REPORT

Boston Alternative Energy Facility – Preliminary Environmental Information Report

Chapter 15 Marine Water and Sediment Quality

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Non-Technical Summary

This chapter of the PEIR considers marine sediment and water quality. To inform the chapter, a description of the baseline is described using site information, desk-based studies and the information provided in **Chapter 16 Estuarine Processes**. The potential impacts associated with construction, operation and decommissioning of the Facility are identified and an assessment made on the severity of each impact using the methodology detailed in **Chapter 6 Approach to EIA**. The assessment also considers cumulative impacts where the Facility is considered alongside the predicted impacts of other plans and projects within the Study Area.

The outcome of the assessment is that all impacts are predicted to temporary and be **minor adverse** on marine sediment and water quality for both the construction and operational phase.

No impacts during decommissioning are anticipated with relation to marine water and sediment quality considered to be within the range of impacts identified during construction and therefore the conclusions reached for decommissioning are similar to those identified for construction.

In relation to cumulative effects, the only project identified to have the potential to interact with the works to construct the Facility is the Boston Tidal Barrier. This is in relation to the sediment plumes created during simultaneous dredging campaigns (capital or maintenance). Overall it is concluded that the cumulative impact of suspended sediment concentrations from the plume of the two projects being dredged at the same time is **negligible**. Furthermore, this represents the worst case position because it is likely that the construction of the Boston Barrier will be completed before any construction starts on the Facility.

15 Marine Water and Sediment Quality

15.1 Introduction

15.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) describes the existing environment in relation to marine sediment and water quality and details the assessment of the potential impacts during the construction, operational and decommissioning phases of the Boston Alternative Energy Facility (the Facility). Mitigation measures are detailed, and a discussion of the residual impacts provided where significant impacts were identified.

15.1.2 This chapter has been informed by **Chapter 16 Estuarine Processes**.

15.2 Legislation, Policy and Guidance

Legislation

15.2.1 The principal European and International policy and legislation used to inform the assessment of potential impacts on marine water and sediment quality for this project includes:

- Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (the Water Framework Directive (WFD));
- Directive 2008/105/EC Priority Substances establishing Environmental Quality Standards for contaminants in water; and
- The International Convention for the Prevention of Marine Pollution by Ships (MARPOL Convention) 73/78.

15.2.2 The key European Directives are transposed into UK law through several regulations which are discussed further in **Chapter 3 Policy and Legislation**.

National Planning Policy Framework

15.2.3 The updated National Planning Policy Framework (February 2019) states the following in relation to water and sediment quality:

> Planning policies and decisions should contribute to and enhance the natural and local environment by *"…preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental*

conditions such as air and water quality, taking in to account relevant information such as river basin management plans."

National Planning Policy

15.2.4 The assessment of potential impacts on marine water and sediment quality has been made with specific reference to the relevant National Policy Statement (NPS). These are the principal decision-making documents for Nationally Significant Infrastructure Projects (NSIPs). Those relevant to the project are:

- Overarching NPS for Energy (EN-1) (Department for Energy and Climate Change (DECC), 2011a); and
- NPS for Renewable Energy Infrastructures (EN-3) (DECC 2011b).

15.2.5 The specific assessment requirements for marine water and sediment quality are provided in **Table 15.1.**

Table 15.1 NPS Requirements for the Marine Sediment and Water Quality Chapter

NPS requirement	NPS reference	PEIR reference
Infrastructure development can have adverse effects on the water environment, including transitional waters and coastal waters. During the construction, operation and decommissioning phases, discharges would occur. There may also be an increased risk of spills and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health or on protected species and habitats and could, in particular result in surface waters, ground waters of protected areas failing to meet environmental objectives established under the Water Framework Directive (WFD).	EN-1 Paragraph 5.15.1	Potential impacts of the project on water quality are assessed in **Section 15.7**. Impacts to habitats and species are assessed in **Chapter 17 Marine and Coastal Ecology**. A WFD Compliance Assessment is provided in **Chapter 13 Appendix 13.1 Water Framework Directive Compliance Assessment**.
Where the project is likely to have adverse effects on the water environment, the application should undertake an assessment of the existing status of, and impacts of the proposed project, on water quality, water resources and physical characteristics of the water environment as part of the Environmental Statement or equivalent.	EN-1 Paragraph 5.15.2	Potential impacts of the project on water quality are assessed in **Section 15.7**. Impacts to habitats and species are assessed in **Chapter 17 Marine and Coastal Ecology**. A WFD Compliance Assessment is provided in **Chapter 13 Appendix 13.1 Water Framework Directive Compliance Assessment**. .

15.2.6 Other UK policies and plans of relevance to this chapter are the Marine Policy Statement (MPS) (HM Government, 2011). This document guides decision making with regard to marine developments and signpost the relevant legislation to be followed.

15.2.7 The MPS provides the high-level approach to marine planning and general principles for decision making. It also sets out the framework for environmental, social and economic considerations that need to be considered in marine planning. Section 2.6.4 of the MPS states that:

> "*Developments and other activities at the coast and at sea can have adverse effects on transitional waters, coastal waters and marine waters. During the construction, operation and decommissioning phases of developments, there can be increased demand for water, discharges to water and adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills and leaks of pollutants into the water environment and the likelihood of transmission of invasive non-native species, for example through construction equipment, and their impacts on ecological water quality need to be considered*."

Local Planning Policy

15.2.8 The South-East Lincolnshire Local Plan was adopted in March 2019 and replaces all policies in the previous Boston Borough Local Plan. *Policy 30: Pollution* is relevant to water and sediment quality, where it is stated that development proposals will not be permitted where they would lead to unacceptable adverse impacts upon surface water quality.

15.2.9 *Policy 28: The Natural Environment* of the South-East Lincolnshire Local Plan also includes elements which are indirectly related to water and sediment quality, where development proposals that would cause harm to the assets of internationally designated sites will not be permitted, except in exceptional circumstances, where imperative reasons of overriding public interest exist, and the loss will be compensated by the creation of sites of equal or greater nature conservation value.

Guidance

15.2.10 This chapter refers to two sets of guidance in relation to assessing sediment quality as follows. The first are the Centre for Environment, Fisheries and Aquaculture Science (Cefas) Action Levels (Marine Management Organisation (MMO), 2018). These levels are used to indicate general contaminant levels in the sediments. If overall levels do not generally exceed the lower threshold values of these guideline standards, then contamination levels are not considered to be of significant concern and are low risk in terms of potential impacts on the marine environment. Most of the material assessed against these standards arises from dredging activities but they are considered an acceptable way of assessing the risks to the environment from other marine activities as part of the Environmental Impact Assessment (EIA) process.

15.2.11 The MMO (using the Cefas Action levels) states that, in general, contaminant levels below Action Level 1 are not considered to be of concern. Material with persistent contaminant levels above Action Level 2 is generally considered to pose an unacceptable risk to the marine environment (and therefore material is unlikely to be considered suitable for disposal to sea). For material with persistent contaminant levels between Action Levels 1 and 2, further consideration of additional evidence is often required before the risk can be quantified. Therefore, for EIA, in the same way, if contaminant levels in the sediments under consideration persistently exceed Action Levels, additional assessment is required. This might be the application of additional sediment quality guidelines or undertaking more detailed water quality modelling.

15.2.12 The second set of sediment quality guidelines referred to in this assessment uses Threshold Effects Level (TEL) and Predicted Effects Level (PEL) as interim Sediment Quality Guidelines (Canadian Council of Ministers of the Environment CCME, 1992). The TEL is the lower level and represents the concentration below which sediment associated chemicals are not considered to represent significant hazards to aquatic organisms. The PEL is the upper level and represents the lower limit of the range of chemical concentrations that have been associated with adverse biological effects.

15.3 Consultation

15.3.1 Consultation undertaken throughout the pre-application phase informed the approach and the information provided in this chapter. A summary of the consultation of particular relevance to marine sediment and water quality is detailed in **Table 15.2Table *15.2*.**

Table 15.2 Consultation and Responses

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
The Planning Inspectorate July 2018	The inspectorate advices that an assessment of the potential land contamination and hydrogeological effects that may arise from the construction of the wharf including the disturbance of sediment within the River Witham should be included within the ES. The ES should include a full assessment of the potentially significant environmental effects that may arise from the construction and operation of the wharf and fully describe any required mitigation.	Disturbance of sediment associated with the construction of the wharf is assessed in **Section 15.7**
The Planning Inspectorate July 2018	Regarding scoping out environmental effect to The Wash Inner WFD water body on the basis that the distance from the proposed development and the embedded migration measures will avert a likely	The main potential effect to The Wash is associated with sediment plumes

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
	significant effect. Require more information on embedded mitigation measures – therefore any likely significant environmental effects on The Wash must be assessed in the ES with appropriate cross reference to the ecology assessment.	during construction – the potential impacts associated with sediment plumes are assessed in **Section 15.7.** Specific consideration of the Inner Wash WFD water body is provided in the WFD Compliance Assessment in **Chapter 13 Appendix 13.1 Water Framework Directive Compliance Assessment**.
The Planning Inspectorate July 2018	Consider the potential effects of surface water run off on the marine environment.	There will be no direct discharges to the marine environment either during the construction or the operation of the Facility. Details regarding the management of surface water on land are detailed in **Chapter 5 Project Description** and considered in **Chapter 13 Surface Water, Flood Risk and Drainage Strategy**.
The Planning Inspectorate July 2018	No approach is provided for the assessment of some of the potential construction and operational effects identified in the Scoping Report -for example release of contaminants from dredging and spread of invasive species. In addition, it is not clear what information will be gathered to inform the assessments outlined. The ES should clearly set out the information on which the assessments have been based, including detailed information on the construction activities and operation of the proposed development. Details of the methodologies applied and any limitations to the assessments should be provided in the ES.	The approach to the assessment of release of contaminants is provided in **Section 15.4**. The information used to assess the baseline is provided in **Section 15.6**. Spread of invasive species is covered

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
		in **Chapter 17 Marine and Coastal Ecology** and is also included in the WFD Compliance Assessment found in **Chapter 13 Appendix 13.1 Water Framework Directive Compliance Assessment**.
MMO July 2018	Should a new offshore disposal site need to be designated, further impacts at the disposal site (such as increased suspended sediment, changes to sediment properties and their effects on biological receptors) would need to be considered. Should there be an identified need for maintenance dredging, the impacts should also be identified in section 6.9.11 (operational impacts).	A new offshore disposal site is not required. None of the capital or maintenance-dredged material will be disposed at sea. All will be managed on land in accordance with the waste hierarchy. There will be no discharges to the marine environment once landed as the stockpile area will include arrangements for any process water to be transferred to collection tanks and used in the aggregate facility. Given the above, no further consideration is necessary within this chapter.
Port of Boston 5th July 2018	Various comments regarding the requirement for sea disposal.	See response above.

15.4 Assessment Methodology

Impact Assessment Methodology

15.4.1 Three main phases of development are considered, in conjunction with the present-day baseline, over the life cycle of the Facility (at least 25 years). These are:

- construction phase;
- operational phase; and
- decommissioning phase.

15.4.2 The method for assessment follows that presented in **Chapter 6 Approach to EIA** with topic specific definitions for sensitivity and magnitude as outlined below.

15.4.3 The sensitivity of a receptor, in this case marine water quality, is dependent upon its:

- Tolerance to an effect (i.e. the extent to which the receptor is adversely affected by a particular effect);
- Adaptability (i.e. the ability of the receptor to avoid adverse impacts that would otherwise arise from a particular effect); and
- Recoverability (i.e. a measure of a receptor's ability to return to a state at, or close to, that which existed before the effect caused a change).

15.4.4 The sensitivity is assessed using expert judgement and described with a standard semantic scale. Definitions for each term are provided in **Table 15.3**.

Table 15.3 Definitions for Assessing the Sensitivity for Marine Sediment and Water Quality

Sensitivity	Definition
High	The water quality of the receptor supports or contributes towards the designation of an internationally or nationally important feature and/or has a very low capacity to accommodate any change to current water quality status, compared to baseline conditions.
Medium	The water quality of the receptor supports high biodiversity and/or has low capacity to accommodate change to water quality status.
Low	The water quality of the receptor has a high capacity to accommodate change to water quality status due, for example, to large relative size of the receiving water and capacity for dilution and flushing. Background concentrations of certain parameters already exist.
Negligible	Specific water quality conditions of the receptor are likely to be able to tolerate proposed change with very little or no impact upon the baseline conditions detectable.

15.4.5 Prediction of the magnitude of potential effects has been based on the consequences that the Facility might have upon the marine water quality status.

These descriptions of magnitude are specific to the assessment of marine water quality impacts and are considered in addition to the generic descriptors of impact magnitude that will be presented in the EIA. Potential impacts have been considered in terms of permanent or temporary, and adverse or beneficial effects. The magnitude of an effect is dependent upon its:

- Scale (i.e. size, extent or intensity);
- Duration;
- Frequency of occurrence; and
- Reversibility (i.e. the capability of the environment to return to a condition equivalent to the baseline after the effect ceases).

15.4.6 The magnitude of effect is assessed using the terms in **Table 15.4**.

Table 15.4 Definitions for Assessing the Magnitude of Effect for Marine Sediment and Water Quality

Magnitude	Definition
High	Large scale change to key characteristics of the water quality status of the receiving water feature. Water quality status degraded to the extent that a permanent or long-term change occurs. Inability to meet (for example) Environmental Quality Standard (EQS) is likely.
Medium	Medium scale changes to key characteristics of the water quality status taking account of the receptor volume, mixing capacity, flow rate, etc. Water quality status likely to take considerable time to recover to baseline conditions.
Low	Noticeable but not considered to be substantial changes to the water quality status taking account of the receiving water features. Activity not likely to alter local status to the extent that water quality characteristics change considerably or EQSs are compromised.
Negligible	Although there may be some impact upon water quality status, activities are predicted to occur over a short period. Any change to water quality status would be quickly reversed once the activity ceases.

15.4.7 Where the potential for an accidental spill or leak is concerned, the focus will be on control measures that would be employed to reduce accidental releases to the marine environment. A separate outline Construction Environmental Management Plan (CEMP) will be provided, identifying the contents of the CEMP.

Cumulative Impact Assessment

15.4.8 Cumulative impacts are assessed through consideration of the extent of influence of changes or effects upon marine sediment and water quality arising from the Facility alone and those arising from the proposed project cumulatively or in combination with other developments and other nearby estuary activities. It is considered likely that only the Boston Tidal Barrier project is close enough to the

Facility to act cumulatively with regards to impacts associated with marine water quality. Information to support the Cumulative Impact Assessment will draw from findings of the Boston Tidal Barrier Environmental Statement (Environment Agency 2016).

Transboundary Impact Assessment

15.4.9 Transboundary impacts are assessed through consideration of the extent of influence of changes or effects and their potential to impact upon estuarine processes receptor groups that are located within other EU member states. Given the distance of the Facility from international boundaries in the North Sea, it is concluded that transboundary impacts on marine sediment and water quality would not occur.

15.5 Scope

Study Area

15.5.1 This chapter reflects the Study Area presented in **Chapter 16 Estuarine Processes** given that marine sediment and water quality effects will reflect the extent of any sediment plume created during dredging. The Study Area therefore addresses the potential effects on marine sediment and water quality along The Haven and into The Wash embayment (**Chapter 16 Estuarine Processes**, **Figure 16.1**).

Data Sources

15.5.2 The assessment was undertaken with reference to several sources, as detailed in **Table 15.5.**

Table 15.5 Key Information Sources

Data Source	Reference
Geology: six boreholes at a site about 900 m to the south of the Facility	Lincs Laboratory (2011)
Geology: four boreholes at a site about 500 m to the south of the Facility	T.L.P. Ground Investigations (2012)
Estuary-bed sediment: six samples collected in the Haven in 2010 and	Halcrow Jacobs Alliance (2011)
Eight samples recovered for the Boston Tidal Barrier EIA in 2014	WYG Environment (2014)
12 Samples recovered for the Boston Tidal Barrier 2017 for the Environment Agency	Newton (2017)
Information on Water Quality in the WFD water bodies	Environment Agency Data Catchment Explorer. https://environment.data.gov.uk/catchment-planning/ [Accessed, 2018]

Assumptions and Limitations

15.5.3 The Assumptions and Limitations associated with the development of this chapter reflect those of **Chapter 16 Estuarine Processes**, particularly in relation to ambient suspended solids concentrations. Additionally, as agreed with the MMO, it was assumed that the available vibrocore data (from the Boston Barrier baseline data collection) was sufficient to use for the purposes of this assessment, and that it was representative of the Facility's wharf location.

15.6 Existing Environment

15.6.1 This section provides an overview of the key information for marine sediment and water quality. It is separated into two sections, water quality and sediment quality.

Sediment Quality

15.6.2 Particle Size Distribution (PSD) data are relevant to this chapter because sediment grain size is a significant factor that controls the capacity for both suspended and bed sediments to concentrate and retain metals and organic pollutants (Horowitz, 1987). Finer sediments (clay and silt fractions) have a greater adsorbing capacity and, therefore retain higher concentrations of contaminants.

15.6.3 PSD data is described in **Chapter 16 Estuarine Processes**. To summarise, boreholes collected in 2011 (Lincs Laboratory, 2011) recovered 9.45 m (but mostly 5.8 m to 6.7 m) of silt and clay with the occasional silty fine sand layers on top of glacial diamicton or sand and gravel. Four additional boreholes recovered in 2012 (T.L.P Ground Investigations, 2012) found 4.75 m to 4.8 m of silty clay underlain by 0 to 0.6 m of peat, underlain by 0.85 to 1.7 m of medium sand, all resting on diamicton.

15.6.4 Two sediment samples were collected in August 2000 and August 2005 at two locations in The Haven by the Environment Agency (one upstream of the Facility and one downstream). The samples recorded median particle sizes equating to very fine sand with between 19% and 32% mud.

15.6.5 Three intertidal and three subtidal sediment samples were also collected in the Haven in April 2010 (Halcrow Jacobs Alliance, 2011), one of each at upstream of the Docks, Corporation Point and Hobhole Drain, (**Figure 15.1**). The nearest sample recorded silt/very fine sand for the subtidal sample and very fine silt for the intertidal sample.

15.6.6 Samples were also collected at eight locations in The Haven in 2014 to inform the environmental studies for the Boston Tidal Barrier (WYG Environment, 2015). Pre-construction vibrocores were also collected at 12 stations along the section of The Haven stretching up and downstream of the Port of Boston, at depths ranging from 0.5 m to 2 m depth (Newton, 2017) (**Chapter 16 Estuarine Processes**, **Figure 16.6**). Vibrocores were collected at stations SC12 **-** S23, whereas surface sediment samples were taken from the remaining locations.

15.6.7 The particle size analysis results show slightly different characteristics for samples located upstream, opposite and downstream of the Facility. Upstream of the Facility the sediments are finer with a higher proportion of mud to sand. Downstream, the bed sediments are slightly coarser and the bed samples opposite the Facility with roughly 50:50 sand and mud proportion

15.6.8 Overall therefore it is anticipated that the material to be dredged will consist of very fine sand with a relatively large percentage of silt.

15.6.9 In terms of sediment quality, the three intertidal and three sub-tidal sediment samples collected in 2010-2011, outlined above were also sent for chemical analysis. The results were then compared to the Canadian Sediment Quality Guidelines (CCME, 1999) in Halcrow Jacobs Alliance (2011) to assess potential impacts to the aquatic environment. The results concluded that no PELs were exceeded although arsenic, chromium, copper, lead and nickel and zinc TELs were exceeded, principally at sites with a predominance for fine sediments. Several Polycyclic Aromatic Hydrocarbons (PAHs) were also elevated above their respective TELs with Naphthalene at Hobhole Drain above its PEL.

15.6.10 The 2017 samples have been compared to the Cefas Action Levels (see **Table 15.6**). Note that locations SC22 and SC23 were the closest sampling sites to the Facility where vibrocores were taken.

15.6.11 Generally, most of the trace metal levels were below Cefas Action Level 1 concentrations. However, some trace metals exceeded the respective Cefas Action Level 1 values, as listed below.

- Arsenic (SC17, 2 m);
- Chromium (SC13, 0.5 m; SC21, 1 m);
- Nickel (SC12, 0.5 m, 2 m; SC13, 0.5 m; SC14, 1 m; SC17, 0.5 m, 2 m; SC19, 1m; SC21, 0.5 m, 1 m; SC22, 0.5 m); and
- Zinc (SC13, 0.5 m).

15.6.12 The concentrations, were however, recorded as being close to the Action Level 1 concentration and therefore are considered marginal exceedances. There were no exceedances of Action Level 2 concentrations. As a result, sediment contamination associated with metals within The Haven sediments is not considered to be significantly elevated.

15.6.13 In terms of PAHs, there are several exceedances of Cefas Action Level 1 (note there are no Action Level 2 concentrations). PAHs are a diverse group of aromatic compounds containing two or more fused arenes structures and are formed by the incomplete/inefficient combustion of organic material, diagenesis and biosynthesis (http://www.ukmarinesac.org.uk/activities/water-quality/wq8_40.htm, accessed 2019). PAHs are ubiquitous in the environment, with natural background levels resulting from forest fires, volcanoes and possibly production by some plants. However, a significant fraction of PAHs resulting in the environment are due to anthropogenic sources (e.g. burning of fuel, internal combustion engines etc.).

15.6.14 Their widespread occurrence results largely from formation and release during the incomplete combustion of coal, oil, petrol and wood, but they are also components of petroleum and its products. PAHs therefore reach the marine environment via sewage discharges, surface run-off, industrial discharges, oil spillages and deposition from the atmosphere (CCME 1992). **Table 15.7** summarises the common sources of PAHs found within The Haven sediment samples.

Table 15.6 Sediment Contamination Data for The Haven (2017 vibrocore samples), Compared to the Cefas Action Levels (yellow indicates exceedance of Action Level 1, no Action Level 2 exceedances were recorded).

Contaminant	Unit	Sample site																								
		SC12		SC13		SC14		SC15		SC16		SC17		SC18		SC19		SC20		SC21		SC22		SC23		
		0.5	1	2	0.5	1	0.5	1	2	0.5	0.5	1	2	0.5	1	0.5	1	2	0.5	1	2	0.5	1	0.5	1	1.5
Arsenic	mg/kg	15.4	-	18.8	16.9	16.2	12.3	n/a	n/a	12.8	13.6	11.9	24.8	12.2	12.5	-	n/a	n/a	14.7	15.7	14.8	12	12.9	12.8	10.3	9.06
Cadmium	mg/kg	0.246	0.195	-	-	0.195	0.242	0.185	0.358	0.202	0.146	-	-	0.263	0.278	-	0.321	0.231	0.212	0.181	0.143	0.115	0.246	0.195	-	-
Chromium	mg/kg	38.9	-	32.1	41.5	35.8	32.8	-	-	32.4	38.1	25.4	27.1	29.4	33	-	-	-	40.6	42.2	35.6	37.4	32.5	28	21.9	21.2
Copper	mg/kg	34.3	23.7	17.7	23.2	19.5	18	19.5	10.9	17.5	20.1	14.2	11.5	14.4	17.4	-	18.8	17.7	21.2	19.9	21	19.4	16.5	12.7	10.2	8.33
Lead	mg/kg	-	-	9.17	33.4	33.6	29.9	-	-	28.4	34	27.6	14.7	24.9	9.48	-	-	-	35.3	40.1	41.7	34.2	29.1	33.8	26.9	19.5
Mercury	mg/kg	0.143	-	<0.1	0.143	0.133	0.114	-	-	<0.1	0.139	<0.1	<0.1	<0.1	<0.1	-	-	-	0.14	0.154	0.207	0.137	<0.1	0.111	<0.1	<0.1
Nickel	mg/kg	24.2	-	28	27	21.8	20	-	-	20	21.4	15.9	24.2	17.1	25.5	-	-	-	23.5	22.6	19.9	21	19.1	18	13.9	13.9
Zinc	mg/kg	117	-	62.4	135	108	101	-	-	99.1	109	66.7	54.1	81.2	61.8	-	-	-	114	110	105	103	88.1	72.1	55.1	49.3
Acenaphthene	µg/kg	28.6	-	<4	25.1	23.3	30.4	-	-	22.8	42	20	<4	15.1	<4	34.5	-	-	-	41.2	69.3	33	23.5	21.9	25.4	7.06
Acenaphthylene	µg/kg	8.99	-	<4	10.5	8.86	8.61	-	-	8.57	11.6	9.8	<4	6.82	<4	10.8	-	-	-	13.7	16.4	9.18	8.43	7.82	5.62	4.36
Anthracene	µg/kg	50.5	-	<4	50.3	46.6	43.1	-	-	45.6	49.1	56.2	5.99	35.1	<4	51.4	-	-	-	67.6	146	57.4	36.7	55.6	42.1	18
Benzo(a)Anthracene	µg/kg	143	-	11.6	180	141	138	-	-	122	200	202	24	95.7	4.12	178	-	-	-	202	410	151	122	215	218	82.4
Benzo(a)Pyrene	µg/kg	141	-	11.1	201	154	138	-	-	115	167	181	27.4	69.9	<4	166	-	-	-	166	316	157	98.2	165	164	58.4
Chrysene	µg/kg	187	-	15.9	251	195	165	-	-	156	232	215	37.2	121	6.27	244	-	-	-	266	388	184	161	255	217	99.5
Dibenzo(a,h)Anthracene	µg/kg	31	-	<4	41	31.5	25	-	-	22.3	29.8	30.4	6.43	18.9	<4	33	-	-	-	33.8	72.1	32.3	25.8	26.9	27.9	13

Contaminant	Unit	Sample site																								
		SC12		SC13		SC14			SC15	SC16			SC17	SC18			SC19		SC20		SC21		SC22		SC23	
		0.5	1	2	0.5	1	0.5	1	2	0.5	0.5	1	2	0.5	1	0.5	1	2	0.5	1	2	0.5	1	0.5	1	1.5
Fluoranthene		331	-	28.8	429	313	315	-	-	302	436	662	64.8	217	14.1	463	-	-	-	489	1140	375	277	584	490	180
Fluorene		62.7	-	6.71	56.4	56.9	68.8	-	-	53.6	84.8	45.1	9.51	43.4	<4	77.7	-	-	-	110	144	72.8	51.1	51.2	40.8	20.8
Naphthalene		192	-	16.7	178	203	194	-	-	119	255	83.3	34.1	144	4.5	245	-	-	-	331	342	196	194	75.9	66.2	43.8
Phenanthrene		303	-	26.3	295	300	264	-	-	265	333	225	68.3	199	<9	351	-	-	-	440	542	289	288	248	282	138
Pyrene		287	-	32.5	377	279	278	-	-	253	382	518	59.4	191	17.5	397	-	-	-	429	915	322	238	463	459	155

Table 15.7 List of Main PAHs Found Around the Proposed Dredge Area Sediments

Contaminant	Source
Anthracene	Coal tar
Benzo(a)Anthracene	Gasoline and diesel exhaust, tobacco smoke, coal tar, coal pitch, wood and soot smoke. Considered to be a human carcinogen.
Benzo(a)Pyrene	Coal tar and tobacco smoke. Can cause mutations in DNA and eventually cause cancer.
Chrysene	Coal tar and tobacco smoke.
Dibenzo(a,h)Anthracene	PAH that is a common pollutant of smoke and oils. Highly genotoxic in bacterial and mammalian cell systems, because it intercalates in to DNA and causes mutations.
Fluoranthene	Isomer of pyrene, coal tar pitch, used as an intermediate for dyes (fluorescent), pharmaceuticals and agrochemicals.
Fluorene	Coal tar. Insoluble in water and soluble in many organic solvents.
Naphthalene	Naphthalene is a very common, relatively light, semivolatile. PAH found in numerous petroleum products and by-products.
Phenanthrene	Coal tar and petroleum
Pyrene	Coal tar, produced in a wide range of combustion conditions (created when products like coal, oil, gas, and rubbish are burnt but the burning process is incomplete). Used commercially to make dyes, plastics and pesticides. Oil spills, storm water runoff, vehicle exhausts are all sources.

15.6.15 Given the historical industrialisation of the estuary, these concentrations are expected in an estuary with a working dock and associated industrialised history (Halcrow Jacobs Alliance, 2011) and all pre-construction surveys for the Boston Barrier, including the 2017 vibrocore samples noted elevated levels of PAHs at differing degrees.

15.6.16 In terms of the potential risk to water quality, most PAHs (except for some low-molecular weight compounds, such as naphthalene) are strongly sorbed by particulate matter and biota in the aquatic environment (CCME 1992). It is therefore highly likely that a large percentage would remain bound to the material.

15.6.17 Whilst the above samples were not collected within the footprint of the proposed dredge area, it is anticipated that sediment quality is likely to be of a similar nature and reflect generalised sediment conditions in the estuary given that there are no specific pollution sources to the dredge area that could give rise to variances. As a result, the sediments are likely to exhibit marginally elevated levels of metals with concentrations of PAHs above sediment quality guidelines.

Water Quality

15.6.18 The proposed works are shown in **Figure 15.2** against the WFD water bodies in the Study Area. Note that WFD compliance is not specifically considered here – an assessment focussing on all WFD compliance parameters, including water quality, can be found in **Chapter 13 Appendix 13.1 Water Framework Directive Compliance Assessment**. Water quality information available for the WFD water body in which the Facility is located is presented here to provide context to the water quality baseline only.

15.6.19 The WFD water body in which the Facility is located is the Witham transitional water body (GB530503000100). This water body is a ‘heavily modified’ water body due to ‘flood protection’ and ‘ports, harbours and navigation’ and is currently classified to have an overall status of ‘bad’. Classification for biological parameters is considered bad due to phytoplankton and the mitigation measures assessment is at **moderate** or less. Physico-chemical quality elements are also considered to be at **moderate** classification status due to dissolved inorganic nitrogen (DIN). The River Basin Management Plan lists reasons for the elevated inorganic nitrogen concentrations as diffuse pollution (poor soil and nutrient management associated with agriculture and rural land management). In terms of chemical contaminants, the waterbody is at ‘good’ status, thus indicating no significant exceedances of EQS.

15.6.20 Water quality samples were also undertaken within the Witham Estuary in 2010/2011 (see **Chapter 16 Estuarine Processes**, **Figure 16.6** for locations) by Halcrow Jacobs Alliance (2011). The survey results indicated good water quality for all sites at which samples were taken with only one exceedance of EQS for iron. The survey also concluded that physicochemical parameters were within expected levels for the type of estuarine environment under consideration.

15.6.21 Data quantifying the baseline suspended sediment concentrations along The Haven are available from the environmental studies undertaken to inform the Boston Tidal Barrier work. Suspended sediment concentrations measured during the baseline studies for the Boston Barrier project showed background concentrations of 134 – 1,790 mg/l, with the highest concentrations being recorded nearest the seabed (see **Chapter 16 Estuarine Processes** for further detail).

Anticipated Evolution of the Baseline Condition

15.6.1 If the Facility was to not go ahead, the baseline conditions would continue to be impacted by natural events and already-existing activities. The baseline conditions for marine water and sediment quality are relatively stable within The Haven, with multiple datasets covering several years exhibiting similar patterns.

15.7 Potential Impacts

Embedded Mitigation

15.7.1 As part of the project design, several embedded mitigation measures have been proposed to reduce potential impacts on marine water quality. Embedded mitigation is a type of primary mitigation and is an inherent aspect of the EIA process. The Facility has committed to several techniques and engineering designs/modifications as part of the project, during the pre-application phase, to avoid several impacts or reduce the impacts as far as possible. The main embedded mitigation measures have been proposed to reduce potential impacts, as outlined below:

- The volume of capital dredging will be minimised by setting the quay wall as close to the channel as possible, whilst maintaining a safe distance from the berthing point to the navigable channel to allow vessels to pass safely;
- Complete as much of the capital dredging as possible using land-based equipment to reduce impacts in The Haven water column;
- Dispose of capital dredged sediment on land rather than at sea;
- Commitment to a Construction Environmental Management Plan (CEMP); and,
- Good environmental practices during construction works will be followed in accordance with Pollution Prevention Guidance (PPG) (Environment Agency Archives, 2011). Whilst it is accepted that these documents have now been withdrawn they still provide useful reference material for working in and around water.

Worst Case

15.7.2 Full details of the range of design options being considered are provided in **Chapter 5 Project Description**. The principal aspect of the Facility which has the potential to affect water quality is the proposed wharf and associated dredging both during the construction and operational phases. A worst case project envelope for wharf construction and operation is considered below.

Wharf Construction

15.7.3 The preferred structure is a suspended deck on piles over a sloping revetment (1 in 2 slope) with a fronting quay wall. The suspended deck would be approximately 400 m long and 20 m wide and constructed on top of about 300 driven piles. Two phases of sediment extraction are proposed; excavation of about 40,000 m^3 of sediment to create a slope for the revetment and dredging of about 110,000 m^3 of sediment to create sufficient water depth in the berthing areas in front of the quay wall. The construction of the wharf is anticipated to take around 18 months.

15.7.4 Elements of wharf construction that could potentially influence marine sediment and water quality are:

- Excavation of slope for the revetment (suspended solids, water quality);
- Option chosen to install suspended deck (i.e. precast or pouring in situ) (water quality); and
- Capital dredging in front of the quay wall to create berthing areas (suspended solids, water quality).

15.7.5 Although the capital dredging element of the wharf construction is unlikely to take 18 months, the exact duration will be clarified, and the impact assessment updated accordingly at the ES stage of this assessment.

15.7.6 Note that there will be no surface water drainage discharged to the marine environment during construction and therefore this activity is not considered further within this chapter.

15.7.7 The distance of the revetment from the subtidal channel would allow dredging of the slope to be completed using land-based equipment. Long-arm hydraulic excavators (and/or suitable cranes equipped with a grab) would excavate the slope from land. The dredged sediment would be managed on land in accordance with the waste hierarchy. As a result, sediment released into the marine environment will be significantly reduced thus reducing the potential for significant sediment plumes.

15.7.8 The capital dredging of the berthing areas in front of the quay wall would be completed from the land with the berthing pocket anticipated as being cut working backwards in a north to south (or vice versa). However, the 60m distance from the quay wall to the subtidal channel means that it may still be necessary to use floating plant. It is estimated that approximately one third of the sediment would be dredged by floating plant. This estimate is based on the expectation that the land-based plant could only reach approximately 15 m estuary-ward from land above mean high water springs.

15.7.9 The dredged sediment would comprise of a mix of recent intertidal mud and older Holocene mud with possible peat layers. The boundary between these two units in the berthing areas is difficult to establish, and so the volumes of the different units that would be dredged are also difficult to quantify.

15.7.10 The distinction between the volumes of recent and Holocene sediment is important because during the dredging process the recent sediment is more likely to break down into its constituent particles (and be suspended), whereas the Holocene sediment is more likely to remain as aggregated clasts of mud. These clasts would fall rapidly to the estuary bed (in less than a minute), rather than being disaggregated into their individual fine-grained sediment components immediately upon release.

15.7.11 For the worst case scenario for increase in suspended sediment concentrations due to capital dredging, it is assumed that all the sediment that is released into the water column is broken down into its constituent particles.

15.7.12 In relation to the potential for concrete pouring, the worst case is considered to where in-situ pouring is required. This carries with the most risk in relation to the potential for contamination of the marine environment.

Wharf operation

15.7.13 During the operation of the wharf, the only potential impact on marine sediment and water quality is related to the requirement for maintenance dredging to keep the berthing areas navigable. This could impact on suspended sediments concentrations within the water column.

15.7.14 To inform maintenance dredging requirements, **Chapter 16 Estuarine Processes** uses estimated siltation rates. For The Haven, the anticipated sedimentation rate is considered likely to be around 0.05 m/year (5 cm/year) in the berthing area. Given that the dredged footprint of this area is 32,850 m^2, this would lead to an accumulation of sediment of approximately 1,643 m^3/year. All material would be lifted directly onto the wharf and any resulting run-off will be collected and transferred to a holding tank prior to use in the aggregate facility. No discharges to the marine environment will be permitted.

15.7.15 For this chapter, only those design parameters with the potential to influence the level of impact to relevant receptors are identified. Therefore, if the design parameter is not described below in **Table 15.8**, it is not considered to have a material bearing on the outcome of this assessment.

15.7.16 After the operational lifetime of the proposed Facility of 25 years, if it is deemed not appropriate to continue operation, the Facility will be decommissioned. It is proposed that the wharf will not be decommissioned and will be kept in place, replacing a section of the current primary flood defence and forming a permanent structure. As such, no significant adverse impacts from decommissioning are predicted, and no further assessment has been carried out.

Table 15.8 Worst Case Assumptions

Impact	Design Parameter
Construction	
Impact 1: Impacts on suspended sediment concentrations due to capital dredging of the berth	Water Quality - Physico-chemical parameters (suspended solid concentrations) Worst case equates to maximum volume of dredging to be removed and assumes all material breaks down into component parts.
Impact 2: Impacts on water quality (contaminants) due to capital dredging of the berth	Water Quality - Chemical parameters (contaminants) Worst case equates to maximum volume of dredging to be removed.
Impact 3: Impacts on water quality due to pouring of concrete in situ	Water quality – Physico-chemical parameters (pH) Worst case equates to pouring concrete in situ
Operation	
Impact 1: Impacts on suspended sediment concentrations due to maintenance dredging	Water Quality - Physico-chemical parameters (suspended solid concentrations) Worst case equates to maximum volume of dredging to be removed and assumes all material breaks down into component parts.
Decommissioning	
No significant adverse impacts are anticipated.	-

Potential Impacts during Construction

Impact 1: Impacts on suspended solids concentrations due to capital dredging

Magnitude of impact

15.7.17 To allow access for vessels to the berths, capital dredging of approximately 150,000 m^3 of sediment from the intertidal area in front of the quay wall would be undertaken. There is the potential for the dredging activities to disturb sediment resulting in localised and short-term increases in suspended sediment concentrations. The dredging method would be excavators operating from both the land and marine sides of the dredging area. The worst case scenario assumes that sediment would be dredged and then managed on land in accordance with the waste hierarchy.

15.7.18 The potential for changes to suspended solids concentrations is assessed in **Chapter 16 Estuarine Processes**. To summarise, the chapter concludes that a small volume of the dredged sediment would be lost from the excavator during the dredging process and enter the water column. As a result, a plume would be created, which would be dispersed by tidal currents (and waves) away from the site, either up-estuary on the flood tide or down-estuary on the ebb tide. However, due to the small volume of sediment released and the fine size of the particles (silt and clay), it is likely to be rapidly dispersed, resulting in very low suspended sediment concentrations (less than tens of mg/l) unlikely to be distinguishable from background levels within a few kilometres of the Facility. As a result, the magnitude of the impact is considered to be **low.**

Sensitivity of receptor

15.7.19 The sensitivity of the receptor is considered to be **medium** given the current overall status of bad and the already **low** classification status of some of the water quality parameters. Additionally, the relatively small cross-sectional area will limit the ability of the water body to readily dilute any impacts on water quality parameters.

Significance of effect

15.7.20 The significance of effect is therefore **minor adverse**. Given that only **minor adverse** impacts are predicted, effects further downstream are not anticipated.

Mitigation Measures

15.7.21 No further mitigation measures are considered necessary.

Residual Impacts

15.7.22 The residual impact is therefore minor adverse.

Impact 2 Impacts on water quality as a result of releasing contamination during dredging

Magnitude of impact

15.7.23 While baseline information from sediments in and around the site indicate that the sediments to be dredged area are likely to contain some contamination, the reduced risk of resuspending sediment by the dredging methodology as outlined in Impact 1 reduces the risk of any sediment bound contamination being released as releases of sediment will be reduced as far as possible.

15.7.24 In relation to PAHs, as already outlined above, the compounds have a low water solubility and hydrophobic nature therefore they tend to be associated with inorganic and organic material within sediments and therefore remain bound. It is therefore highly likely that a large percentage will remain bound to the material. Additionally, any contamination that is released will be short lived and localised to the dredging equipment. As a result, changes to concentrations of contaminants in the water column are likely to be undisguisable from baseline levels. As a result, the magnitude of the impact is considered to be **negligible**.

Sensitivity of receptor

15.7.25 The sensitivity of the receptor is considered to be **medium** given the current overall status of bad and the already **low** classification status of some of the water quality parameters. Additionally, the relatively small cross-sectional area will limit the ability of the water body to readily dilute any impacts on water quality parameters.

Significance of effect

15.7.26 The significance of effect is therefore minor adverse. Given that only **minor adverse** impacts are predicted, effects further downstream are not anticipated.

Mitigation Measures

15.7.27 No further mitigation measures are considered necessary.

Residual Impacts

15.7.28 The residual impact is therefore **minor adverse**.

Impact 3: Impacts on water quality as a result of pouring concrete in situ

Magnitude of impact

15.7.29 A solid, stable base is required for construction which is assumed to be stable slab cast in place using formers. There may also be some foundations required for trestles as per other foundations on site. However, none of these activities will be located near to the marine environment or any other water body which could indirectly impact on the marine environment. Additionally, there will be Temporary Works Risk Assessments carried out and Temporary Works Method Statements to reduce any accidental risk to the environment in general. All wash down of mixers and forms will take place away from site in designated wash down areas which will be bunded to prevent leaks. As a result, no effects are anticipated.

Mitigation Measures

15.7.30 As outlined above, Temporary Works Risk Assessments will be carried out alongside Temporary Works Method Statements to reduce any accidental risk to the environment in general. All wash down of mixers and forms will take place away from site in designated wash down areas which will be bunded to prevent leaks. No further mitigation measures are identified.

Residual Impacts

15.7.31 There are no residual impacts anticipated.

Potential Impacts during Operation

Impact 1: Impacts on suspended solid concentrations and chemical contaminants associated with maintenance dredging

Magnitude of impact

15.7.32 The berthing areas would potentially create a sink for deposition of fine sediment and they may require maintenance dredging to maintain depth during the operational phase. This material would have recently been deposited and therefore significant contamination is not anticipated.

15.7.33 The method of dredging would be using excavators (cf. the capital dredge) from the land side of the wharf. Loss of sediment from the excavator would be less than the capital dredge given the reduced amount to be dredged, and hence the effects would be lower in magnitude.

Sensitivity of receptor

15.7.34 The sensitivity of the receptor is considered to be **moderate** given the current overall status of bad and the already **low** classification status of some of the water quality parameters. Additionally, the relatively small cross-sectional area will limit the ability of the water body to readily dilute any impacts on water quality parameters.

Significance of effect

15.7.35 The significance of effect is therefore **minor adverse**. Given that only **minor adverse** impacts are predicted, effects further downstream are not anticipated.

Mitigation Measures

15.7.36 No further mitigation measures are required.

Residual Impacts

15.7.37 The residual impact is **minor adverse**.

15.8 Cumulative Impacts

15.8.1 **Table 15.9** presents projects that are likely to have cumulative impacts when considered alongside the Facility. Each of these projects have been scoped in or out of the marine water and sediment quality aspect of the cumulative impact assessment.

15.8.2 Given the location of the Boston Tidal Barrier upstream of the Facility, cumulative effects may result from simultaneous dredging, either during capital and/or maintenance dredging at the two sites. The two impacts that could potentially give rise to a cumulative impact are therefore sediment plumes and any associated sediment contamination.

15.8.3 A summary of the potential cumulative impacts with the Boston Tidal Barrier is set out in **Table 15.10** below. However, it is noted that due to the consenting programme for the Facility compared to the construction programme for the Boston Barrier, it is likely that the Barrier will be completed before consent is granted for the Facility.

Table 15.9 Projects in the Vicinity of the Facility with the Potential to have Cumulative Impacts.

Project	Status	Development period	Distance from the Facility (km)	Project definition	Project data status	Included in CIA	Rationale
Boston Barrier Flood Defence	Transport and Works Act Order consented	2017 - ongoing	Boston Barrier at closest point to the Facility is 500 m.	Environmental Statement	Complete/high	Yes	The dredging programmes of this project and the Facility have the potential to overlap if the Barrier construction programme runs late and the Facility consenting programme is early.
Triton Knoll Offshore Wind Farm	DCO consented	2008 - ongoing	Onshore cable corridor and Construction compound at Langrick 9.7 km from the Facility.	Environmental Statement	Complete/ high	No	Land based, therefore no interaction with marine water and sediment quality.
Viking Link Interconnector B/17/0340	Application approved	2014 - 2023	Bicker Fen substation 14.4 km from the Facility.	Environmental Statement	Incomplete	No	Land based, therefore no interaction with marine water and sediment quality.
Battery Energy Storage Plant (Marsh Lane) B/17/0467	Application approved	2017 - ongoing	Beeston Farm less than 10 m from the Facility.	Detailed application	Incomplete	No	Land based, therefore no interaction with marine water and sediment quality.
The Quadrant Mixed-use development of 502 dwellings and commercial/ leisure uses B/14/0165	Application approved Construction started	2014 - ongoing	Quadrant 1 1.2 km from the Facility.	Details within ES	Quadrant 1 – Complete/ high Quadrant 2 - Incomplete/low	No	Land based, therefore no interaction with marine water and sediment quality.

Project	Status	Development period	Distance from the Facility (km)	Project definition	Project data status	Included in CIA	Rationale
Land to the west of Stephenson Close Residential Development of up to 85 dwellings B/17/0515	Application not yet determined	2017 - ongoing	From the most eastern part of the Scheme to the Facility is 550 m.	Outline only	Incomplete/low	No	Land based, therefore no interaction with marine water and sediment quality.

Table 15.10 Potential Cumulative Impacts

Impact	Potential for cumulative impact	Data confidence	Rationale
Construction Impact 1: Changes in suspended solid concentrations due to capital dredging	Yes	High	When dredging is undertaken for the Facility and the Boston Tidal Barrier, plumes could overlap
Construction Impact 2: Changes in water quality (contaminants) due to capital dredging	Yes	High	When dredging is undertaken for the Facility and the Boston Tidal Barrier, plumes could overlap
Operation Impact 1: Changes in suspended solid and chemical contaminant concentrations due to maintenance dredging	Yes	High	When dredging is undertaken for the Facility and the Boston Tidal Barrier, plumes could overlap
Decommissioning	None anticipated		

15.8.4 The impacts of the capital dredging activities on the identified receptors were identified to be of **minor adverse** for the Facility alone both for impacts on suspended solids concentrations and impacts on water quality (contaminants).

15.8.5 The construction programmes of the Facility and the Boston Tidal Barrier are not anticipated to overlap. However, as a worst case it is assumed they could overlap if there are delays to the final construction programme for the Barrier and so there is potential for cumulative impacts. The worst case scenario from a marine sediment and water quality perspective would be for both to be dredged at the same time. This would provide the greatest opportunity for interaction of sediment plumes during their construction. The combined change in suspended sediment concentrations could therefore have a greater spatial extent and persist for longer than each individual project.

15.8.6 The EIA for the Boston Tidal Barrier concluded that the impact of increased suspended sediment concentrations would be **negligible**. Given this conclusion a similar conclusion can be reached for simultaneous maintenance dredging operations, where the release of suspended sediment would be lower in volume and with likely lower concentrations of contaminants given the material would have recently settled.

15.9 Inter-Relationships with Other Topics

15.9.1 The range of effects on estuarine processes of the Facility not only have the potential to directly affect marine sediment and water quality but may also manifest as impacts upon receptors other than those considered within the context of estuarine processes. The assessments of significance of these impacts on other receptors are provided in the chapters listed in **Table 15.11**. This chapter has inter-relationships with **Chapter 17 Marine and Coastal Ecology**.

Table 15.11 Chapter Topic Inter-Relationships

Topic and description	Related Chapter	Where addressed in this Chapter
Effects on water quality (suspended sediments and contamination)	**Chapter 17 Marine and Coastal Ecology**	**Section 15.7**.

15.9.2 These inter-relationships are included because receptors of changes to suspended solid concentrations and contamination levels in the water are fish, marine mammals and marine ecology.

15.10 Interactions

15.10.1 The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts because of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity, the areas of interaction between impacts are presented in **Table 15.12Table *15.12***, along with an indication as to whether the interaction may give rise to synergistic impacts. There is no potential for synergistic impacts in the operational phase as there is only one potential impact on water quality associated with dredging.

Table 15.12 Interaction Between Impacts

Potential interaction between impacts			
Construction			
	1. Impacts on suspended solids concentrations due to capital dredging	**2. Impacts on water quality (contamination) concentrations due to capital dredging**	**3. Impacts on water quality associated with use of concrete**
1. Impacts on suspended solids concentrations due to capital dredging	-	No	No

Potential interaction between impacts			
Construction			
2. Impacts on water quality (contamination) concentrations due to capital dredging	No	-	No
3. Impacts on water quality associated with use of concrete	No	Yes	-
Decommissioning			
No impacts on marine water and sediment quality are anticipated during the decommissioning phase.			

15.11 Summary

15.11.1 The assessment of the construction, operational and decommissioning phases of the proposed Facility could cause a range of effects on marine sediment and water quality. The magnitude of these effects has been assessed using expert assessment. In all cases, the effects that have been assessed resulted in impacts of **minor adverse** significance. A summary of impacts to these receptors are listed in **Table 15.13**.

Table 15.13 Impact Summary

Potential Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
Impact 1: Impacts on suspended solids concentrations associated with capital dredging	Water Quality	Medium	Low	Minor Adverse	None required	Minor Adverse
Impact 2: Impacts on water quality associated with release of sediment contamination	Water Quality	Medium	Low	Minor Adverse	None required	Minor Adverse
Impact 3: Impacts on water quality associated with using concrete in the marine environment	Water Quality	Medium	No Impact			
Operation						
Impact 1: Impacts on suspended solids concentrations and chemical contaminants associated with maintenance dredging	Water Quality	Medium	Low	Minor Adverse	None required	Minor Adverse
Decommissioning						
No impacts on marine water and sediment quality are anticipated during the decommissioning phase.						

15.12 References

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