA for the original development, a discussion between Able, the MMO and Natural England provided a statement of common ground (ERM, 2012) on original development and the requirement for compensatory habits to be required.

Excavation of saltmarsh to enable the breach at the Cherry Cobb Sands site will result in permanent local loss of existing habitat and its associated benthic communities. Section 34.6.3 in Chapter 34 Aquatic Ecology and Nature Conservation of the original ES states that this impact has been assessed to be of a local scale restricted to the zone of influence (i.e. the saltmarsh and intertidal habitat within the excavated footprint).

However, even after the breach, the bed levels at the frontage of the Cherry Cobb Sands site will remain intertidal, and there is expected to be compensation for loss of saltmarsh within the Cherry Cobb Sands site once fully established and new saltmarsh habitat forms in the managed realignment part of the compensation site. There is therefore no permanent loss of intertidal zone and as the biological effects are not considered to be significant at water body level then the effects on the intertidal zone structure supporting element are also not considered to be significant at water body level.

All the species recorded in the vicinity of the reclamation site and Cherry Cobb Sands are typical of the benthic community within the Humber Estuary, with moderate abundance and diversity of mostly common species with low sensitivity. There are no species of particular conservation importance (SLR, 2021).

Change in bathymetry resulting from disposal of inerodible dredged material at site HU082 will affect wave direction in the intertidal zone through changes to the refraction process. There is the potential for minor impacts on the intertidal area as a result of this change, however this is not expected to result in changes at the water body scale and is unlikely to have significant secondary effects on the benthic infauna present at those location.

New Intertidal Habitat

Whilst construction of the Cherry Cobb Sands site will result in a small loss of intertidal habitat in the area of the breach, this will be compensated for by the additional area of intertidal created as a result of the breach. It is expected that the area immediately around the breach in the set-back site will become colonised quickly by the opportunistic benthic species which are present in the Humber (SLR, 2021). Within approximately six months pioneer communities should be established and after 12 months more stable communities potentially mimicking those found in the Humber may be present. Colonisation will be incremental with areas nearest to the breach being colonised first and the communities slowly spreading out to the furthest edges of the site (Section 34.6.10 Chapter 34 Aquatic Ecology and Nature Conservation of the original ES). The regulated tidal exchange fields will be managed to promote the development of wet mudflat habitat.

Aquatic flora (saltmarsh)

With respect to the Cherry Cobb Sands compensation site, there is no mechanism for an impact on any of the WFD elements in the Humber Lower water body until the breach in the flood defence and the channel through the existing saltmarsh between the seawall and Cherry Cobb Sands Creek are made. This is confirmed in Section 32.6.2 Chapter 32 Hydrodynamic and Sedimentary Regime of the original ES which states that during the construction phase of the project the habitat creation site will not have an impact on the hydrodynamics and sedimentary regime of the estuary until the final stage when the flood defence is breached. At this point the aquatic flora (saltmarsh) (included in the aquatic flora WFD parameter) will be removed. Construction of the breach in the flood defence and channel requires the removal of approximately 2 ha of saltmarsh. This includes both direct removal and any additional loss due to scour around the mouth of the breach. Although saltmarsh is part of the designated nature conversation sites (SPA, SAC and Ramsar) the area lost equates to 0.3% of the total saltmarsh habitat in the Humber Estuary (627 ha). Section 34.6.1 Chapter 34 Aquatic Ecology and Nature Conservation of the original ES states that the loss of saltmarsh will be compensated for and will eventually become part of the Lower Humber water body once new saltmarsh habitat forms in the managed realignment part of the compensation site. In this instance the consideration of deterioration relates to the effect on the protected area rather than the effect at water body level.

The loss of designated intertidal and sub tidal habitat is acceptable in the context of the agreed compensation package in HRA terms, and therefore it is considered that the protected area objectives under the WFD are satisfied. In the longer term the compensation scheme may well provide a net benefit in terms of the status of saltmarsh in the Lower Humber water body.

The updated aquatic baseline information, reported in Appendix UES10-1 of the updated ES (SLR, 2021) identifies a region of new saltmarsh that has developed on and around the main development site, including the area of reclamation. Given the increase in elevation of the intertidal profile around the mean high water neap (MHWN) elevation, and a corresponding increase in the width of upper shore intertidal zone, there has been an increase in the extent of colonisation by saltmarsh vegetation, that was not present at the time of the original assessments for the Proposed Development.

There is some loss of saltmarsh at the main development site as a result of new saltmarsh development since the original DCO and original WFD assessment (HR Wallingford, 2012). The compensation site at Cherry Cobb Sands is expected to develop from intertidal mud flat into saltmarsh over time. The assessment of the new saltmarsh has been indicated during the updated Environmental Statement (SLR, 2021) as not representing a net loss of saltmarsh arising from the material amendment, as it would have been lost purely by implementing the consented scheme and the extant DCO. However as the compensation site was intended to compensate for the loss of intertidal habitat due to the Proposed Development, the likelihood is, it will also contribute toward offsetting the loss of the saltmarsh that has developed at the main site.

Benthic invertebrate fauna

Benthic invertebrates in the Lower Humber water body are currently at moderate status (Environment Agency Catchment Data Explorer, accessed 01 March 2021).

The WFD Assessment should consider whether the activities associated with the AMEP development are likely to:

- cause deterioration to the status of benthic invertebrates (i.e. cause the status to change from good to moderate, or moderate to poor); and,
- (if benthic invertebrates are at moderate status) prevent the benthic invertebrates from achieving good status.

It should be noted that the WFD is principally concerned with deterioration between status classes at the water body level; the WFD implicitly accepts that there may be local variation including deterioration within a status class.

The updated assessment of potential ecological impacts due to the proposed material change (SLR, 2021) concluded that there were not likely to be an significant impacts to benthic inverts as a result of the material change.

Reclamation, dredging and disposal

Whilst there is a net reduction in habitat loss under the footprint of the quay, there is an expectation that dredging will take place over a larger area (Table 2.2). Dredging and dredge disposal operations will lead to the resuspension of sediments in the water column (sediment plume), with possible physiological effects on components of the invertebrate communities due to the increase in water turbidity, as considered in the original ES. The proposed changes in quay layout at the AMEP site combined with natural changes in the estuarine bathymetry will lead to a small increase in the dredging activity overall, with an increase in the total volume of dredged material at the AMEP site.

The potential effects on benthic invertebrates arising from the reclamation, dredging and disposal activities are as follows:

- loss of sub tidal habitat due to the reclamation and dredging;
- temporary local deposition of sediment associated with overflow during the trailer suction hopper dredging and cutter suction dredging; and,
- disposal of dredged material at existing licensed disposal sites.

The loss of sub tidal habitat relates to less than 1% of the Humber Lower water body area (247 km^2). This is not considered to be a significant effect on benthic invertebrates at water body level. The loss of designated intertidal and sub tidal habitat is acceptable in the context of the agreed compensation package in HRA terms, and therefore it is considered that the loss of habitats for benthic invertebrates objectives under the WFD are satisfied.

The dredging of finer seabed material using hydraulic methods will result in the overflow of suspended sediment into the water body. Modelling of the dispersion of the plume indicates that deposition levels beyond the immediate vicinity of the site are low to negligible (HR Wallingford, 2021a). Deposition is predicted on the intertidal areas up and down stream of the main Proposed Development site, however these areas do not form part of the assessment of the (sub-tidal) benthic invertebrate parameter. Temporary deposition levels of up to 10 mm in parts of the Humber Lower water body, (HR Wallingford, 2021a) are predicted due to the hydraulic dredging activity of sands and gravels.

Whilst the effects of the proposed dredging as characterised in this study cannot be dismissed as negligible, they do represent a relatively small proportional increase in suspended sediment concentrations and levels of deposition that does not significantly change the range of suspended sediment values and levels of deposition commonly experienced in what is a highly turbid estuary (HR Wallingford, 2021). Temporary deposition of up to 10 mm is not considered likely to affect the benthic invertebrate species in the Humber Estuary, which are naturally well adapted to this scale of deposition. Therefore, the temporary effects of the short term capital dredging activity are not considered likely to affect status at water body level.

There are two types of dredged material that will be disposed of at existing licensed disposal sites in the Humber Lower water body. Erodible material will be placed at the dispersive site HU080 while non-erodible material will be placed at the capital sites HU081 and HU082. As HU080 is used on a regular basis for very large quantities of dredged material. For the period 1986 to 2012, the peak amount being disposed at this site occurred in 1997, of 8.95 million wet tonnes (ABP, 2014). The average yearly amount of material being disposed at HU080 for this 27-year period is approximately 3.59 million wet tonnes (ABP, 2014). As a result it can be concluded that disposal activities are not adversely affecting the benthic invertebrates in this area. The site was in use during the water body classification period of 2006-08 and disposal activities at this site can be considered to form part of the baseline. The site has previously received up to 8.9 million tonnes per year therefore it is reasonable to assume that the placement of the material from the AMEP project is within the capacity of the site and that any effects will be temporary (i.e. weeks to months).

The erodible material also contains a fraction of coarse gravel which is coarser in nature than that found at HU080. An assessment has been carried out of the impact of the gravel fraction of the erodible material on the HU080 disposal site and any other areas that may be subject to receiving the gravel as a result of physical processes such as tidal currents (JBA, 2012b).

A further assessment has been carried out of the ecological impact of the gravel disposal (HR Wallingford, 2016), which was a requirement of the consented DCO, to discharge requirements (DCO Schedule 8, Requirement 52). The report concluded that the communities present are adapted to a degree of disturbance, and are therefore not likely to be affected by temporary gravel deposition in the long term. Any short and medium term changes in the affected communities are unlikely to represent a permanent alteration to the outer Humber estuary ecosystem. Indeed, where increases in the gravel content of the surface sediments locally persist, there may be a rise benthic diversity (HR Wallingford, 2016). The report was accepted by the MMO (MMO reference: DCO/2013/00020, letter dated 12 May 2016) to discharge the requirements set out in the DCO (Schedule 8, Requirement 52).

The disposal of the erodible material at the HU080 disposal site is not, therefore, considered likely to have a non-temporary effect on the water body that will affect status at water body level.

The non-erodible material will be placed at the existing capital disposal sites (HU081 and HU082). When placed at these sites material will remain *in situ* with gradual erosion occurring over a period of months to years. There will therefore be a local, temporary loss of benthic invertebrates during the placement of material at the site.

Disposal of dredged material to sites HU081 and HU082 by barge will result in localised changes to the tidal currents and wave action in proximity to the site. These changes to the hydrodynamics will have no effect on the ongoing coastal erosion to the north east of Hawkins Point or to the proposed site for managed realignment further to the east.

The material placed at sites HU081 and HU082 will be eroded by the action of the tidal currents and waves and the silt and clay sized material arising will disperse rapidly from the sites. Sands and gravel sized material arising from the placement will tend to accumulate in undulations on the seabed at the disposal site. Any glacial till dredged by BHD or CSD and placed by barge at HU081 or HU082 will slowly be eroded by the action of tidal currents and waves. Sands and gravel sized material at the disposal sites and arising from the erosion of the glacial till will reduce the overall rate of erosion of the placed till. It is expected that the majority of the glacial till placed at either site will erode within a few years of placement.

The disposal of dredged material at the disposal sites is not considered likely to have a non-temporary effect on the status of the Humber Lower water body at water body level.

Cherry Cobb Sands Intertidal Compensation Site

During operation, soils from the agricultural land will enter the water column in the local vicinity of the compensation site; however the input rate is considered likely to be relatively low as annual erosion is predicted to be less than deposition across the majority of the site, so overall the ground level within the compensation site is expected to rise (Black and Veatch, 2012). After 5-10 years there will be a requirement to remove siltation from the regulated tidal exchange fields. This will be undertaken by a combination of flushing, bed levelling and dredging during the months of April to June and will result in elevated suspended sediment concentrations discharging from the compensation site. Increases in concentration are likely to be comparable to those occurring during the largest spring tides and storm conditions. Further, the sensitivity of the intertidal habitat in the Lower Humber water body is low due to the very high concentrations of suspended sediment already present in the Humber Lower water body (Section 33.6.4 Chapter 33 Water Quality and Sediment Quality of the original ES).

During construction, the creation of the breach will result in the scouring of a channel immediately in front of the breach location (section 32.6.7 Chapter 32 Hydrodynamic and Sedimentary Regime of the original ES). Material within this channel is likely to be dispersed into the Humber Lower water body. This process usually takes place over a relatively short period (weeks to months) in response to the discharge of water from the new habitat compensation site. It is assumed that this material will comprise fine muddy sediments that are similar to the large quantity of suspended sediment that is carried in suspension in the Humber Estuary. The release of sediment will only occur on the ebb tide as water flows out of the estuary and will therefore be carried seaward, dispersed and deposited in the existing sediment sinks in the Humber Estuary. Given the very high volume of dredged material that is disposed of into the Humber as well as the high natural suspended sediment concentration and bedload, this temporary addition, from the proposed material change, of a relatively small quantity of material is not considered to be significant for any of the biological elements at water body level.

Conclusion

In summary the components of the proposed material change that will affect subtidal benthic invertebrates are not considered likely to have a non-temporary effect on the status of the Humber Lower water body at water body level. Saltmarsh that has developed since the DCO and last WFD assessment (HR Wallingford, 2012) is likely to be offset by the development of the compensation sites at Cherry Cobb Sands into saltmarsh over time. Overall, no deterioration in WFD status is predicted. In addition, based on the evidence presented above it is concluded that the Proposed Development, including the proposed material change, will not affect the ability of the benthic invertebrates to achieve the objective to reach good ecological potential as set out in the RBMP (EA, 2015).

5.3.3. Biology Fish

The current status of the fish parameter is good, based on the Transitional Fish Classification Index (TFCI), the monitoring tool used to classify the ecological status of fish communities (including migratory species) in transitional waters under the WFD (EA catchment data explorer: Accessed March 2021).

Reclamation, Dredging and Disposal of Dredged Material

The Humber estuary is an important migratory route for a range of species between coastal waters and their spawning areas, such as lamprey, eel, salmon and smelt (SLR, 2021). Some species are thought to migrate up along the banks of the estuary and may be more vulnerable to localised habitat disturbance at the shoreline. However, there have been a number of previous developments as well as ongoing disturbance along the banks of the Humber and the fish fauna parameter is presently at good status, indicating an ability to tolerate and adapt to these pressures.

Habitat disturbance during the construction phase is unlikely to have long-term impacts on fish as they are mobile and, given the width of the water body at this point, will avoid any area affected by disturbance, returning once the disturbance has ceased. Given the naturally high suspended sediment concentrations found in the Humber it is unlikely dredging and disposal operations will have an impact on fish populations (Section 10.6.60 Chapter 10 Aquatic Ecology of the original ES, and is also considered unlikely in terms of the material change in Chapter 10 Aquatic Ecology (SLR, 2021).

Although local displacement of some fish species may occur as a result of impacts to fish, a significant negative impact on fish populations is not predicted from operation of the Proposed Development (Section 10.6.95 Chapter 10 Aquatic Ecology of the original ES). The Humber Estuary provides a wide availability of similar habitat for foraging and reproduction for fish of conservation interest, and fish have the ability to avoid disturbed areas (Section 10.8.7 Chapter 10 Aquatic Ecology of the original ES).

In addition there are a number of objectives within the marine environmental mitigation and monitoring plan (MEMMP: Able UK Ltd, 2020) which require compliance with the percussive piling restrictions to restrict or remove potential impacts on sensitive fish receptors, which will ensure this impact is reduced. These restrictions are to be monitored via controls set out in the active monitoring scheme (AMS).

It is not considered likely that there will be a non-temporary effect on fish fauna at water body level as a result of the Proposed Development, including the proposed material change.

Dissolved Oxygen

Dissolved oxygen (DO) levels are important for the biological health of fish within transitional water bodies. Levels of DO can fluctuate naturally with the seasons, generally being lower during periods of higher temperature. A management restriction that is required under the DCO includes the collection on in situ measurements of DO. Restrictions are placed on the Proposed Development to ensure percussive is not undertaken when DO levels are lower than 5 mg/l. This will further mitigate any potential impacts on migratory fish that may be present. The proposed material change is not expected to significantly alter the DO levels.

Cherry Cobb Sands Intertidal Compensation Site

Fish fauna in the Humber Lower water body may use intertidal and shallow sub tidal areas as spawning or nursery grounds (Section 34.5.16 Chapter 34 Aquatic Ecology and Nature Conservation of the original ES).

During the construction phase, following the initial breach there will be a localised temporary increase in suspended sediment concentration in the waters adjacent to Cherry Cobb Sands (Section 33.6 Chapter 33 Water Quality and Sediment Quality of the original ES). The Humber Estuary has an existing high concentration of suspended sediment and therefore the impact upon fish fauna is considered to be of minor negative significance, and temporary.

The operation of the compensation scheme (including the RTE) is not anticipated to affect fish feeding or breeding which may be associated with the mudflat and saltmarsh habitats adjacent to the site, therefore the impact on fish fauna is considered to be negligible (Section 34.6.12 Chapter 34 Aquatic Ecology and Nature Conservation of the original ES). The managed realignment element of the compensation site is considered to provide a benefit of resource of food and shelter for the fish as well as providing nursery grounds. The proposed material change is not expected to have an effect.

Conclusion

The loss of designated intertidal and sub tidal habitat, as a result of the proposed material change, is acceptable in the context of the agreed compensation package in HRA terms (Able UK Ltd, 2015), and therefore it is considered that the subtidal and intertidal area loss as habitat for fish under the WFD are also satisfied. As such the updated WFD assessment concludes that there will not be a deterioration of the status of the biological quality elements (i.e. there will not be a non-temporary effect on status at water body level). Further, it is not considered that the Proposed Development, including the proposed material change, or the habitat compensation scheme will prevent the biological quality fish elements from reaching or remaining at good potential.

5.3.4. Water quality

The reasons for inclusion of effects upon water quality as outlined in the Scoping Template in Appendix A, are that the proposed activities:

- could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days);
- could release chemicals on the Environmental Quality Standards Directive (EQSD) list; and,
- will disturb sediment with contaminants above Cefas Action Level 1.

Water quality parameters contribute to the classification of WFD ecological potential and to WFD chemical status.

Water clarity

The Humber is one of the most turbid estuaries in England (Section 9.5.14 Chapter 9 Water and Sediment Quality of the original ES). Increases in suspended sediment concentrations can affect light penetration; however as indicated, the Humber Lower water body has a low sensitivity to increases in suspended sediment concentration due to the existing high concentrations of suspended sediment and the size of the water body. Losses of suspended sediment from the dredging and disposal activities and from the reclamation run-off will be temporary. Suspended solids levels decay relatively quickly as the material is dispersed by the currents and levels are likely to return to background within a short period of the dredging or disposal ceasing.

The Proposed Development has a waste permit to allow a range of materials to be used to build up the main development site (Permit reference: EA/EPR/FB3104MM/V003) which confirm the works can be carried out without the likelihood of harm to the environment or human health. The measures proposed to control run-off from these reclamation activities will prevent the deterioration of the water quality elements of the Humber Lower water body.

With respect to the run-off from the compensation site the impact would be low given the size of Cherry Cobb Sands and the localised area that would be affected compared to the size of the water body. The proposed material change is not expected to have any effect.

Disturbing sediments

The Humber Estuary is known to have historically received contaminants from a number of industrial and urban sources. Trace metals, polychlorinated biphenyls (PCBs), hydrocarbons, and tributyl tin (TBT) are all known to be present in the sediments of the Humber, and they are transient within the system as a result of tides, currents, bioturbation, and maintenance dredging (Section 9.5.26 of the original ES).

The EA undertakes classification of water quality supporting elements as part of water body monitoring and reporting. Long term monitoring of WFD water quality suites is undertaken frequently by the EA at fixed locations throughout the estuary of the River Humber with the nearest stations to the Proposed Development being 6 km downstream at Cherry Cobb Sands (Clean Site T02), 6 km upstream at River Humber Committee Site, as well as three additional water quality sampling points that are just inside the Humber Middle water body, which are Humber Buoy 26, Humber No. 28 Buoy and Humber near Hessel (approximately 11 km, 15 km and 17 km upstream of the Proposed Development. The upstream sites in the Humber Middle are suitable for baseline conditions for Humber Lower as the water would net flow past the Proposed Development site. Environment Agency monitoring data is presented in Appendix C for these water quality sampling locations for 2018-2021.

A summary of the current Humber Lower water body WFD status is presented in Table 4.1 including some chemicals, indicating all of the supporting elements that do not currently meet at least good status and their associated objectives. This table indicates that the Humber Lower HMWB has moderate ecological potential and is failing for chemical status with an overall water body potential of moderate (Table 4.1).

Sediment samples were collected for the original ES and original WFD assessment in 2011. These samples included samples at top, middle and bottom of the dredge depth, throughout the dredge area. Due to the age of these samples, the MMO requested that surface (only) samples were collected from a number of sediment sampling points throughout the dredge area to re-confirm the sediments were similar enough to those sampled in 2011, so as not to require re-sampling at depth. The re-sampling of surface (only) samples were completed in 2017 and again in 2021. A number of additional samples were also requested to be taken from the intertidal area in the vicinity of the Cherry Cobb Sands compensation site.

The results of the sediment sampling is provided in Appendix B. The results tables include comparison of the sediment sampling chemical results against Cefas action levels (CAL) as an indication of contaminants and if that would pose a risk to water and sediment quality during the dredging and disposal activity. The full results are presented in Appendix B and are summarised below.

Metals

The metal suite were analysed in all of the sampling years, 2011, 2017 and 2021. A number of heavy metal contaminants, including arsenic, chromium, nickel lead and zine exceed the CAL 1 within the material to be dredged. None of these metals approach their respective CAL 2.

Overall impact is not considered to be significant, because of the wide dispersion, and tendency of contaminants to remain bound to or quickly re-adsorb upon dissociation from the sediment. Resuspension of contaminated sediments due to dredging is therefore assessed in the original ES as having an insignificant impact on water quality (Section 9.8.18 Chapter 9 Water and Sediment Quality of the original ES).

Organotins

Organotins, specifically TBT and DBT, were analysed during the 2011 and 2021 sampling years. DBT was lower than the level of detection (LOD) in all but one sample. TBT was generally either below the LOD or present in low concentrations. The CAL 1 was not exceeded in any samples for any organotin compound.

Although the Humber Lower fails on the presence of TBT in the water, the results of the organotin analysis indicates levels of TBT within the Lower Humber water body will not be impacted by the Proposed Development.

Polychlorinated Biphenol (PCBs)

PCBs were analysed during the 2011 and 2021 sampling years. There are no CALs for individual PCBs, however there are action levels available for the sum of all of the 25 PCBs that are analysed for, and for the sum of seven of the PCBs, which are referred to as the ICES 7. The ICES 7 suite was initially selected by the International Council for the Exploration of the Sea (ICES) as a PCB screen for monitoring biota and sediment samples, and became a mandatory requirement of the OSPAR Co-ordinated Environmental Monitoring Programme (CEMP).

In all, 10 of the samples (across 2011 and 2021) exceed the CAL 1 for the sum of ICES 7. There is no CAL 2 for the this group. 9 samples exceeded the CAL 1 for the sum of all PCBs and one sample (Site M) exceeded the CAL 2.

It is not unusual to have isolated samples that fail at CAL 2. Overall the levels of PCBs is unlikely to result in the deterioration of the water quality of the Humber Lower.

Polycyclic Aromatic Hydrocarbon (PAH)

In general, most of the samples exceed the CAL1 for the majority of PAHs. There are no specific CALs for individual PAHs and instead a level of 100 ug/kg is adopted for all PAHs. There are also no CAL 2 for PAHs.

Therefore, to summarise the toxicity within any given sample, the assessment of PAH toxicity markers for both low molecular weight (LMW, predominantly oil sourced) and high molecular weight (HMW, predominantly combustion derived) PAHs were developed (Gorham-Test 1998), see Table 5.3 below. These provide benchmark values and a proposed CAL 1 and CAL 2 is recommended by Cefas in a recent review of action levels (Cefas, 2020).

Table 5.3: Summary of the Gorham-Test results for the sediment samples. Yellow shading indicates exceedance of the recommended CAL1, red shading indicates exceedance of recommended CAL 2

Sampling year	Sum Low Molecular Weight PAHs	Sum High Molecular Weight PAHs
Mean 2011	2262	1760
Mean 2017 (not inc CCS X, Y, Z)	1960	1438
Mean 2021 (not inc CCS X, Y, Z)	1732	2300
Mean all Years (not inc CCS X, Y, Z)	2095	1804
CAL 1	552	1700
CAL2	3160	9600

Note: LMW PAHs: Naphthalene, Acenaphthene, Fluorene, Anthracene, C1-naphthalenes, Acenaphthylene, Phenanthrene

HMW PAHs: Fluoranthene , Pyrene, Benz[a]anthracene, Chrysene, Benzo[a]pyrene, Dibenz[a,h]anthracene.

On average, the CAL 1 is exceeded in most cases, however all results are below the CAL 2 for both the sum of low molecular weight and the sum of high molecular weight PAHs. However as the Humber lower fails for a number of PAHs, further analysis is considered using the SeDiChem tool.

SeDiChem

The updated WFD assessment also makes use of the Environment Agency's SeDiChem software (Environment Agency, 2019), a water quality assessment tool developed for the EA, to consider exceedances of environmental quality standards (EQS) within a sediment plume associated with the dredging of sediments. This approach is considered proportionate to the scale of chemical contamination found in the sediments to be dredged, and the nature of the receiving water bodies.

SeDiChem is designed to assess the effects of a single suspended sediment concentration increase ('SSC uplift') and a single set of sediment chemistry data at any one time. Accordingly, its outputs give a 'snapshot' chemical parameter concentration, within the sediment plume, representing the likely partitioning of a given chemical from the surfaces of suspended sediment (e.g. adsorbed and precipitated forms) into the water column (e.g. as dissolved or free forms).

The results of the SeDiChem tool indicate that there are no exceedances of within plume EQS for any metals or organotins.

There are exceedances within plume for all of the PAHs that are considered on the SeDiChem tool. These chemicals are predicted to exceed EQS values within the plume caused by the capital dredging for the

Proposed Development. The SeDiChem tool assesses a limited range of PAHs which are Benzo[a]pyrene, Benzo[b]fluoranthene, benzo(g,h,i)perylene, Benzo[k]fluoranthene and Fluoranthene. These PAHs are often responsible for chemical failures of water bodies. The exceedances of the EQS for these PAHs as a result of the dredging required for the Proposed Development, is largely due to its very low MAC-EQS concentration (MAC-EQS of 0.00082 µg/l).

No sediment chemistry data were available for cypermethrin (indicated to be failing in the Humber Lower water body) as it was not requested to include this in the analyses when consulting with MMO and Cefas about the sediment chemistry sampling plan for the Proposed Development. In addition, cypermethrin is not currently included in the SeDiChem tool. Consequently, it has not been possible to consider cypermethrin in the assessment although conclusions associated with the PAHs are anticipated to apply.

The Proposed Development has a waste permit to allow a range of materials to be used to build up the main development site (Permit reference: EA/EPR/FB3104MM/V003) which confirm the works can be carried out without the likelihood of harm to the environment or human health. The measures proposed to control run-off from these reclamation activities will prevent the deterioration of the water quality elements of the Humber Lower water body. The measures proposed would also prevent any deterioration caused by the proposed material change.

Cherry Cobb Sands Intertidal Compensation Site

In areas of erosion potential contaminants within the soils of the site could remobilise and enter the water body from this 'grade 2 agricultural land' site (Section 31.5.16 Chapter 31 Geology, Hrdrogeology and Ground Conditions of the original ES). This could lead to flushing of pollutants into the estuarine waters after the breach and discharge into the Humber during the first few tidal floods. The Ground Investigation Study carried out in August 2011 (Section 33.5.16 Chapter 33 Water Quality and Sediment Quality of the original ES) observed that although the 12 samples inside the Cherry Cobb Sands site contained contaminants below the CAL 1, two nearby samples (outside the site in the north western fields) contained levels of contaminants (zinc, copper, lead and total petroleum hydrocarbons) above the CAL 1 (Section 33.5.16 Chapter 33 Water Quality and Sediment Quality of the original ES).

Conclusion

Sediment quality levels of the material to be dredged are considered to be within acceptable levels and the temporary nature of the dredging and disposal activity limits the potential for any effects from the Proposed Development, including the proposed material change. The levels of PAHs within sediments are consistent with sediments generally found within the Humber Estuary (ABP, 2014). The Lower Humber has a current 'fail' status for the chemicals water quality element. This included a number of PAHs that contribute to the fail status, which are benzo(b)fluoranthene and benzo(g-h-i)perylene. Where there are already PAH failures, the Proposed Development and proposed material change are not expected to be made to contribute to a worsening of the chemical status within the Lower Humber. Overall, no deterioration in WFD water quality elements are predicted as a result of the Proposed Development or proposed material change, and so this is not significant at the water body scale.

5.3.5. Protected areas

Natura 2000 designated sites

The loss of designated estuary habitat that forms part of the Natura 2000 site is considered in detail in the original HRA (Able UK Ltd, 2015), for the consented DCO. The original WFD assessment has concluded that, with respect to the protected area, the consideration of deterioration relates to the effect on the protected area rather than the effect at water body level. It is understood that the loss of these designated habitats is addressed through the HRA which is the appropriate vehicle for assessing the impacts on Natura 2000 sites.

The loss of designated intertidal and sub tidal habitat is understood to be acceptable in the context of the agreed compensation package in HRA terms, and therefore it is considered that the protected area objectives under the updated WFD assessment are also satisfied.

5.3.6. Invasive non-native species (INNS)

As with many activities within the marine environment, there is potential risk that activities that are required at the Proposed Development, including the proposed material change, could result in the introduction or spread of INNS. These could be vectored by the movement of vessels from differing water bodies, the release of ballast or the transfer of organisms attached to vessel hulls.

A range of mitigation will be in place to reduce the risk of introduction and spread of INNS due to the Proposed Development. This is outlined in the Marine Environmental Management & Monitoring Plan (MEMMP) (Able UK Ltd, 2020). Measures to address INNS, which are likely to be sufficient to mitigate the threat of INNS in terms of the material change, include:

- Industry best practice will be followed, with clean, check, dry procedures in place for plant and materials arriving on site.
- A Biosecurity Plan will be in place incorporating a Biosecurity Risk Assessment. Biosecurity Plan will be based on best practice guidance as set out in the Natural England and Natural Resources Wales Biosecurity Planning guidance (Payne *et al*. 2015). The Biosecurity Plan will encompass:
  - Management of vehicles and vessels during construction including:
    - Biofouling;
    - Ballast water;
    - Movement of slow or stationary vehicles;
    - Use of small vessels where possible.
  - Conforming to industry guidelines:
    - Follow best practice guidance, apply Best Available Technology (BAT).

Although the Ballast Water Management Convention (BWMC) became international maritime law in 2017, 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. It is considered that risks of introduction of INNS via ballast water would be reduced once the Ballast Water Management Convention has been ratified and implemented into UK law although it is anticipated that all vessels would be fully compliant with International Maritime Organisation (IMO) guidelines.

The proposed works are therefore not expected to lead to a deterioration of the Humber Lower water body in terms of INNS (note this parameter is not currently assessed by the Environment Agency and does not contribute to the current status assessment).

5.3.7. Effect on mitigation measures 'not in place'

The Humber RBMP identifies the requirement for mitigation measures related to the flood protection aspect of the HMWB designation. These measures are to preserve and enhance marginal habitats, promote managed realignment, and replace hard defences with soft engineering solutions etc. With respect to engineering solutions for hard defences, although the Proposed Development extends riverwards beyond the present land boundary it does not alter significantly the length of frontage that will be subject to hard defences. The Proposed Development will affect marginal habitats but is compensating for this impact through the provision of a managed realignment site.

It is considered that the Cherry Cobb Sands site (which at approximately 102.4 ha is greater than the area of intertidal habitat lost within the water body) will complement and support the achievement of the proposed mitigation measures. The habitat creation site at Cherry Cobb Sands will not, therefore, compromise the mitigation measures 'not in place' for the Humber Estuary; rather it will contribute to the achievement of those measures, such as improvement to condition of the riparian zone and/or wetland habitats and removal or modification of engineering structure . The compensation site is indicated on the current Humber flood risk strategy document (Environment Agency, 2008) and shown in Figure 5.1.

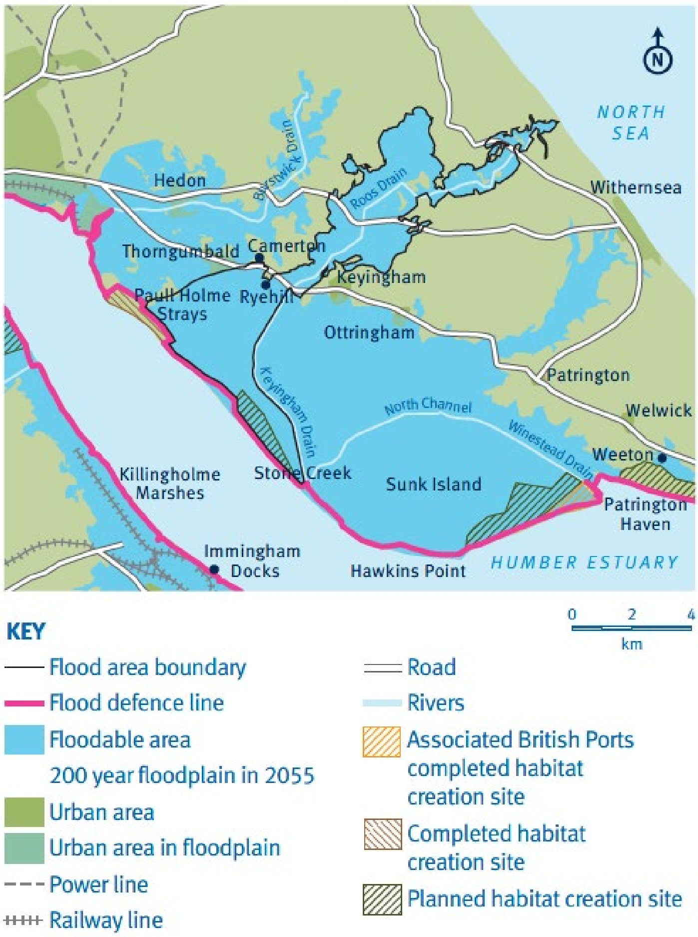


Figure 5.1: Cherry Cobb compensation site indicated in Humber flood risk strategy document

Source: Humber Flood Risk Management Strategy (Environment Agency, 2008)

5.3.8. Future maintenance dredging

The updated Dredging Strategy, Appendix UES4-2 (Able, 2021) indicates that, following calibration against actual maintenance dredge volumes at existing berths, and allowing for uncertainty, a maximum annual maintenance dredge of 1.5M wet tonnes was predicted.

In addition, when maintenance of the regulated tidal exchange (RTE) at the Cherry Cobb Sands compensation site begins to be undertaken (approximately 5 years after it becomes operational) there will be a requirement to remove gradual build-up of mud to maintain operability of the RTE fields. It is estimated that up to 20,000 m^3 in total will be annually flushed or discharged by pipeline out of the RTE fields into the new creek in the managed realignment site to disperse into the wider estuary.

Maintenance dredging material will be placed at the existing dispersive disposal site HU080. According to the 'Humber Estuary: Maintenance Dredge Protocol and Water Framework Directive Compliance Baseline Document' (ABP, 2014), HU080, receives all of maintenance dredging from the Sunk Dredged Channel and has historically received up to 8,945,818 tonnes in a year. Furthermore between 1986 and 2012, the average quantity of dredge arisings disposed of at HU080 was 3.59 m wet tonnes. Therefore the placement of maintenance dredging material from the Proposed Development, including the proposed material change, is within the capacity of the site and it is concluded that any effects will be temporary (i.e. weeks to months). Disposal activities at this site can be considered to form part of the baseline, therefore this is not considered to be a loss as a result of maintenance dredging for the Proposed Development.

Benthic communities that are removed by maintenance dredging will begin to recover between dredging events; however full recovery between events is unlikely (Section 10.6.78 of the original ES). Section 5.3.1 to Section 5.3.6 of this updated WFD Assessment indicates the capital dredge is unlikely to affect WFD status at water body level. This applies to the biological status (the biological quality elements and the supporting physico-chemical and hydromorphological elements) and chemical status and also to relevant protected areas (via means of habitat compensation agreed as part of the DCO). There is no reason to anticipate that future maintenance dredging will affect water body status. The capital dredging will already have locally modified the area in the vicinity of the Proposed Development and the maintenance dredge will revert the structure of the seabed back to post development levels.

Applying a worst case scenario, if the total area to be dredged during the construction operation (berthing pocket, turning circle and approach channel of approximately 659,000 m^2 (see Table 2.2) is assumed to be subject to maintenance dredging and is considered to be permanently lost, the zone of effect of maintenance dredging activities (dredging footprint x 1.5) will be approximately 988,500 m^2. This equates to less than 1 % of the total water body area of 247 km^2. As well as being less than 1 % of the whole area, it is also on lower sensitivity habitat, and so is unlikely to be of significant at the water body scale.

Where future maintenance dredging is required for the Proposed Development, this will not involve any new physical modifications nor would it be expected to lead to any deterioration in biological or chemical status. As a matter of good practice, mitigation measures will be implemented to deal with any temporary local effects, and will likely include the collection of in-date (usually within 2 years) sediment samples and associated chemical analysis from within the to-be-dredged maintenance area. So there is unlikely to be a deterioration of the status of the Humber Lower as a result of the maintenance dredging that will be required for the Proposed Development, including the proposed material change.

6. WFD Assessment inland waterbodies

The assessment provided in this section is does not follow the guidance for transitional water bodies (Clearing the Waters for All: EA, 2015) and instead considers if there is likely to be any interaction between the Proposed Development, including the proposed material change, and the inland water body, which in the cases below are artificial water bodies (AWB). Any potential for subsequent interaction and potential for deterioration of the Humber Lower transitional water body is also indicated.

6.1. Keyingham Drain water body

The Sands/Keyingham/Roos Drain from Source to Humber water body (ID GB104026067230) is a freshwater surface water body. It is designated as an AWB and as such, in WFD terms, the ecological objective for the water body is to meet good ecological potential (GEP) rather than good ecological status. The ecological and chemical quality of Keyingham Drain (which runs along the edge of the Cherry Cobb Sands Wet Grassland Site) is provided below.

6.1.1. Current status

The Environment Agency catchment data explorer 2019 status (available at https://environment.data.gov.uk/catchment-planning/WaterBody/GB104026067230) [Accessed March 2021] classifies the Keyingham Drain AWB as being at moderate status overall. This is made up of moderate ecological potential and a fail chemical status. It is listed as being at bad potential due to the status of macroinvertebrates, but no measures are required because the 'bad' status is directly related to the designation of the water body as an AWB (i.e. the nature of its drainage purpose is not compatible with achieving a higher status in this regard). The AWB is also at moderate physico-chemical potential due, *inter alia*, to issues with dissolved oxygen (poor), phosphate (poor), and ammonia (moderate; specific pollutants).

The Keyingham Drain AWB is described as being 'supports good' for hydrology. Two mitigation measures which are currently 'not in place' but which could contribute to improving its status notwithstanding the designation of the Keyingham Drain as an AWB are: structures or mechanisms to enable fish to access the water body; and a sediment management strategy. Finally, 'other pollutants' in the Keyingham Drain area 'does not require assessment'.

6.2. Otteringham Drain from Ottringham Grange to Humber water body

The Otteringham Drain AWB (ID GB104026066510) is a freshwater surface water body, which is to the eastern side of the Cherry Cobb Sands wet grassland site. It is designated under the Habitats/Birds Directive and the Nitrates Directive.

There are no groundwater source protection zones, aquifers, or licensed abstractions within 2 km of the Cherry Cobb Sands Wet Grassland Site.

6.2.1. Current status

The Environment Agency catchment data explorer 2019 status (available at https://environment.data.gov.uk/catchment-planning/WaterBody/GB104026066510 [Accessed March 2021])

RBMP classifies the Otteringham Drain AWB as being at moderate ecological potential overall. It is listed as being at bad potential due to the status of macroinvertebrates, but no measures are required because the 'bad' status is directly related to the designation of the water body as an AWB (i.e. the nature of its drainage purpose is not compatible with achieving a higher status in this regard). The AWB is also at moderate physico-chemical potential due, *inter alia*, to issues with dissolved oxygen (poor), phosphate (poor), and ammonia (moderate; specific pollutants).

6.3. WFD Assessment

As partial compensation for the loss of SPA bird habitat associated with the construction of the Able Marine Energy Park (AMEP), it is proposed to create wet grassland immediately adjacent to the Cherry Cobb Sands managed realignment site (Black & Veatch, 2012). This wet grassland site is approximately 38.5 ha and is known as the Cherry Cobb Sands wet grassland site and is located near to or adjacent to the Otteringham Drain and Keyingham Drain. The site currently comprises arable farmland on reclaimed saltmarsh or other intertidal habitat. The Cherry Cobb Sands site is not situated close enough to either of these two drains to have likely impact. The proposed material change will also have no impact on these two drains.

6.3.1. Physico-chemical conditions

The location of the wet grassland site are not predicted to result in any significant changes in impacts on the physic-chemical conditions. It is possible that contaminated material may be encountered during the reprofiling works at the Cherry Cobb Sands wet grassland site, as the soils are likely to contain agricultural pesticides and fertilisers, which has the potential be transferred to the Otteringham Drain AWB or Keyingham Drain AWB. Excavation of material across much of the site to a maximum depth of 1 m is unlikely to mobilise substantial additional contaminants compared to the baseline, as most agricultural chemicals are held in the surface layers of the soil and are disturbed regularly during normal ploughing.

The creation of the wet grassland at Cherry Cobb Sands will not require the removal or rerouting of any significant water courses, including the Otteringham Drain AWB or Keyingham Drain AWB. Extraction of water from Otteringham Drain or Keyingham Drain which was originally a possibility is no longer a likely option due to the high salinity of the water. As such mains water would be used if required.

No changes to the quality of the Keyingham Drain AWB or Otteringham Drain AWB are expected to arise as a result of the creation of the wet grassland scheme at Cherry Cobb Sands. Residual impacts described in the original ES are assessed as being temporary minor negative, associated with the possible increase in suspended sediment concentrations however, as the Cherry Cobb Sands wet grassland site will not be flooded, sedimentation of surrounding watercourses is expected to be negligible. The proposed material change will also have no impact on the Otteringham Drain AWB or Keyingham Drain AWB.

All water extraction would be carried out under licence from the Environment Agency and would not result in changes in salinity levels.

Conclusion

Taking into account the above, it is expected that the creation of the Cherry Cobb Sands Wet Grassland Site will not cause deterioration in or otherwise affect the ability of the Keyingham Drain or Cherry Cobb sands Drain AWBs to reach their ecological status (potential) objectives. There is also unlikely to be any deterioration of any other water body, including the Humber Lower water body, at the water body scale as a result of the Proposed Development, including the proposed material change.

7. Cumulative effects assessment

New projects

An assessment of the potential for cumulative assessment is presented within the updated assessments provided as part of the updated ES Chapter 6 Description of Committed Developments. The list of potentially cumulative projects presented in the updated ES Chapter 6 Description of committed Developments, indicates that there is unlikely to be a cumulative impact due to a number of reasons, depending on the specific project. These include:

- This planning permission has now expired;
- Construction completed;
- Distance between developments and absence of marine based works; or,
- No cumulative impact predicted.

As such there is unlikely to be a cumulative impact due to new projects that have been identified since the original ES and original WFD assessment were completed.

Ongoing projects

No substantive deleterious cumulative impacts have been identified from multiple developments in the vicinity of the Proposed Development from those addressed in the original ES. Activities that were considered as part of the original assessment included the maintenance dredge disposal from ports activity in the Humber, as well as power station cooling water abstraction and discharge. These projects and their associated impacts are considered as part of the current baseline for this updated WFD Assessment, and as such would not contribute to a new cumulative impact.

Based on the assessment of impacts from the material amendment, and plans and projects in the vicinity of the Proposed Development, it has been concluded that there are unlikely to be any significant cumulative effects on the Humber Lower water body, at the water body scale as a result of the Proposed Development, including the proposed material change.

8. Conclusions

A review has been conducted of the relevant original ES chapters for the consented scheme (DCO) and the assessments presented within the updated ES, in the context of the material change now planned to the Proposed Development. This has included associated technical reports prepared for the Proposed Development and the habitat compensation scheme.

The review has concluded that the project components (alone and in-combination) with the material change are not likely to have a non-temporary effect on the status of WFD parameters that is significant at water body level. This assessment includes consideration of the acceptability of the compensation areas as a result of the Habitats Regulations process.

The Proposed Development, including the proposed material change, is not predicted to cause deterioration to the current status of the Humber Lower water body nor should it prevent it achieving its future status objectives. Further, the intertidal habitat creation may contribute to future improvements in WFD status as the site, once established, could improve the ecological value for saltmarsh communities and fish.

Based on the assessment of impacts from the material amendment, and plans and projects in the vicinity of the Proposed Development, it has been concluded that there are unlikely to be any significant cumulative effects on the Humber Lower water body, at the water body scale as a result of the Proposed Development.

Insofar as the Keyingham Drain or Otteringham Drain AWBs are concerned, there should similarly not be any deterioration in status or any effect on the ability of the water bodies to meet their WFD objectives.

Successful implementation of recommendations in a number of monitoring and mitigation documents will be required to support this conclusion. These management measures are outlined in:

- Marine environmental management and monitoring plan (MEMMP) (Appendix UES4-2, Able UK Ltd, 2020);
- Compensation environmental management and monitoring plan (CEMMP) (Able UK Ltd, 2015); and,
- Terrestrial environmental management and monitoring plan (TEMMP) (Able UK Ltd, 2018).

Finally, with respect to adjacent water bodies, the WFD assessment concludes that there is no mechanism for any effect of the AMEP (with the proposed material changes) or habitat compensation scheme or associated works in the Humber Lower transitional water body, on the status of the adjacent Humber Middle transitional and Yorkshire South/Lincolnshire coastal water bodies.

Deterioration to the current status of the Humber Lower transitional water body is not likely as a result of the activity, and the AMEP with the planned material change shall not prevent the water body achieving future WFD status objectives.

9. References

Able UK Ltd and Black & Veatch (2011). Able Marine Energy Park. Environmental Statement. December 2011.

Able UK Ltd (2015). Compensation environmental management and monitoring plan (CEMMP). December 2015.

Able UK Ltd (2018). Terrestrial Environmental Management & Monitoring Plan (TEMMP). May 2018.

Able UK Ltd (2020). Marine Environmental Management & Monitoring Plan (MEMMP). October 2020.

Able UK Ltd (2021). Able Marine Energy Park Material Change 2 Dredging Strategy. June 2021.

ABP (2014). Humber Estuary: Maintenance Dredge Protocol and Water Framework Directive Compliance Baseline Document.

Black & Vetch (2011). Cherry Cobb Sands Compensation Site. Assessment of a 110 ha layout. Annex 32.6 November 2011. Available online at: Able Marine Energy Park | National Infrastructure Planning (planninginspectorate.gov.uk) [Accessed April 2021].

Cefas (2020). Review of Action Levels used for assessing dredging and disposal marine licences. Cefas report No. C7590 / Defra report ME5226. August 2020.

Environment Agency (2008). Humber Flood Risk Management Strategy. Summary Document 2008. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/308281/Humber_Strategy_Summary.pdf. [Accessed March 2021].

Environment Agency (2015). Humber River Basin District River Basin Management Plan (RBMP). Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/718328/Humber_RBD_Part_1_river_basin_management_plan.pdf [Accessed March 2021].

Environment Agency (2017) updated. Clearing the Waters for All. Available online at: https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters [Accessed March 2021].

Environment Agency (2019). SeDiChem Technical Report. SC180002: Impact of sediment disturbance on chemical status. November 2019.

ERM (2012). Proposed Able Marine Energy Park. Statement Of Common Ground On Shadow habitats Regulations Assessment. August 2012.

HR Wallingford (2012). Able Marine Energy Park and Habitat Compensation Scheme. Water Framework Directive Assessment. Technical Note. Technical Note DHM6835-02. R05.

HR Wallingford (2016). Assessment of gravel disposal at site HU080. Able Marine Energy Park. RT002-R02. February 2016.

HR Wallingford (2021). Sediment plume dispersion from dredging. Able Marine Energy Park. RT002. June 2021.

HR Wallingford (2021a). Updated ES Chapter 8. June 2021.

MMO (2018). updated. Self-service activities table. Available online at: https://www.gov.uk/government/publications/self-service-marine-licensing/self-service-activities-table [Accessed: March 2021].

Niras (2017). River Basin Management. Monitoring and Management Strategy Compliance with the Water Framework Directive March 2017.

SLR (2021). Able Marine Energy Park Updated Environmental Statement Chapter10: Aquatic Ecology.

Appendix

A. Water Framework Directive assessment – Scoping template

Project and site information

Activity	Description, notes or more information
Applicant name	Able Ports
Application reference number (where applicable)	
Name of activity	Able Marine Energy Park and Habitat Compensation Scheme
Brief description of activity	Able UK Ltd. proposes to construct a Marine Energy Park (AMEP) near Immingham on the southern bank of the Humber estuary. The AMEP will provide a facility for the marine energy sector, initially for the construction of offshore wind turbines and other activities associated with renewable energy generation. The key features of the Proposed Development that require consideration within the WFD assessment are: ■ Reclamation; ■ Quay construction; ■ Capital dredging; ■ Disposal of dredged material; ■ Habitat compensation scheme; and, ■ Maintenance dredging (operational).
Location of activity (central point XY coordinates or national grid reference)	Easting 517535 Northing 419097
Footprint of activity (ha)	Footprint of activities: reclamation and dredging (see Table 2.2) is 1,093,871 (x 1.5 as suggested by the EA guidance (EA, 2017) = 1,640,806 (1.64 km^2) plus footprint within disposal areas.
Timings of activity (including start and finish dates)	The construction activities are likely to last approximately 2 ¾ years.
Extent of activity (for example size, scale frequency, expected volumes of output or discharge)	The extent of the activity is considered to be within the Humber Lower water body.
Use or release of chemicals (state which ones)	Potential for release/resuspension of chemicals from the sediment during dredging and disposal activity, accidental leakages and spills and during construction activities.

Water body	Description, notes or more information
WFD water body name	Humber Lower
Water body ID	GB530402609201
River basin district name	Humber
Water body type (estuarine or coastal)	Estuarine
Water body total area (ha)	24786.211
Overall water body status (2019)	Moderate
Ecological status	Moderate
Chemical status	Fail
Target water body status and deadline	Reaching good ecological potential (GEP) by 2027 Reaching good chemical status (GCS) by 2015 Reaching the protected area objectives
Hydromorphology status of water body	Not assessed
Heavily modified water body and for what use	Yes HMWB - for (1) Coastal protection; (2) Flood protection and (3) Navigation, ports and harbours
Higher sensitivity habitats present	Chalk reef – 689.36 ha; Saltmarsh – 1072.31 ha.
Lower sensitivity habitats present	Cobbles, gravel and shingle – 280.54 ha; Intertidal soft sediment – 8788.69 ha; Subtidal soft sediment – 11286.66 ha.
Phytoplankton status	High
History of harmful algae	No
WFD protected areas within 2km	The Proposed Development is within the Humber Estuary SAC and the Humber Estuary SPA. No other WFD Protected areas are within 2 km of the Proposed Development.

Source: Environment Agency's catchment data explorer and the water body summary table

Specific risk information

Consider the potential risks of your activity to each of these receptors:

- hydromorphology
- biology (habitats and fish)
- water quality
- protected areas
- Invasive non-native species (INNS).

Section 1: Hydromorphology

Consider if hydromorphology is at risk from your activity.

Consider if your activity:	Yes	No	Hydromorphology risk issue(s)
Could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status		Impact assessment is not required	Overall hydromorphology status of the Humber Lower is not assessed, and so unable to determine if the Humber is of high status for hydromorphology.
Could significantly impact the hydromorphology of any water body	Impact assessment is required		The Proposed Development includes: (i) dredging; (ii) land reclamation; (iii) construction of a quay; and, (iv) disposal of sediments at the disposal site. Each of these activities has the potential to impact the hydromorphology of the Humber Lower.
Is in a water body that is heavily modified for the same use as your activity	Impact assessment is required		Humber Lower water body HMWB status for: (i) Coastal protection; (ii) Flood protection; and (iii) navigation, ports and harbours. The Proposed Development will include elements form (ii) and (iiI).

Section 2: Biology

Consider if habitats are at risk from your activity.

Higher sensitivity habitats [2]	Lower sensitivity habitats [3]
chalk reef	cobbles, gravel and shingle
clam, cockle and oyster beds	intertidal soft sediments like sand and mud
intertidal seagrass	rocky shore
maerl	subtidal boulder fields
mussel beds, including blue and horse mussel	subtidal rocky reef
polychaete reef	subtidal soft sediments like sand and mud
saltmarsh	
subtidal kelp beds	
subtidal seagrass	

Source: WFD Scoping template – available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/577892/wfd_scoping_template.odt

Note: [2] Higher sensitivity habitats have a low resistance to, and recovery rate, from human pressures.

[3] Lower sensitivity habitats have a medium to high resistance to, and recovery rate from, human pressures.

Consider if the footprint[4] of your activity is:	Yes	No	Biology habitats risk issue(s)
0.5 km^2 or larger	Impact assessment is required for all sections		Footprint of activity is more than 0.5 km^2. Actual footprint is 1.64 km^2 plus footprint within disposal areas
1% or more of the water body's area			Total water body area: 247.68 km^2 Footprint is likely to be more than 1% of water body's area when area of disposal activities included.
Within 500 m of any higher sensitivity habitat			The compensation sites at Cherry Cobb Sands is within 500 m of a higher sensitivity habitat: saltmarsh

Consider if the footprint[4] of your activity is:	Yes	No	Biology habitats risk issue(s)
1% or more of any lower sensitivity habitat			Footprint of dredging and reclamation activities (actual footprint x 1.5) is 1.64 km^2 (plus disposal areas) within lower sensitivity habitats intertidal soft sediment and subtidal soft sediment Total intertidal and subtidal soft sediment area is 200.75 km^2. Total footprint of dredging, disposal and reclamation likely to be over 1% of lower sensitivity habitats.

Note: *[4] Note that a footprint may also be a temperature or sediment plume. For dredging activity, a footprint is 1.5 times the dredge area.*

Consider if your activity:	Yes	No	Biology fish risk issue(s)
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	Continue with questions		Yes activity is within an estuary. The Humber is considered to be an important migratory route for Atlantic salmon (*Salmo salar*); smelt (*Osmerus eperlanus*); European eel (*Anguilla anguilla*); river lamprey (*Lampetra fluviatilis – SAC feature*); and sea lamprey (*Petromyzon marinus – SAC feature*).
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)	An impact assessment is required.		The Proposed Development includes piling activity that has the potential to produce noise within the Humber Estuary. The Proposed Development includes dredging and disposal activities that will include the creation of a sediment plume (physical barrier), and potential or chemical change due to dredging and disposal activities. The Proposed Development will change the depth and flow at certain locations.
Could cause entrainment or impingement of fish		Impact assessment not required	No risk of entrainment or impingement of fish.

Section 3: Water quality

Consider if water quality is at risk from your activity.

Consider if your activity:	Yes	No	Water quality risk issue(s)
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Impact assessment is required		Duration of dredging, disposal and reclamation works will be greater than 14 days
Is in a water body with a phytoplankton status of moderate, poor or bad		Impact assessment not required	Phytoplankton status is high
Is in a water body with a history of harmful algae		Impact assessment not required	There no history of harmful algae in the Humber Lower

Consider if water quality is at risk from your activity through the use, release or disturbance of chemicals.

If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if:	Yes	No	Water quality risk issue(s)
The chemicals are on the Environmental Quality Standards Directive (EQSD) list	Impact assessment is required		The sediment samples collected contain chemicals that are on the EQSD list.
It disturbs sediment with contaminants above Cefas Action Level 1	Impact assessment is required		The sediment samples collected contain chemicals that are above Cefas Action Level 1.
The chemicals released are on the Environmental Quality Standards Directive (EQSD) list		Impact assessment not required	The activity does not have a pipeline or outfall.

Note: Carry out your impact assessment using the Environment Agency's surface water pollution risk assessment guidance, part of Environmental Permitting Regulations guidance

Section 4: WFD protected areas

Consider if WFD protected areas are at risk from your activity. These include:

- special areas of conservation (SAC)
- special protection areas (SPA)
- shellfish waters
- bathing waters
- nutrient sensitive areas.

Consider if your activity is:	Yes	No	Protected areas risk issue(s)
Within 2 km of any WFD protected area[6]	Requires impact assessment		The Proposed Development is within: Humber Estuary SAC; and, Humber Estuary SPA.

Note: [6] Note that a regulator can extend the 2km boundary if your activity has an especially high environmental risk.

Section 5: Invasive non-native species (INNS)

Consider if there is a risk your 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;
- activities that help spread existing INNS, either within the immediate water body or other water bodies.

Consider if your activity could:	Yes	No	INNS risk issue(s)
Introduce or spread INNS	Requires impact assessment		Potential that INNS could be spread through the core machinery or vessel used for the Proposed Development.

Summary

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	Yes	The Proposed Development includes: (i) dredging; (ii) land reclamation; (iii) construction of a quay; and, (iv) disposal of sediments at the disposal site. Each of these activities has the potential to impact the hydromorphology of the Humber Lower. The Humber Lower is a HMWB for the same use as the Proposed Development of (ii) Flood protection and (iii) navigation, ports and harbours.
Biology: habitats	Yes	Location of the Proposed Development and size of works is above risk thresholds.
Biology: fish	Yes	The Proposed Development is in an estuary that is important for migratory fish. The activities may potentially cause a barrier that is physical (sediment plume) chemical (chemical plume) or noise barrier to fish migrations.

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Water quality	Yes	The Proposed Development could affect water quality for longer than a neap tidal cycle (about 14 days). There are chemicals within the sediments that are above CAL1 which will be disturbed during the Proposed Development.
Protected areas	Yes	The Proposed Development is within part of the Humber SAC and Humber SPA.
Invasive non-native species	Yes	Introduction or spread of INNS is a potential risk that requires assessment.

B. Sediment sample analysis results 2011, 2017 and 2021 and comparison against Cefas Action Levels (CAL)

Table B1: Metal and Organotin Analysis		Lab level of detection (LOD)	0.5 (mg/kg)	0.04 (mg/kg)	0.5 (mg/kg)	0.5 (mg/kg)	0.015 (mg/kg)	0.5 (mg/kg)	0.5 (mg/kg)	2 (mg/kg)	0.001 (mg/kg)	0.001 (mg/kg)
Sample Name	**Year**	**Sample location**	**Arsenic (As)**	**Cadmium (Cd)**	**Chromium (Cr)**	**Copper (Cu)**	**Mercury (Hg)**	**Nickel (Ni)**	**Lead (Pb)**	**Zinc (Zn)**	**DBT**	**TBT**
1+4	2011	Turning Area A+C 0 m	44	0.45	58	34	0.35	31	79	190	<LOD	0.013
3	2011	Turning Area B 1 m	33	0.45	68	44	0.29	40	86	225	<LOD	0.025
5	2011	Appr. Ch. D 0 m	27	0.18	32	22	0.12	24	52	125	<LOD	<LOD
8	2011	Appr. Ch. E 1 m	21	0.32	40	28	0.15	28	53	146	<LOD	0.011
9	2011	Berthing Pocket F 0 m	15	0.21	22	16	0.07	23	34	95	<LOD	<LOD
23+25	2011	Beth. P.K+ an.tr. L 0 m	32	0.4	76	45	0.31	43	93	230	<LOD	0.022
19+26	2011	App. Ch I+anch. Tr.L 1 m	31	0.35	70	37	0.26	38	87	206	<LOD	0.019
27	2011	Approach Ch. M 0 m	22	0.33	38	24	0.14	25	49	134	<LOD	0.010
28	2011	Approach Ch. M 1 m	28	0.12	21	11	0.05	16	37	93	<LOD	<LOD
36	2011	Berthing Pocket Q 0 m	29	0.35	77	42	0.3	45	89	225	<LOD	0.027
37	2011	Berthing Pocket Q 1 m	7.5	0.22	15	12	0	23	8.8	56	<LOD	<LOD
40	2011	Reclamation Area R 0 m	5.2	0.14	15	17	0	20	10	39	<LOD	0.010
45	2011	Reclamation Area T 1 m	22	0.34	57	34	0.22	38	72	179	<LOD	0.011
46+48+50	2011	Recl. Ar. U+V+W 0 m	23	0.29	56	36	0.21	39	71	176	<LOD	<LOD
47+49	2011	Recl, Area U+V 1 m	24	0.39	56	35	0.27	33	70	181	<LOD	0.018
2	2011	Turning Area B 0 m	31	0.44	40	26	0.15	24	53	146	<LOD	<LOD
7	2011	Appr. Ch. E 0 m	28	0.12	17	11	0.06	17	40	93	<LOD	<LOD
12	2011	Berthing pocket G 0 m	36	0.46	90	49	0.36	51	111	265	0.011	0.029
15	2011	Anch. Trench H 0 m	26	0.25	35	22	0.11	28	41	122	<LOD	<LOD
18	2011	Approach Ch. I 0 m	50	0.17	25	24	0.1	23	61	123	<LOD	0.020
29	2011	Appr. Ch. N 0 m	24	0.2	19	13	0.04	14	32	89	<LOD	<LOD
30	2011	Appr. Ch. N 1 m	39	0.44	96	53	0.34	53	135	287	<LOD	0.036
42	2011	Recl. Area S 0 m	21	0.33	52	36	0.22	37	76	182	<LOD	0.017
44	2011	Recl. Area T 0 m	16	0.23	38	26	0.15	29	51	125	<LOD	<LOD
Site B	2017	Site B	34.2	0.08	19.7	4.89	<0.033	14.3	31.8	97	NS	NS
Site G	2017	Site G	28.7	0.38	94.9	38	0.24	41.6	80.9	208	NS	NS
Site J	2017	Site J	28.5	0.25	100	35.5	0.21	49.1	85.2	215	NS	NS
Site M	2017	Site M	33.9	0.11	22.4	21.3	<0.025	21.1	26.8	115	NS	NS
Site Q	2017	Site Q	26.2	0.29	98.4	36.6	0.24	47.5	80.8	218	NS	NS
Site R	2017	Site R	22.7	0.28	85.2	40.9	0.19	41.4	64.4	188	NS	NS
Site T	2017	Site T	25.4	0.29	91.9	35.2	0.25	45.5	74.3	202	NS	NS
Site W	2017	Site W	16.1	0.3	60.8	27.4	0.21	32.5	51.7	155	NS	NS
CCSX	2017	CCSX	20.6	0.21	70.9	27.5	0.2	36.9	53.5	155	NS	NS
CCSY	2017	CCSY	25.5	0.2	112	38.3	0.23	48.8	88.4	202	NS	NS
CCSZ	2017	CCSZ	26.6	0.27	86.7	36.5	0.28	44.8	68	194	NS	NS
MAR00881.001	2021	Site B	16.8	0.37	47	31.6	0.18	34.4	64	159	<LOD	<LOD
MAR00881.002	2021	Site G	15.4	0.31	42	27.8	0.16	30.4	56.4	137	<LOD	<LOD
MAR00881.003	2021	Site J	30.6	0.16	8.7	9.5	0.05	11.6	27.8	63.5	<LOD	<LOD
MAR00881.004	2021	Site M	18.5	0.43	49.7	34	0.22	34.2	69.2	167	<LOD	<LOD
MAR00881.005	2021	Site Q	18.7	0.37	49.4	33.3	0.18	38.3	67.7	174	<LOD	<LOD
MAR00881.006	2021	Site R	16.4	0.46	45.9	36.2	0.24	32.2	61.6	163	<LOD	<LOD
MAR00881.007	2021	Site T	27.5	0.22	18.5	15	0.11	16.8	41.6	88.6	<LOD	<LOD
MAR00881.008	2021	Site W	15.3	0.34	41.8	28	0.16	31.7	52.2	129	<LOD	<LOD
MAR00881.009	2021	CCS X	18.5	0.33	54.2	33	0.19	39.5	72.6	176	<LOD	<LOD
MAR00881.010	2021	CCS Y	15	0.32	44.5	28.8	0.18	33.2	52.9	137	<LOD	<LOD
MAR00881.011	2021	CCS Z	15	0.4	43.4	32.7	0.2	29.7	55.1	152	<LOD	<LOD
	Mean 2011		26.4	0.3	46.4	29.0	0.2	30.9	62.1	155.5	0.011	0.019
	Mean 2017 (not inc CCS X, Y, Z)		26.96	0.25	71.66	29.97	0.22	36.63	61.99	174.75	NS	NS
	Mean 2021 (not inc CCS X, Y, Z)		19.90	0.33	37.88	26.93	0.16	28.70	55.06	135.14	<LOD	<LOD
	Mean all years (not inc CCSX, Y, Z)		**25.2**	**0.3**	**49.7**	**28.8**	**0.2**	**31.6**	**60.7**	**155.3**	**0.011**	**0.019**
	CAL1 (mg/kg)		20	0.4	40	40	0.3	20	50	130	0.1	0.1
	CAL2 (mg/kg)		100	5	400	400	3	200	500	800	1	1

Note: The cells are coloured to show which levels are exceeded. If no exceedance of levels cells are not coloured. Above CAL 1 cells are yellow, red for above CAL2, etc. TEL/PEL exceedances are shown on the determinand mean value, not individual sub-samples.

Table B2: PAH Analysis			PAHs ug/kg dry weight. Lab level of detection (LOD) 1ug/kg for all PAHs										
Sample Name	Year	Sample location	Acenaphthylene	Acenaphthene	Anthracene	Benzo[a]anthracene	Benzo[a]pyrene	Benzo[b]fluoranthene	Benzo[g,h,i]perylene	Benzo[e]pyrene	Benzo[k]fluoranthene	C1-Napthalenes	C1-Phenanthrenes
1+4	2011	Turning Area A+C 0 m	25.3	99.5	140.9	367.9	459.9	486.6	449.1	394.1	262.5	1276.1	1105.4
3	2011	Turning Area B 1 m	33.6	118.6	154.1	443.1	517.6	612.1	540.8	471.4	310.1	1597.4	1261.1
5	2011	Appr. Ch. D 0 m	14.7	49.2	66.6	206.6	223.8	257.2	235.5	223.8	133.4	898.5	767.6
8	2011	Appr. Ch. E 1 m	12.6	43.4	55.9	182.7	180.5	240.1	232.9	209.7	122.9	760.7	616.7
9	2011	Berthing Pocket F 0 m	19.3	62.1	73.5	237.6	260.0	332.6	304.9	273.0	150.3	573.1	639.4
23+25	2011	Beth. P.K+ an.tr. L 0 m	28.1	103.1	147.1	431.8	511.5	654.4	541.3	467.9	312.9	1640.1	1320.5
19+26	2011	App. Ch I+anch. Tr.L 1 m	25.3	80.8	149.5	367.5	423.0	553.9	429.6	389.6	261.4	1363.5	1196.5
27	2011	Approach Ch. M 0 m	14.8	50.9	75.4	211.7	224.5	286.7	236.7	222.0	133.6	868.5	726.2
28	2011	Approach Ch. M 1 m	11.7	40.9	54.3	177.8	204.5	250.7	224.1	196.3	122.4	604.0	534.3
36	2011	Berthing Pocket Q 0 m	29.2	87.4	131.7	417.8	511.5	611.3	573.3	510.9	307.8	1481.0	1222.9
37	2011	Berthing Pocket Q 1 m	0.4	0.8	1.5	8.4	8.5	13.3	21.1	13.6	4.4	33.7	24.3
40	2011	Reclamation Area R 0 m	0.0	23.6	25.1	87.0	110.3	122.8	196.7	125.0	31.0	687.0	1128.5
45	2011	Reclamation Area T 1 m	20.6	90.7	121.2	308.2	470.1	460.7	457.3	348.8	221.0	1719.5	1463.9
46+48+50	2011	Recl. Ar. U+V+W 0 m	16.4	81.7	114.5	309.4	429.6	473.8	429.5	332.5	203.3	1683.2	1327.9
47+49	2011	Recl, Area U+V 1 m	23.9	78.5	123.3	321.4	449.6	492.3	420.9	321.0	212.6	1653.8	1463.9
2	2011	Turning Area B 0 m	9.3	59.0	79.6	154.7	217.3	203.3	195.4	159.7	100.4	789.4	587.2
7	2011	Appr. Ch. E 0 m	3.3	13.1	20.1	66.0	96.4	93.3	93.4	73.5	46.8	317.1	268.1
12	2011	Berthing pocket G 0 m	24.7	98.1	143.2	393.1	575.9	656.9	565.8	440.9	291.2	1793.1	1682.4
15	2011	Anch. Trench H 0 m	8.8	42.7	67.4	163.9	222.3	224.8	219.1	178.0	96.1	1177.5	955.1
18	2011	Approach Ch. I 0 m	10.6	87.5	124.7	263.4	324.6	376.8	347.0	287.5	139.5	2425.5	2323.4
29	2011	Appr. Ch. N 0 m	2.5	10.3	18.8	41.5	52.7	61.2	52.9	43.9	28.3	163.8	139.3
30	2011	Appr. Ch. N 1 m	22.8	105.9	148.9	412.6	536.0	673.7	607.4	472.7	303.7	1604.4	1301.6
42	2011	Recl. Area S 0 m	18.5	85.2	128.0	346.9	405.7	485.1	447.8	357.1	230.9	1458.2	1159.0
44	2011	Recl. Area T 0 m	14.1	70.0	99.1	282.9	316.8	411.3	401.5	322.9	185.6	1262.5	1138.8
Site B	2011	Site B	0.11	0.981	1.23	3.11	3.55	4.08	3.7	3.52	1.57	10.8	8.59
Site G	2017	Site G	17.3	71.3	135	308	385	439	389	407	192	1580	1000
Site J	2017	Site J	13.8	60.4	92.9	236	313	390	390	376	166	1210	845
Site M	2017	Site M	2.24	8.63	12.8	33.4	34.5	43.7	43.7	41.5	15.4	128	116
Site Q	2017	Site Q	13.9	70.3	102	236	289	340	299	318	142	1290	783
Site R	2017	Site R	13.1	67.2	113	281	328	390	338	364	159	1530	1070
Site T	2017	Site T	13.3	53.9	81.9	210	265	321	294	300	129	1300	772
Site W	2017	Site W	13	62.7	97.6	241	275	327	267	291	131	1400	814
CCSX	2017	CCSX	14.2	72.1	122	310	363	442	351	386	179	1450	1060
CCSY	2017	CCSY	13.1	52.9	82	231	298	378	361	350	158	1240	793
CCSZ	2017	CCSZ	18.5	94.4	152	367	404	498	408	455	194	2500	1590
MAR00881.001	2021	Site B	226	368	344	1230	1180	775	452	696	539	466	360
MAR00881.002	2021	Site G	48.5	43.3	122	261	341	309	289	311	169	624	438
MAR00881.003	2021	Site J	39	28.1	91.4	167	238	234	235	240	107	566	365
MAR00881.004	2021	Site M	11.7	5.13	28	47	52.7	47.2	49.5	58.2	20.4	173	196
MAR00881.005	2021	Site Q	79.3	41.9	157	316	416	362	355	381	177	1030	655
MAR00881.006	2021	Site R	46.2	32.6	102	194	266	258	272	275	106	663	430
MAR00881.007	2021	Site T	74.9	41.5	165	331	425	371	337	374	179	962	625
MAR00881.008	2021	Site W	87.4	42.5	202	418	535	406	370	418	209	860	543
MAR00881.009	2021	CCS X	40	34.9	96	197	257	248	244	252	118	677	433
MAR00881.010	2021	CCS Y	39.6	28.1	87.2	212	282	273	273	286	141	604	399
MAR00881.011	2021	CCS Z	43	24.5	92	189	253	242	237	247	119	679	438
	Mean 2011		16.3	66.0	94.3	258.5	322.2	376.5	342.7	284.8	175.5	1159.6	1014.7
	Mean 2017 (not inc CCS X, Y, Z)		10.8	49.4	79.6	193.6	236.6	281.8	253.1	262.6	117.0	1056.1	676.1
	Mean 2021 (not inc CCS X, Y, Z)		76.6	75.4	151.4	370.5	431.7	345.3	294.9	344.2	188.3	668.0	451.5
	Mean all Year (not inc CCSX, Y, Z)		**27.2**	**64.5**	**102.8**	**267.9**	**327.0**	**351.3**	**315.2**	**292.3**	**166.4**	**1040.6**	**834.4**
	Cefas AL1 (ug.kg-1)		100	100	100	100	100	100	100	100	100	100	100

Table B2: PAH Analysis (Continued)			PAHs ug/kg dry weight. Lab level of detection (LOD) 1ug/kg for all PAHs											
Sample Name	Year	Sample location	C2-Napthalenes	C3-Napthalenes	Chrysene	Dibenz[a,h]anthracene	Fluoranthene	Fluorene	Indeno[1,2,3-cd]pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	THC
1+4	2011	Turning Area A+C 0 m	2308.0	2931.5	297.2	82.4	724.5	155.1	430.0	388.4	186.7	547.6	596.8	1006
3	2011	Turning Area B 1 m	2872.8	3804.1	361.0	99.8	850.2	204.8	510.5	472.1	253.1	663.1	651.8	1107
5	2011	Appr. Ch. D 0 m	1589.2	2026.9	170.2	40.4	375.7	90.9	199.9	254.9	99.1	376.2	327.6	591
8	2011	Appr. Ch. E 1 m	1481.2	1828.4	138.1	31.9	300.0	80.3	187.6	226.3	90.5	318.4	256.2	478
9	2011	Berthing Pocket F 0 m	1149.1	1520.9	202.8	48.7	383.7	79.7	277.5	194.9	88.9	351.0	357.1	483
23+25	2011	Beth. P.K+ an.tr. L 0 m	2909.4	3689.1	316.3	95.4	820.7	192.1	492.3	489.0	229.2	691.7	638.9	1114
19+26	2011	App. Ch I+anch. Tr.L 1 m	2427.6	3064.7	288.8	72.3	705.3	159.8	405.4	387.9	188.3	579.2	580.9	914
27	2011	Approach Ch. M 0 m	1435.6	1856.5	166.3	37.3	393.5	103.5	207.4	246.4	106.3	361.6	298.6	601
28	2011	Approach Ch. M 1 m	1124.4	1371.3	136.4	35.3	307.8	80.1	206.4	186.6	100.7	260.9	237.1	450
36	2011	Berthing Pocket Q 0 m	2669.8	3193.6	322.9	94.2	773.5	176.1	527.2	439.8	240.3	657.4	602.5	794
37	2011	Berthing Pocket Q 1 m	38.0	54.6	5.7	2.2	10.0	3.3	9.2	9.6	2.8	12.8	9.2	79
40	2011	Reclamation Area R 0 m	1338.8	2602.8	70.8	20.8	139.9	68.5	59.4	99.6	43.9	355.4	173.1	788
45	2011	Reclamation Area T 1 m	2756.1	3892.0	241.9	75.7	675.1	193.4	399.9	456.5	211.5	610.6	499.0	955
46+48+50	2011	Recl. Ar. U+V+W 0 m	2519.2	3584.6	252.8	70.4	630.5	189.1	363.2	437.1	201.7	593.8	478.4	995
47+49	2011	Recl, Area U+V 1 m	2349.6	3315.6	256.1	73.5	694.0	185.1	380.5	441.7	193.3	577.7	585.9	968
2	2011	Turning Area B 0 m	1127.2	1604.6	123.5	33.1	361.6	99.4	181.6	224.0	97.2	297.6	280.7	516
7	2011	Appr. Ch. E 0 m	420.2	658.8	52.1	15.6	125.1	30.3	80.4	78.4	42.5	136.1	94.1	279
12	2011	Berthing pocket G 0 m	2733.4	3938.3	325.5	96.1	838.7	210.2	524.8	485.9	272.3	687.2	632.0	1064
15	2011	Anch. Trench H 0 m	1707.0	2650.4	135.7	35.0	315.3	98.9	177.5	294.6	98.7	365.8	248.8	588
18	2011	Approach Ch. I 0 m	4128.5	6456.1	225.8	54.1	537.3	163.6	233.3	567.8	129.2	848.2	522.8	1127
29	2011	Appr. Ch. N 0 m	242.8	334.4	32.9	9.0	91.6	20.7	47.9	51.5	26.7	74.3	69.6	174
30	2011	Appr. Ch. N 1 m	2556.6	3516.0	371.1	104.0	797.2	202.1	535.0	459.8	276.4	732.9	668.9	1230
42	2011	Recl. Area S 0 m	2430.6	3452.3	307.7	75.6	671.5	162.5	374.4	427.3	179.6	668.0	567.4	1018
44	2011	Recl. Area T 0 m	2325.7	3005.4	280.1	66.2	512.6	135.6	296.4	398.4	144.3	644.2	440.4	952
Site B	2011	Site B	13.9	19.4	2.57	0.706	7.02	1.41	3.96	2.95	1.46	5.08	7.23	10
Site G	2017	Site G	2150	2740	240	75.7	712	125	383	462	151	601	616	1220
Site J	2017	Site J	1730	2300	185	66.1	500	100	356	326	141	460	460	1110
Site M	2017	Site M	202	303	26.2	6.89	58.1	12.1	36.6	34	14.6	60.7	82.3	132
Site Q	2017	Site Q	1730	2210	199	55.4	509	103	285	362	116	467	464	1110
Site R	2017	Site R	2090	2730	227	59.9	629	106	317	429	137	602	574	1050
Site T	2017	Site T	1790	2360	167	52.3	448	94.6	272	359	114	429	410	1120
Site W	2017	Site W	1930	2490	204	52.6	511	105	258	398	110	468	452	1110
CCSX	2017	CCSX	2040	2620	254	68.2	702	122	329	427	142	638	603	1080
CCSY	2017	CCSY	1600	2100	194	61.5	487	90.4	338	287	130	445	448	782
CCSZ	2017	CCSZ	3530	4500	327	77.1	809	197	361	694	158	906	697	1260
MAR00881.001	2021	Site B	453	268	1100	114	808	153	509	233	298	196	858	21.1
MAR00881.002	2021	Site G	477	387	244	51.5	504	71	243	218	135	425	504	113
MAR00881.003	2021	Site J	428	388	181	40.7	351	60.5	190	197	108	342	365	91.5
MAR00881.004	2021	Site M	159	168	56.6	8.41	108	17.6	34.9	59.7	29.1	157	133	92.2
MAR00881.005	2021	Site Q	801	693	335	62.6	666	118	307	356	164	616	666	47.4
MAR00881.006	2021	Site R	509	405	221	45.6	388	68.1	221	232	131	385	405	60.9
MAR00881.007	2021	Site T	733	633	363	60.6	668	114	302	355	185	626	668	32.6
MAR00881.008	2021	Site W	653	549	428	72.8	766	123	363	342	198	617	742	76
MAR00881.009	2021	CCS X	514	431	198	41.5	373	67.2	193	235	111	384	378	12
MAR00881.010	2021	CCS Y	471	33.8	239	47.6	415	61	232	213	122	369	413	37.8
MAR00881.011	2021	CCS Z	536	444	229	37.7	389	67.7	187	248	107	404	391	79.6
	Mean 2011		1943.4	2681.4	211.7	57.0	501.5	128.5	296.1	321.6	146.0	475.5	409.1	761.3
	Mean 2017 (not inc CCS X, Y, Z)		1454.5	1894.1	156.3	46.2	421.8	80.9	238.9	296.6	98.1	386.6	383.2	857.8
	Mean 2021 (not inc CCS X, Y, Z)		526.6	436.4	366.1	57.0	532.4	90.7	271.2	249.1	156.0	420.5	542.6	66.8
	Mean all Year (not inc CCSX, Y, Z)		**1562.2**	**2074.9**	**231.5**	**54.9**	**491.7**	**111.4**	**279.7**	**302.1**	**138.4**	**446.7**	**430.6**	**641.7**
	Cefas AL1 (ug.kg-1)		100	100	100	100	100	100	100	100	100	100	100	

Table B3: Polychlorinated biphenyls (PCBs)			PCB mg/kg dry weight - Lab Level of Detection (LOD) 0.0008 mg/kg for all PCBs												
Sample Name	**Year**	**Sample location**	**CB101***	**CB105**	**CB110**	**CB118***	**CB128**	**CB138***	**CB141**	**CB149**	**CB151**	**CB153***	**CB156**	**CB158**	**CB170**
1+4	2011	Turning Area A+C 0 m	0.0023	0.00029	0.0013	0.00074	0.00022	0.0012	0.00029	0.0013	0.00039	0.0015	<0.0002	<0.0002	0.00041
3	2011	Turning Area B 1 m	0.0011	0.00025	0.0012	0.00067	0.00021	0.0011	0.00032	0.0011	0.00034	0.0013	<0.0002	<0.0002	0.00034
5	2011	Appr. Ch. D 0 m	0.00061	<0.0002	0.00049	0.0003	<0.0002	0.00043	<0.0002	0.00047	<0.0002	0.00054	<0.0002	<0.0002	<0.0002
8	2011	Appr. Ch. E 1 m	0.00089	<0.0002	0.00067	0.0004	<0.0002	0.00062	<0.0002	0.00063	0.0002	0.00075	<0.0002	<0.0002	<0.0002
9	2011	Berthing Pocket F 0 m	0.00075	<0.0002	0.00088	0.00048	<0.0002	0.00076	<0.0002	0.00079	0.00027	0.0009	<0.0002	<0.0002	0.00022
23+25	2011	Beth. P.K+ an.tr. L 0 m	0.0012	0.00028	0.0013	0.00076	0.00021	0.0012	0.00037	0.0013	0.0004	0.0015	<0.0002	<0.0002	0.0004
19+26	2011	App. Ch I+anch. Tr.L 1 m	0.0038	0.00026	0.0012	0.0007	<0.0002	0.0012	0.00035	0.0012	0.00037	0.0014	<0.0002	<0.0002	0.00034
27	2011	Approach Ch. M 0 m	0.0023	<0.0002	0.0007	0.00045	<0.0002	0.0006	<0.0002	0.00064	<0.0002	0.00074	<0.0002	<0.0002	<0.0002
28	2011	Approach Ch. M 1 m	0.016	0.00025	0.0011	0.00077	0.00022	0.0011	0.00031	0.00093	0.00038	0.0013	<0.0002	<0.0002	0.00036
36	2011	Berthing Pocket Q 0 m	0.014	0.00033	0.0013	0.00089	0.00025	0.0013	0.00037	0.0011	0.00042	0.0015	<0.0002	<0.0002	0.00041
37	2011	Berthing Pocket Q 1 m	0.00027	<0.0002	0.00023	0.00021	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
40	2011	Reclamation Area R 0 m	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
45	2011	Reclamation Area T 1 m	0.014	0.00029	0.001	0.00073	0.00022	0.001	0.00029	0.00095	0.00035	0.0012	<0.0002	<0.0002	0.00034
46+48+50	2011	Recl. Ar. U+V+W 0 m	0.013	0.00024	0.00084	0.00061	<0.0002	0.00081	0.00023	0.00073	0.00031	0.001	<0.0002	<0.0002	0.00027
47+49	2011	Recl, Area U+V 1 m	0.0027	0.00022	0.00091	0.00066	<0.0002	0.00099	0.00031	0.00093	0.00033	0.0013	<0.0002	<0.0002	0.00038
2	2011	Turning Area B 0 m	0.003	<0.0002	0.00059	0.00042	<0.0002	0.00053	<0.0002	0.00052	<0.0002	0.00065	<0.0002	<0.0002	<0.0002
7	2011	Appr. Ch. E 0 m	0.0016	0.00028	0.00028	<0.0002	<0.0002	0.00024	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
12	2011	Berthing pocket G 0 m	0.023	0.00054	0.0014	0.00082	0.00037	0.0013	0.00051	0.0011	0.00048	0.0015	0.00037	<0.0002	0.00044
15	2011	Anch. Trench H 0 m	0.012	0.00046	0.001	0.00067	0.00029	0.00085	0.00036	0.00066	0.00031	0.00078	0.00032	<0.0002	0.00023
18	2011	Approach Ch. I 0 m	0.0042	0.00035	0.00059	0.00035	0.00022	0.00057	0.00028	0.00042	0.00021	0.00053	0.00028	<0.0002	<0.0002
29	2011	Appr. Ch. N 0 m	0.005	0.00035	0.00053	0.00031	0.00023	0.00055	0.00026	0.00038	<0.0002	0.00048	0.00028	<0.0002	<0.0002
30	2011	Appr. Ch. N 1 m	0.0095	0.00058	0.0016	0.00092	0.00041	0.0016	0.00057	0.0013	0.00052	0.0017	0.00039	<0.0002	0.00051
42	2011	Recl. Area S 0 m	0.0072	0.00043	0.00093	0.00055	0.00029	0.00091	0.00037	0.0007	0.00031	0.00096	0.00033	<0.0002	0.0003
44	2011	Recl. Area T 0 m	0.0032	0.00041	0.00077	0.00051	0.00027	0.00077	0.00032	0.00057	0.00025	0.00075	0.00031	<0.0002	0.00025
MAR00881.001	2021	Site B	0.00013	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
MAR00881.002	2021	Site G	0.00064	0.00019	0.00087	0.00031	0.00012	0.00105	0.00022	0.00067	0.00021	0.00096	<LOD	0.00011	0.00019
MAR00881.003	2021	Site J	0.00054	0.00019	0.00068	0.00043	0.00013	0.00086	0.0001	0.00051	0.00014	0.00084	<LOD	<LOD	0.00011
MAR00881.004	2021	Site M	0.02085	0.00819	0.02113	0.0245	0.01305	0.05398	0.00963	0.03129	0.0094	0.0589	0.00656	0.00211	0.02792
MAR00881.005	2021	Site Q	0.00075	0.00024	0.0009	0.0005	0.00021	0.00127	<LOD	0.00073	0.00028	0.00108	<LOD	0.0001	0.00021
MAR00881.006	2021	Site R	0.00069	0.00021	0.00072	0.00053	0.00008	0.00106	0.00016	0.00052	0.00016	0.00082	<LOD	0.00015	0.00021
MAR00881.007	2021	Site T	0.00077	0.0002	0.0009	0.00054	0.00018	0.00081	0.00012	0.0007	0.00015	0.00095	0.00009	0.00015	0.00025
MAR00881.008	2021	Site W	0.00069	0.00019	0.00079	0.00039	0.00016	0.00085	<LOD	0.00055	0.00017	0.00094	<LOD	<LOD	0.00013
MAR00881.009	2021	CCS X	0.00058	0.00019	0.00067	0.00041	0.00009	0.00082	<LOD	0.00054	0.00015	0.00066	<LOD	0.00009	0.00016
MAR00881.010	2021	CCS Y	0.00064	0.00017	0.00074	0.00056	0.00015	0.00098	0.0002	0.00066	0.00018	0.00099	<LOD	<LOD	0.00021
MAR00881.011	2021	CCS Z	0.00058	0.00014	0.0006	0.0004	0.00011	0.00053	0.00009	0.0005	0.00012	0.00068	<LOD	<LOD	0.00013
	Mean 2011		0.00616	0.00034	0.00090	0.00059	0.00026	0.00089	0.00034	0.00084	0.00034	0.00106	0.00033	<0.0002	0.00035
	Mean 2021 (not inc CCS X, Y, Z)		0.00313	0.00134	0.00371	0.00389	0.00199	0.00855	0.00205	0.00500	0.00150	0.00921	0.00333	0.00052	0.00415
	Mean All year (not inc CCSX, Y, Z)		**0.00538**	**0.00063**	**0.00156**	**0.00138**	**0.00087**	**0.00274**	**0.00075**	**0.00188**	**0.00068**	**0.00310**	**0.00099**	**0.00052**	**0.00156**

Table B3: Polychlorinated biphenyls (PCBs) Cont..			PCB mg/kg dry weight - Lab Level of Detection (LOD) 0.0008 mg/kg for all PCBs													
Sample Name	Year	Sample location	CB18	CB180*	CB183	CB187	CB194	CB28*	CB31	CB44	CB47	CB49	CB52*	CB66	Sum of 25	Sum of ICES 7*
1+4	2011	Turning Area A+C 0 m	0.00074	0.00098	0.00023	0.00066	0.00031	0.0014	0.00082	0.00072	0.0016	0.00069	0.0012	0.00082	0.0201	0.00932
3	2011	Turning Area B 1 m	0.00058	0.00087	0.00021	0.0006	0.00027	0.0013	0.00072	0.00065	0.0014	0.00063	0.0011	0.00075	0.0170	0.00744
5	2011	Appr. Ch. D 0 m	0.00031	0.00031	<0.0002	0.00032	<0.0002	0.00051	0.00033	0.00029	0.00072	0.00029	0.0005	0.0003	0.0067	0.0032
8	2011	Appr. Ch. E 1 m	0.00037	0.00045	<0.0002	0.00034	<0.0002	0.00068	0.00044	0.0004	0.00088	0.00039	0.00065	0.00042	0.0092	0.00444
9	2011	Berthing Pocket F 0 m	0.0004	0.00058	<0.0002	0.00041	<0.0002	0.00079	0.00044	0.00046	0.0022	0.0004	0.00082	0.0005	0.0121	0.00508
23+25	2011	Beth. P.K+ an.tr. L 0 m	0.00063	0.001	0.00023	0.00074	0.00032	0.0014	0.00081	0.00069	0.0016	0.00068	0.0011	0.00082	0.0189	0.00816
19+26	2011	App. Ch I+anch. Tr.L 1 m	0.00062	0.00087	<0.0002	0.00065	0.00028	0.0013	0.00075	0.00065	0.0015	0.00066	0.0011	0.00078	0.0200	0.01037
27	2011	Approach Ch. M 0 m	0.00045	0.00043	<0.0002	0.00033	<0.0002	0.00074	0.00049	0.00042	0.00096	0.00042	0.00069	0.00044	0.0108	0.00595
28	2011	Approach Ch. M 1 m	0.00053	0.00089	0.0002	0.00061	0.00035	0.0011	0.00064	0.00056	0.00069	0.00053	0.00091	0.00074	0.0305	0.02207
36	2011	Berthing Pocket Q 0 m	0.00064	0.001	0.00022	0.00068	0.00033	0.0013	0.00074	0.00067	0.00077	0.00062	0.001	0.00087	0.0307	0.02099
37	2011	Berthing Pocket Q 1 m	0.00026	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00027	<0.0002	0.00022	0.00039	0.00023	0.0021	0.00087
40	2011	Reclamation Area R 0 m	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
45	2011	Reclamation Area T 1 m	0.00059	0.00085	0.0002	0.0006	0.00043	0.00099	0.00059	0.00055	0.00075	0.0005	0.0009	0.0007	0.0280	0.01967
46+48+50	2011	Recl. Ar. U+V+W 0 m	0.00051	0.00067	<0.0002	0.00048	0.00028	0.00081	0.00052	0.00044	0.00066	0.00041	0.00072	0.00058	0.0241	0.01762
47+49	2011	Recl, Area U+V 1 m	0.00055	0.00097	0.00021	0.00065	0.00056	0.00088	0.00054	0.0005	0.00069	0.00048	0.00079	0.00066	0.0162	0.00829
2	2011	Turning Area B 0 m	0.00046	0.00039	<0.0002	0.00028	<0.0002	0.00057	0.00038	0.00036	0.00047	0.00034	0.00057	0.00042	0.0100	0.00613
7	2011	Appr. Ch. E 0 m	<0.0002	0.00023	<0.0002	<0.0002	<0.0002	0.00029	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00026	0.0032	0.00236
12	2011	Berthing pocket G 0 m	<0.0002	0.0011	0.00034	0.00068	0.00032	0.0015	0.00092	0.00075	0.0012	0.00065	0.001	0.001	0.0413	0.03022
15	2011	Anch. Trench H 0 m	<0.0002	0.00057	0.00022	0.00033	<0.0002	0.00076	0.00044	0.00037	0.00077	0.00027	0.00057	0.00062	0.0229	0.0162
18	2011	Approach Ch. I 0 m	<0.0002	0.00044	<0.0002	0.00023	<0.0002	0.00067	0.00039	0.00031	0.00076	0.00021	0.00037	0.00047	0.0119	0.00713
29	2011	Appr. Ch. N 0 m	<0.0002	0.00046	<0.0002	0.00023	<0.0002	0.0006	0.00037	0.00021	0.00043	<0.0002	0.00023	0.00046	0.0114	0.00763
30	2011	Appr. Ch. N 1 m	0.00031	0.0013	0.0004	0.00081	0.00036	0.0018	0.001	0.00083	0.0012	0.00073	0.0012	0.0011	0.0306	0.01802
42	2011	Recl. Area S 0 m	<0.0002	0.00073	0.00025	0.00044	0.0002	0.0011	0.00066	0.00048	0.00081	0.00038	0.00064	0.00073	0.0197	0.01209
44	2011	Recl. Area T 0 m	<0.0002	0.00059	0.00022	0.00032	<0.0002	0.00082	0.00052	0.00036	0.0006	0.00028	0.00046	0.00059	0.0131	0.0071
MAR00881.001	2021	Site B	0.00025	<LOD	<LOD	<LOD	<LOD	0.00015	0.00024	0.0002	<LOD	0.00015	0.00024	<LOD	0.0014	0.00052
MAR00881.002	2021	Site G	0.00043	0.00057	0.00014	0.00036	0.00015	0.00063	0.00084	0.00057	0.00019	0.00042	0.00073	0.00071	0.0113	0.00489
MAR00881.003	2021	Site J	0.00035	0.00056	0.00011	0.00029	0.00011	0.00053	0.00076	0.00054	0.00018	0.0004	0.00069	0.00071	0.0098	0.00445
MAR00881.004	2021	Site M	0.00025	0.06172	0.01069	0.03748	0.04183	0.00027	0.00032	0.00154	0.00068	0.0018	0.00512	0.00374	0.4530	0.22534
MAR00881.005	2021	Site Q	0.00076	0.0007	0.00017	0.00047	0.00014	0.00081	0.00129	0.00064	0.00042	0.00059	0.00104	0.00089	0.0142	0.00615
MAR00881.006	2021	Site R	0.00039	0.00056	0.00014	0.00031	0.0001	0.00058	0.00071	0.00049	0.00274	0.00049	0.00074	0.00078	0.0133	0.00498
MAR00881.007	2021	Site T	0.00061	0.00054	0.00012	0.00033	0.00015	0.00076	0.00199	0.00062	0.00019	0.00055	0.00088	0.00076	0.0133	0.00525
MAR00881.008	2021	Site W	0.00065	0.00047	0.0001	0.00034	0.00011	0.00077	0.00108	0.00058	0.00019	0.00051	0.00087	0.00068	0.0112	0.00498
MAR00881.009	2021	CCS X	0.00099	0.00048	0.00011	0.00025	0.00009	0.0008	0.00144	0.00064	0.00022	0.00061	0.00096	0.0007	0.0117	0.00471
MAR00881.010	2021	CCS Y	0.00052	0.00068	0.00019	0.00047	0.00016	0.00067	0.00094	0.00046	0.00017	0.00041	0.00073	0.00066	0.0115	0.00525
MAR00881.011	2021	CCS Z	0.00071	0.00044	<LOD	0.00028	<LOD	0.00069	0.00099	0.00054	0.00018	0.00049	0.00085	0.00068	0.0097	0.00417
	Mean 2011		0.00050	0.00071	0.00024	0.00049	0.00033	0.00097	0.00060	0.00050	0.00098	0.00047	0.00077	0.00062	0.01784	0.01088
	Mean 2021 (not inc CCS X, Y, Z)		0.00046	0.00930	0.00164	0.00565	0.00608	0.00056	0.00090	0.00065	0.00066	0.00061	0.00129	0.00118	0.06593	0.03207
	Mean All year (not inc CCSX, Y, Z)		**0.00049**	**0.00279**	**0.00076**	**0.00178**	**0.00245**	**0.00086**	**0.00068**	**0.00054**	**0.00090**	**0.00051**	**0.00091**	**0.00075**	**0.03025**	**0.01635**

CAL1 Sum* ICES 7 (mg/kg)	**n/a**	**0.01**
CAL1 Sum ICES 25 (mg/kg)	**0.02**	**n/a**
CAL2 Sum ICES 25 (mg/kg)	**0.2**	**n/a**

Table B4: Organochlorine pesticides			mg/kg dry weight Lab Level of Detection (LOD) 0.0001 mg/kg for all Organochlorides							
Sample Name	**Year**	**Sample location**	**alpha-hexachlorocy-clohexane (AHCH)**	**beta-hexachlorocy-clohexane (BHCH)**	**gamma-hexachlorocy-clohexane GHCH**	**DIELDRIN**	**Hexachlorob-enzene (HCB)**	**1, 1-Dichloro-2, 2-bis(pchlorop-henyl) ethylene (PPTDE)**	**Dichlorodiph-enyltrichloro ethane (PPDDE)**	**1, 1-Dichloro-2, 2-bis(pchlorop-henyl) ethane (PPDDT)**
MAR00881.001	2021	Site B	<LOD	<LOD	<LOD	0.0001	0.0002	0.0002	<LOD	0.0009
MAR00881.002	2021	Site G	<LOD	0.0001	<LOD	0.0009	0.0005	0.0014	0.0035	0.0068
MAR00881.003	2021	Site J	<LOD	<LOD	<LOD	0.0003	0.0006	0.0011	0.0034	0.0055
MAR00881.004	2021	Site M	<LOD	<LOD	<LOD	0.0003	0.0002	0.0003	0.0002	0.0018
MAR00881.005	2021	Site Q	<LOD	<LOD	<LOD	0.0008	0.0008	0.0015	0.0021	0.0079
MAR00881.006	2021	Site R	<LOD	0.0002	<LOD	0.0008	0.0006	0.0014	0.0016	0.0066
MAR00881.007	2021	Site T	<LOD	0.0001	<LOD	0.001	0.0007	0.0015	0.0016	0.0074
MAR00881.008	2021	Site W	<LOD	<LOD	<LOD	0.0008	0.0006	0.0011	0.0037	0.0067
MAR00881.009	2021	CCS X	<LOD	<LOD	0.0001	0.0005	0.0006	0.0013	0.0016	0.005
MAR00881.010	2021	CCS Y	<LOD	<LOD	<LOD	0.0008	0.0007	0.0012	0.0052	0.006
MAR00881.011	2021	CCS Z	<LOD	<LOD	<LOD	0.0005	0.0006	0.001	<LOD	0.0047
	Mean 2021		**<LOD**	**0.00013**	**0.00010**	**0.00062**	**0.00055**	**0.00109**	**0.00254**	**0.00539**
	EQS Priority Substance (annual average, ug/l)					Σ = 0.01	0.01	0.01		
	EQS Dangerous Substance (annual average, ug/l)						0.03	0.01		
	CAL 1 mg/kg					0.005				0.001

C. EA Water sample data and available headroom calculation

Table C.1: EA Water quality sample data from 4 sites (locations of sampling points shown on Figure 2.1) from 2018-2021. Indication of available headroom in annual-averaged (AA) EQS.

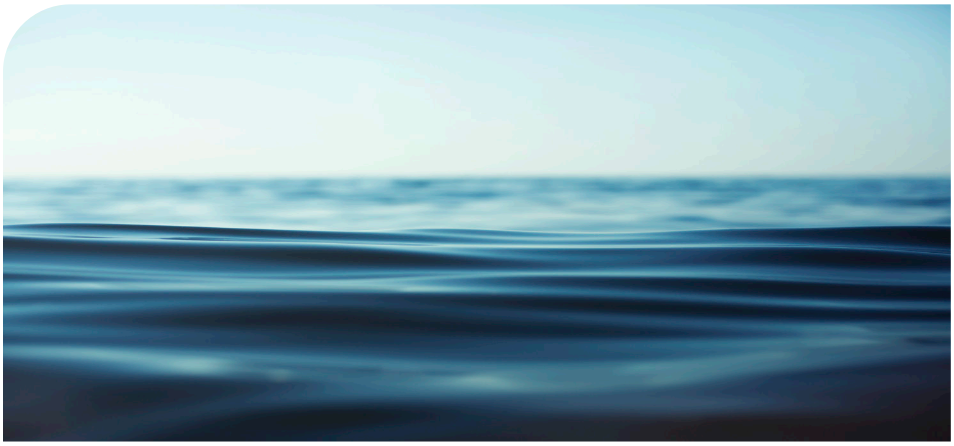
CONTAMINANT (Red indicates WFD failure in 2019 reporting)	CLEAN SITE - TI02	HUMBER BUOY 26	HUMBER NEAR HESSLE SAND	HUMBER NO.28 BUOY	R.HUMBER COMMITTEE	Average	AA-EQS	Headroom	% of Available Headroom
Ammoniacal Nitrogen, Filtered as N	0.0289	0.0382	0.0430	0.0545	0.0326	0.0393	21.00	20.96	99.81
Arsenic, Dissolved	2.1950	2.7375	4.0450	3.0650	2.4950	2.9075	25.00	22.09	88.37
Benzo(a)Pyrene	0.0285	0.0547	0.1818	0.1034	0.0610	0.0818	0.00017	-0.08167	
Benzo(b)Fluoranthene	0.0247	0.0408	0.1517	0.0902	0.0464	0.0691	Uses benzo(a)pyrene as a marker		
Benzo(g,h,i)Perylene	0.0240	0.0426	0.1749	0.0980	0.0455	0.0774	Uses benzo(a)pyrene as a marker		
Benzo(k)Fluoranthene	0.0132	0.0222	0.0846	0.0599	0.0307	0.0416			
Cadmium, Dissolved	0.0809	0.0970	0.0954	0.0945	0.0907	0.0917	0.20	0.11	54.15
Carbon, Organic, Dissolved as C :- {DOC}	1.5900	2.4425	3.2550	2.8700	2.0800	2.4475			
Chlorophyll : Acetone Extract	3.0575	3.6263	5.9796	3.7289	4.4993	4.1592			
Chromium Hexavalent, Dissolved :- {Cr VI}	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.60	0.30	50.00
Copper, Dissolved	2.0475	3.2550	4.0825	3.4350	2.6000	3.0840	6.23	3.15	50.50
Fluoranthene	0.0273	0.0501	0.1267	0.0689	0.0418	0.0606	0.01	-0.05	
Indeno(1,2,3-cd)pyrene	0.0265	0.0503	0.2022	0.1079	0.0488	0.0872			
Iron, Dissolved	100.0	246.5	198.7	100.0	100.0	149.1	1000.0	850.9	85.10
Lead, Dissolved	0.0598	0.2501	1.5272	0.0963	0.0684	0.4004	1.30	0.90	69.20
Mercury, Dissolved	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100			
Nickel, Dissolved	1.7333	2.4125	3.3683	2.6008	2.0075	2.4245	8.60	6.18	71.81
Nitrate, Filtered as N	1.9500	3.2215	4.1447	3.9510	2.5871	3.1434			

CONTAMINANT (Red indicates WFD failure in 2019 reporting)	**CLEAN SITE - TI02**	**HUMBER BUOY 26**	**HUMBER NEAR HESSLE SAND**	**HUMBER NO.28 BUOY**	**R.HUMBER COMMITTEE**	**Average**	**AA-EQS**	**Headroom**	**% of Available Headroom**
Nitrite, Filtered as N	0.0115	0.0125	0.0151	0.0187	0.0132	0.0142			
Nitrogen, Dissolved Inorganic : as N	1.9895	3.2720	4.2037	4.0245	2.6329	3.1967			
Nitrogen, Total Oxidised, Filtered as N	1.9659	3.2076	4.1460	3.9419	2.5623	3.1385			
Orthophosphate, Filtered as P	0.0757	0.1034	0.1147	0.1145	0.0902	0.0992			
Oxygen, Dissolved as O2	9.24	9.27	9.07	9.3	9.23	9.22			
Oxygen, Dissolved, % Saturation	94.68	90.49	85.86	89.35	92.62	90.61			
Salinity : In Situ	23.34	15.64	11.28	13.48	20.19	16.81			
Sample Depth below surface	0.20	0.20	0.20	0.20	0.20	0.20			
Silicate, Filtered as SiO2	2.2012	3.4114	4.2055	4.1786	2.8036	3.3359			
Tributyl Tin as Cation	0.0003	0.0004	0.0007	0.0005	0.0004	0.0005	0.0002	-0.0003	
Turbidity : In Situ	168.4	288.6	516.7	369.8	195	307.2			
Zinc, Dissolved	3.3750	5.7650	6.4500	5.1000	4.0200	4.9420	7.9000	2.9580	37.44

Source: EA Water quality sampling. Data averages from 2018 – 2021.

EA Water quality archive. Available at: https://environment.data.gov.uk/water-quality/view/explore [Accessed 22 March 2021]

HR Wallingford
Working with water



HR Wallingford is an independent engineering and environmental hydraulics organisation. We deliver practical solutions to the complex water-related challenges faced by our international clients. A dynamic research programme underpins all that we do and keeps us at the leading edge. Our unique mix of know-how, assets and facilities includes state of the art physical modelling laboratories, a full range of numerical modelling tools and, above all, enthusiastic people with world-renowned skills and expertise.

HR Wallingford, Howbery Park, Wallingford, Oxfordshire OX10 8BA, United Kingdom
tel +44 (0)1491 835381 fax +44 (0)1491 832233 email info@hrwallingford.com
www.hrwallingford.com