Note / Memo

HaskoningDHV UK Ltd.
Industry & Buildings

To:	Marine Management Organisation (MMO)
From:	Royal HaskoningDHV
Date:	18 January 2023
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Our reference:	PC1084-RHD-SB-EN-NT-EV-1142
Classification:	Project related

Subject: **MLA/2020/00506/2 South Bank Quay MLV2 Appraisal of Environmental Effects**

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1 Introduction

A variation request (herein referred to as 'MLV2') for the following amendments to marine licence for Phase 1 of the South Bank Quay redevelopment (L/2021/00333/2) was submitted to the Marine Management Organisation (MMO) on 4 October 2022 for determination:

- An additional 231,000m^3 of material to be disposed of at sea;
- An additional 29,000m^3 of material to be dredged from the Tees Dock turning circle;
- An additional 416,000m^3 of material to be dredged from the channel and berth pocket; and
- Minor amendments to the wording of the licensed activity relating to the placement of rock within the berth pocket and the licensed activities relating to dredging to account for dredging tolerances.

The Phase 1 marine licence relates to dredging of laying of rock blanket within the downstream section of the berth pocket and channel (450m), together with dredging within the Tees Dock turning circle and associated offshore disposal and demolition of existing structures. The marine licence for Phase 2 relates to dredging of laying of rock blanket within the upstream section of the berth pocket and channel (585m), together with associated offshore disposal and demolition of existing structures. The footprint of the Phase 1 and Phase 2 works is illustrated on the figure provided in **Appendix A**.

The proposed change in dredge and disposal volumes from the current version of the marine licence (L/2021//00333/2), together with a breakdown of material types, is presented in the style requested by Cefas within **Table 1.1**.

Table 1.1 Change in dredge and disposal volumes and material type breakdown requested as part of MLV2[1].

Activity	Existing Allowance	Proposed Variation	Extent of Change	Total
Dredging				
Turning Circle	187,000 m^3	216,000 m^3	+29,000 m^3	+445,000 m^3
	715,000 m^3	1,131,000 m^3	+416,000 m^3	

[1] The specific gravity factors used within the original application (which has therefore been used to convert the varied volumes) are 1.7 for 'clay' (which is representing the geological mudstone and till material) and 1.9 for sand.

Activity	Existing Allowance	Proposed Variation	Extent of Change	Total
Channel and Berth Pocket	15.6m bCD	15.9m bCD	+0.3m bCD	
Disposal at sea				
Turning Circle (Sand)	355,300 WT	410,400 WT	+55,100 WT	+355,700 WT
Channel and Berth Pocket (Clay)	280,500 WT	987,700 WT	+707,200 WT	
Channel and Berth Pocket (Sand)	1,045,000 WT	638,400 WT	-406,600 WT	

The additional material to be dredged and disposed of is required due to a change in the approach of removing material landward of the current OSPAR line but riverward of the new quay wall line (herein referred to as 'OSPAR material'). The approach is considered feasible under the OSPAR convention, as agreed with the MMO through a general enquiry (ENQ/2021/00205) (see **Appendix B**). The scope of the marine licence variation request and supporting application material was agreed through subsequent engagement with the MMO, including an EIA Screening Opinion (see **Appendix C**). The following information was submitted in support of MLV2:

- Logs of 15 no. boreholes taken within the footprint of the OSPAR material;
- Sediment sampling results for 15 no. boreholes;
- A methodology options paper, setting out the construction approaches considered and discussed with the MMO prior to submission of MLV2;
- Cross-sectional drawing illustrating the depth profile of OSPAR material to be excavated then disposed to land, or otherwise dredged then disposed to land or dredged then disposed to sea; and
- A plan showing the position of the existing OSPAR line and the location of the 15 no. boreholes in relation to the new quay wall and dredging areas.

MLV2 follows a previous marine licence variation for the following amendments to the original Phase 1 South Bank Quay marine licence (L/2021/00333/1), which received a positive determination on 26 August 2022 and is herein referred to as 'MLV1':

- Addition of a new dredger type within the dredging methodology, to allow for the use of a cutter suction dredger (CSD);
- Change in the dredge areas and descriptions to account for dredging tolerances; and
- Addition of a new licensed activity to allow enabling works to provide access to South Bank Wharf where dredged material unsuitable for disposal at sea would be transferred from barge to truck for disposal to a land-based waste management facility.

MLV1 was supported by further sediment plume modelling, presented in the Hydrodynamic and Sediment Plume Modelling Report (see **Appendix D**). This updated modelling was undertaken to reflect the changes in dredging type and dredge and disposal volumes associated with dredging of the OSPAR material (being applied for under MLV2).

The application for the original marine licence was supported by an Environmental Impact Assessment (EIA) Report (Royal HaskoningDHV, 2020) (herein referred to as the 'EIA Report'), which provides an assessment of the potential effects arising from the construction and operation of the scheme upon identified receptors. The EIA Report assessed a worst case scenario based on Phase 1 and Phase 2 works being carried out simultaneously. **Table 1.2** summarises the status of marine licences for each Phase of the scheme.

Table 1.2 Summary of marine licences and licence variation requests for each Phase of the scheme

Consent	Scheme Phase	
	Phase 1	Phase 2
Marine licence application	Marine licence (L/2021/00333/1) approved for: • Capital dredge of Tees Dock turning circle; • Capital dredge of the downstream section of the channel and berth pocket; • Disposal of dredged material to sea; • Placement of rock blanket within berth pocket.	Marine licence (L/2021/00433/1) approved for: • Capital dredge of the upstream section of the channel and berth pocket; • Disposal of dredged material to sea; • Placement of rock blanket within berth pocket.
Marine licence variation 1	Marine licence (L/2020/00333/2) approved. Amendments to the original marine licence for: • An additional dredger type within the dredging methodology; • To correct dredging tolerances within the dredging methodology; and • Addition of a licensed activity for temporary enabling works.	Not applicable
Marine licence variation 2	Marine licence variation under determination for: • Increase of dredging volumes associated with the dredging of OSPAR material; and • Increase of disposal volumes associated with the dredging of OSPAR material; • To correct dredging tolerances within the dredging methodology; and • Minor corrections.	Not applicable

Within Section 3.6, the EIA Report acknowledges the removal of OSPAR material as 'excavation of soils / landside materials within the riverbank'. Section 3.6.2 of the EIA Report notes that the volume of OSPAR material to be removed during Phase 1 is predicted to amount to 440,000m^3 and would either be re-used on site or disposed to land. MLV2 is applying for 416,000m^3 of OSPAR material to be dredged, a proportion of which will be disposed to sea (where suitable). As explained previously, the additional dredge and disposal volumes are required due to the change in approach from excavating landside material (and associated disposal to land) to dredging the OSPAR material (and associated disposal to sea).

Whilst the EIA Report assessed as worst case scenario based on programme, dredging and disposal activities associated with Phase 1 and Phase 2 will not overlap in time. Therefore, no cumulative effects arising between the two phases of the scheme will arise.

2 Request for Information (RFI) 19

As part of their determination of MLV2, MMO issued the supporting documents to relevant consultees (including their scientific advisers, the Centre for Ecology, Fisheries and Aquaculture Science (Cefas)) for consultation. A Request for Information ('RFI 19') was published on 4 January 2023 subsequent to receiving comments from the following advice teams within Cefas:

- The dredging and disposal (SEAL) team;
- The coastal processes team;
- The fish and fisheries team;
- The shellfish team; and
- The benthic team.

The MMO has collated Cefas' comments and identified a number of actions, which in turn comprise RFI 19 and have informed this response. Following engagement with the MMO on the approach to responding to RFI 19, this response provides further assessment on the following receptors:

- Fish, shellfish and fisheries (**Section 4**); and
- benthic ecology (**Section 5**).

The assessments listed above have been presented within the following sections in turn below and have been undertaken in the context of previous assessments submitted to MMO in support of the original marine licence application, MLV1 and related engagement. Other actions identified by MMO within RFI 19 not listed above have either been addressed within the main document submitted in response to RFI 19 (document reference - PC1084-RHD-SB-EN-NT-EV-1141).

3 Previous Assessment

The EIA Report submitted in support of the original marine licence application provided an assessment of potential environmental effects arising from the construction and operation of the scheme. At the time the EIA Report was submitted, the proposed approach to delivering the scheme was to dredge and dispose of material riverward of the existing OSPAR line to sea (where deemed suitable for at-sea disposal by MMO) and excavate and dispose of material landward of the existing OSPAR line (the OSPAR material) to land. Dredged material not considered suitable for disposal at sea is recovered to land. This was the basis on which the scheme was originally assessed within the EIA.

At the time of writing the EIA Report, given uncertainty on phasing, the EIA assumed that the dredging associated with both Phase 1 and Phase 2 would be undertaken within one campaign to reflect a worst-case scenario. The total volume of dredged material for the two phases assessed within the EIA is 1,800,000m^3. The scheme is to be undertaken in two phases – Phase 1 and Phase 2, which are consented under separate marine licences.

The scope of the original marine licence application therefore did not include for dredging or disposal of the OSPAR material, since this material fell outside of the marine environment and, by extension, the MMO's remit. In light of the MMO's confirmation to Teesworks general enquiry (ENQ/2021/00205), MLV2 is applying to vary the current marine licence to enable dredging and disposal of the proportion of OSPAR material considered suitable for disposal to sea by MMO.

In addition, as previously mentioned the programme assessed within the EIA Report reflected a worst case scenario and there will be no temporal overlap between dredging activities associated with Phase 1 and Phase 2, so no risk of in-combination effects. As such, the assessment of potential effects within this note solely relate to the dredge and disposal volumes associated with Phase 1 of the scheme.

4 Fish and Shellfish

Section 13 of the EIA Report provided an assessment of potential effects upon fish and fisheries from the construction and operation of both Phase 1 and Phase 2 of the scheme, whilst Section 26 of the EIA Report considers the potential effects on fish and other marine species and habitats from the disposal of dredged material to sea. This section provides a review of the EIA Report and considers the effects associated with the changes requested as part of MLV2 with respect to fish and shellfish.

4.1 Baseline Environment

The EIA Report reviewed the following information sources to define the existing environment with respect to fish and fisheries within the study area of the Tees estuary:

- Existing studies within the Tees estuary and adjacent marine areas;
- 2019 benthic trawls within the lower Tees estuary;
- 2014 epibenthic beam trawl survey in the lower Tees estuary;
- 2018 benthic trawls for the Hartlepool Approach Channel project; and
- 2012 and 2013 fish surveys in the Dogger Bank Teesside A & Sofia export cable corridor.

4.1.1 Fish and Shellfish

A review of existing fish and shellfish studies for the Tees estuary undertaken at the time of writing the EIA Report identified that the intertidal and subtidal habitat supported a number of benthic-feeding fish species, including the following documented species:

- Flounder *Platichthys flesus*;
- Plaice *Pleuronectes platessa*;
- Herring *Clupea harengus*;
- Sprat *Sprattus sprattus*;
- Cod *Gadus morhua*;
- Spurdog *Squalus acanthias*;
- Anglerfish *Lophius piscatorius*;
- Whiting *Merlangius merlangus*;
- Lemon sole *Microstomus kitt*; and
- Nephrops *Nephrops norvegicus*.

Both flounder and plaice are known to use the Tees estuary as a nursery ground.

A campaign of 16 benthic trawl surveys conducted in 2019 recorded 18 species of finfish and several shellfish species such as common lobster *Homarus gammarus*, pink shrimp *Pandalus montagui* and various species of crab. Of the species recorded during benthic trawls, those listed as species of principal importance for conservation in England under Section 41 of the NERC Act 2006 include plaice, whiting, cod and herring.

Data from epibenthic surveys undertaken during 2014 within and downstream of the Tees Dock turning circle were also reviewed to inform the EIA Report. The 2014 surveys recorded a total of 13 finfish species and two commercial shellfish species (brown shrimp *Crangon spp.* and pink shrimp), with cod the most abundant.

Benthic trawl survey data collected in 2018 for the Hartlepool Approach Channel project, approximately 5km north of the scheme, was also reviewed to provide wider context for the EIA Report. Five species of fish were reported, alongside shellfish: brown shrimp and harbour crab *Liocarcinus depurator*. The species recorded during the 2018 trawls were reported to be typical of North Sea inshore assemblages inhabiting soft sediment environments.

The survey data presented above represents the latest known survey data available for the Tees.

4.1.2 Migratory Fish

The EIA Report identified that several key migratory fish species, all listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006, have been recorded within the Tees estuary, including:

- Salmon *Salmo salar*;
- Brown trout *Salmar trutta*;
- European eel *Anguilla anguilla*;
- Sea lamprey *Petramyzon marinus*; and
- River lamprey *Lampetra fluviatilis*.

It is noted within the EIA Report that population numbers of salmonid within the Tees have been increasing in recent years, demonstrating that the Tees is an important migration route for salmon. Salmon, sea lamprey and river lamprey are afforded further legal protections as Annex II species in the EU Habitats Directive.

Both lamprey species to be recorded within the Tees estuary are anadromous ‘jawless’ fish species that develop to maturity in estuarine areas before migrating upstream to spawn. Sea lamprey have been recorded at the Tees Barrage at Stockton, circa 9km upstream of the scheme at South Bank Quay. Fish surveys undertaken in 2018 by the Environment Agency also recorded catadromous European eels in the area of the Tees Barrage.

An electronic fish counter at the Tees Barrage installed by the Environment Agency in 2011 monitors upstream migration of salmonids through a fish pass. Annual upstream migration of salmonids is observed to start in April and stop around November, with peak migrations occurring in July-August. The EIA Report identifies that the peak number of upstream migrations counted in any given month between January 2012 and June 2020 (inclusive) was 735 in August 2012. Whilst downstream migration of smolt is not recorded by the electronic counter installed on the Tees, this is principally driven by temperature with downstream migrations known to peak during May for other rivers in the northeast, such as the Tyne.

A desk-based review of the existing baseline with regard to migratory fish species undertaken for this note identified that the peak migrations identified within the EIA Report remain unchanged. **Table 4.1** summarises the most recent monthly salmonid count data from the Tees Barrage monitoring station.

Table 4.1 Most recent salmonid count data from Tees Barrange electronic fish counter (Environment Agency, 2022)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2012	1	0	4	15	22	75	392	735	192	162	48	15	1,661
2013	3	0	0	5	52	105	261	355	186	156	28	10	1,161
2014	1	0	2	7	13	60	111	70	74	42	48	2	430
2015	0	0	2	4	29	24	54	80	102	41	24	7	367
2016	0	1	4	17	33	76	87	225	31	13	6	5	498
2017	0	1	1	7	31	86	95	35	25	10	4	2	297
2018	3	1	0	8	36	51	46	47	11	7	7	0	217
2019	0	4	4	12	15	39	59	26	13	18	14	8	204
2020	2	1	1	10	14	56	74	114	5	18	27	6	328
2021	0	0	5	6	10	31	100	86	19	15	24	9	305
2022	3	2	4	6	21	40	71	53	17	23	24	-	264

4.1.3 Commercial species

The EIA Report identified at least 31 species of fish and shellfish species that may be commercially targeted within the lower Tees estuary and Tees Bay area, based on significant commercial landings data (greater than 1 tonne) from the International Council for the Exploration of the Sea (ICES). Tees Estuary and Tees Bay, where the scheme is located, are within ICES statistical rectangle 38E8.

In light of the review of ICES data, the following species were the most common (listed in order of abundance):

- Red mullet *Mullus surmuletus*;
- Whiting;
- Edible crab *Cancer pagurus*;
- Lobster; and
- Cod.

The OSPAR List of Threatened and / or Declining Species includes 22 species of fish, 19 of which are present within the OSPAR Region II (Greater North Sea) as identified in the EIA Report. Furthermore, species listed under Section 41 of the NERC Act 2006 contain a number of bony, cartilaginous and jawless fish species which are afforded the status of species of principle importance for the purpose of conserving biodiversity in England and are derived from the Biodiversity Action Plan (BAP) list of Priority Species.

Certain migratory diadromous fish species are provided additional legal protections by being listed in Annex II to the EU Habitats Directive. These are:

- Salmon;
- Sea lamprey; and
- River lamprey.

Such species require consideration during the designation of Natura 2000 sites across Europe and sites designated for such species must be managed in accordance with the ecological needs of the species. Several sites within the north east of England have been designated for at least one of the Annex II species listed above, including the River Tweed Special Area of Conservation (SAC) at Berwick-upon-Tweed (for Atlantic Salmon) and the Humber Estuary SAC near Grimsby (for both river lamprey and sea lamprey). Both sites are over 100km from the Tees Estuary and Tees Bay C.

4.1.4 Spawning and nursery grounds

A literature review undertaken at the time of writing the EIA Report identified eight species which may utilise the Tees estuary for spawning, nursery grounds or both. The species identified to use the Tees estuary as a nursery ground include (but are not limited to[2]):

- Whiting (high intensity);
- Spurdog (low intensity);
- Plaice (low intensity);
- Herring (high intensity);
- Cod (high intensity);
- Anglefish / monkfish (low intensity);
- Lemon Sole (unspecified intensity); and
- *Nephrops* (unspecified intensity).

Of those species, only plaice, lemon sole and *Nephrops* are known to use the Tees estuary as a spawning area. The EIA Report notes, however, that all species listed above have extensive nursery and spawning grounds encompassing much of the central North Sea. For instance, extensive herring spawning grounds are recorded at Flamborough, which extend north along the Yorkshire coastal waters, though at the nearest point the defined spawning grounds are at least 5km from the mouth of the Tees estuary.

The EIA Report notes that it may be possible that other species use the Tees estuary and adjacent coastal areas as spawning and / or nursery grounds but identified a paucity of available data to sufficiently define the extent of such grounds. Recent benthic trawl surveys (such as those undertaken in 2018) observed dab smaller than length at first maturity and an assemblage of pogge and common goby was identified to comprise a mix of both juvenile and mature individuals.

[2] The list below represents the species for which defined spawning or nursery areas have been mapped and does not represent an exhaustive list of species which may use the Tees estuary for these purposes.

4.2 Potential Effects

Within their consultation response, Cefas requested further assessment of the effects upon fish and shellfish from changes to the dredge and disposal volumes associated with MLV2. In response to Cefas' comments, the following relevant effects with regard to fish and shellfish that were screened into the original EIA Report have been afforded further considered within this section:

- Changes in marine water quality due to dredging activity;
- Direct loss / alteration of habitat and food resources.

Given the changes requested as part of MLV2 apply to construction activities only, operational effects are not considered further within this section. Each of the potential effects listed above are considered within the context of MLV2 in turn within the following sections.

4.2.1 Changes in marine water quality due to dredging

Without mitigation, the EIA Report concludes that the construction of the scheme would result in a moderate adverse effect upon fish populations within the estuary, particularly when considering the migratory species that may be prevented from undertaking their migratory journeys throughout the dredging campaign. The mitigation proposed within the EIA Report, which forms a condition on the current version of the marine licence, is to limit dredging activities to one side of the river at any one time. This would confine water quality effects to half of the river channel during dredging operations. By implementing this mitigation, the EIA Report concludes an effect of minor adverse significance.

As the same condition (limiting dredging activities to one side of the river channel at any time) is expected to remain on the marine licence if a positive determination is made, it is considered that a sufficient width of the river channel will remain available for migratory fish species to use during their migratory periods. The OSPAR material to be dredged also originates from the existing bank of the river, at the furthest point from the midline of the current channel. The hydrodynamic and sediment plume modelling previously undertaken and submitted to support MLV1 (provided within **Appendix D**) demonstrates that the trajectory of suspended sediment is influenced predominantly by river and tidal currents, and so is transported in a direction parallel with the river banks. Sediment plumes are therefore unlikely to move perpendicular to the bank (i.e. at right angles to the prevailing current) into the other side of the river channel.

It is therefore considered that, through adhering to the current marine licence condition limiting dredging activities to one side of the river channel at any one time, the residual effect on fish of changes to water quality arising from dredging activities will be no greater than that assessed in the original EIA Report (minor adverse).

4.2.2 Direct loss / alteration of habitat and food sources

Without mitigation, the original EIA Report concluded that direct loss of, and alteration to, habitat and food sources would lead to a moderate adverse effect on small and juvenile fish. This conclusion was based on the removal of existing structures obstructing the construction of the scheme that provide sheltering opportunities for such species. This, however, is considered to be offset by the relatively small area of such habitat being affected (~2ha) and the fact that numerous other intertidal locations and sheltering structures exist within the vicinity and wider Tees estuary.

Whilst the removal of structures providing sheltering opportunities for fish within the scheme footprint is unavoidable, mitigation measures have been embedded into the design of the quay, such as the incorporation of 'verti-pool' features at different heights within the tidal frame. Such features would retain water and provide new sheltering opportunities for small and juvenile fish from larger marine predators as well as aerial predators. The implementation of this mitigation is considered to reduce the overall effect of direct habitat loss or alteration to minor adverse.

No change in the number of structures to be removed or extent of direct habitat loss is proposed through the amendments requested as part of MLV2, as the footprint of the overall scheme has not changed since the EIA Report. At present, the OSPAR material would be removed through excavation and disposed to land. The footprint of direct effects on habitat is therefore the same for both the current method (covered by the licensed activities on the current licence) and the proposed method (requested as part of MLV2). It is therefore considered that the conclusion drawn within the EIA Report remains valid and applicable to the changes requested within MLV2.

4.3 Conclusion

In light of the similarities in the fish and shellfish baseline at the time of writing this note and the time of writing the EIA Report, it is considered that the potential effects upon fish and shellfish receptors from the changes applied for in MLV2 are within the scope of what was assessed in the original EIA Report. For this reason, it is considered that the potential effects are no greater than those presented within the EIA Report, as summarised within the **Table 4.2**.

Table 4.2 Summary of findings from the original EIA Report and with consideration of MLV2 with regard to effects on fish

Topic	Potential Effect	Original EIA Report Conclusion (with mitigation)	Re-appraisal Conclusion
Fish and Shellfish	Changes in marine water quality due to dredging activity	Minor adverse	Minor adverse
	Direct loss / alteration of habitat and food resources	Minor adverse	Minor adverse

5 Benthic Ecology

Chapter 9 of the EIA Report provided an assessment of potential effects upon benthic ecology from the construction and operation of both Phase 1 and Phase 2 of the scheme. This section provides a review of the EIA Report and considers the effects associated with the changes requested as part of MLV2 with respect to benthic receptors.

5.1 Baseline Environment

The EIA Report reviewed the following information sources to define the existing environment with respect to benthic receptors within the study area of the Tees estuary:

- Readily available internet resources, specifically broad scale habitat maps (which have been developed using modelling technology (UKSeaMap)) and habitat maps which have been informed by research (Marine Environmental Mapping Programme (MAREMAP)). EUSeaMap 2019 is an online mapping resource that is hosted by the European Marine Observation and Data Network (EMODnet). This provides broadscale habitat maps as well as more specific habitat maps on a broad, medium and fine scale, obtained from surveys.

- Benthic surveys undertaken elsewhere within the Tees estuary in support of marine licence applications for other developments.

5.1.1 Habitats

As noted within the EIA Report, the majority of the dredging footprint is located within the subtidal zone with the exception of the dredging and excavation required in front of the new quay wall to create a berth pocket where there is currently existing land which will remove both intertidal sediments and landside materials / soils.

Following a review of the Priority Habitats Inventory using Defra's MAGIC map online application, localised areas of intertidal mudflat within the footprint of the berth pocket have been identified together with a much larger area of intertidal mudflat on the opposite side of the river (North Tees Mudflat). No other priority habitats have been recorded within the immediate vicinity of the scheme and the EIA Report notes that the extent of intertidal habitat within the Tees estuary has been significantly reduced over time as the banks of the estuary have been developed. Intertidal habitat, particularly intertidal mudflat, within the Tees estuary is fragmented, which in turn increases the sensitivity of this habitat as a resource. Intertidal mudflat is listed as a UK BAP Priority Habitat.

Medium and broadscale habitat classifications were identified during the EIA Report using EMODnet. Whilst limited data was available within the location of the scheme, the upstream section of the river Tees appears to be comprised solely of mudflat habitat. The data illustrates that the downstream part of the berth pocket is classified as high energy circalittoral sandy mud or circalittoral fine mud and high energy infralittoral sand. The EIA Report notes that isolated patches of mudflat within the footprint of the scheme (but outside of the footprint of OSPAR material to be removed, as is being requested in MLV2) amount to 0.74ha in area and that there are also areas of saltmarsh located downstream of the scheme, near Seal Sands.

5.1.2 Designated sites for nature conservation

The scheme is located within and immediately adjacent to the Teesmouth and Cleveland Coast Special Protection Area (SPA), as well as adjacent to the Teesmouth and Cleveland Coast Ramsar site. These sites are designated for the populations of waterbird and seabirds known to use the area. The scheme is also located within and adjacent to the Teesmouth and Cleveland Coast Site of Special Scientific Interest (SSSI), which has been notified for a range of reasons including its geology, sand dune system, wildlife (seals, breeding and non-breeding birds, and invertebrates) and saltmarsh habitat. No marine conservation zones (MCZs) are located adjacent to, or overlap with, the site of the scheme.

5.1.3 Previous survey results

The EIA Report reviewed the following benthic surveys which had been previously undertaken within the Tees estuary and within the vicinity of the scheme:

- 2006 benthic survey for Northern Gateway Container Terminal;
- 2014 benthic survey for Anglo American Harbour Facilities;
- 2019 benthic survey for Northern Gateway Container Terminal;
- 2020 site walkovers; and
- 2020 benthic ecology survey.

The early benthic survey in 2006 confirmed that none of the species present in sediments from the survey area were rare, and that the species found were typical of the estuarine environment. Within the footprint of the Northern Gateway Container Terminal works, species abundance and diversity were both recorded to be low. The most abundant species recorded during this survey was shrimp (*Crangon spp.*), which was recorded throughout the estuary, followed by shore crab *Carcinus maenas*, which was more abundant in the middle section of the estuary. Epifauna was recorded in low abundance at the mouth of the estuary, as well as infaunal species (the most abundant being *Abra alba*).

The 2014 survey undertaken within the Anglo American Harbour Facilities study area identified the dominant biotope complex within the Tees navigation channel to be SS.SMU.ISaMu (Infralittoral sandy mud), which is typically dominated by a rich variety of polychaetes and is commonly characterised by the presence of *A. alba*. The outer channel was found to comprise two biotopes, these being SS.SMu.ISaMU.Cap (*Capitella capitata* in enriched sublittoral muddy sediments) and SS.SMU.SMuVS.CapTubi (*Capitella capitata* and *Tubificoides* spp. in reduced salinity infralittoral muddy sediment), where *C. capitata* dominated and was accompanied by large numbers of *Ophryotrocha* spp. The presence of these species typifies fine sediment habitats, usually with some level of organic pollution and associated low oxygen levels. Epifaunal surveys identified that the most abundant species was shrimp. *C. maenas* and *A. alba* were also abundant.

An extensive, targeted benthic survey was undertaken by PD Teesport in 2019 to support a marine licence application for the construction of the Northern Gateway Container Terminal, located approximately 1km downstream of the scheme. However, there is some spatial overlap in the dredge footprint of these two projects, specifically at the site of the Tees Dock turning circle. The 2019 survey identified the most frequently occurring biotope within the survey area was EUNIS biotope A5.323 '*Nephtys hombergii* and *Tubificoides* spp. in variable salinity infralittoral soft mud'.

Benthic grabs taken during the 2019 survey supported the findings of previous surveys, species assemblages were dominated by polychaetes (in terms of abundance and diversity across all sample stations). Whilst mollusc taxa generally contributed most to biomass, crustaceans, echinoderms and other taxa all generally contributed little to abundance, diversity and biomass. However, unlike the surveys of 2006 and 2014, *Capitella capitata* was only recorded in high abundance at one sample station, suggesting the population of this opportunistic species may have declined.

In terms of macrobenthic faunal groups, Faunal Group A was identified at 25 of the trawl stations and all grab sample stations within the Tees estuary during the 2019 survey. Communities comprised of a range of taxa, with no dominance of a single taxa. Polychaetes *Chaetozone gibber* and Dialychone contributed most to within group similarity (11% and 9% respectively), whilst *Tubificoides swirencoides, Abra alba*, and Nematode worms also contributed 8%, 6% and 6% to the within group similarity respectively. At the disposal site, Faunal Group B and C were identified.

Two species of conservation interest were recorded from benthic grabs undertaken during the 2019 survey, ocean quahog *Arctica islandica* and Ross worm *Sabellaria spinulosa*. *A. islandica* is on the OSPAR List of threatened and / or declining species and habitats and is also a Feature of Conservation Importance in England and Wales. This species was only found in very low numbers (maximum two individuals) within only three of the 25 grab samples taken from the Tees estuary. *S. spinulosa* is also on the OSPAR List of threatened and / or declining species and habitats and also listed in Annex 1 of the Habitats Directive. Again, *S. spinulosa* was recorded in very low numbers (maximum of eight individuals in one sample) and at only seven of the 25 grab sample sites. However, larger populations of both these species were found in samples taken at the offshore disposal sites in Tees Bay. *S. spinulosa* was confined to Tees Bay C only, whilst *A. islandica* was recorded at both offshore disposal sites.

Despite the presence of *S. spinulosa* in grab samples, visual inspection determined that the individuals recorded were not deemed to meet Annex 1 reef qualifying criteria and so it was concluded that the *S. spinulosa* tube aggregations sampled within the Tees estuary were not deemed to be representative of biogenic reef habitat.

A total of 40 epibenthic species were identified during the 2019 survey including 18 species of fish, which supports the findings of previous surveys. However, the 219 survey results indicate a reduction of annelids recorded, which appear to contribute to 5% of species in 2019 compared with 21% in 2013 (although the discrepancy could also be due to the way the identification and analysis process was undertaken). On the contrary, a significant increase in the number of brittlestars *Ophiura spp.* was recorded in 2019 when compared with the results of previous surveys. Brown shrimp and plaice have remained abundant across all surveys since 2006 and occurred at all or most of sample stations in 2013 and 2019. Shore crab *Carcinus maenas* was also abundant suggesting that the main characterising species of the epibenthic communities remain largely unchanged.

Observations made during site walkovers in 2020 to ground-truth desk-based studies identified brown algae (likely fucoids, such as *Fucus ceranoides*) on structures proposed to be demolished as part of the scheme, as well as populations of green, mat-like algae (possibly *Rhizoclonium riparium* or *Ulva intestinalis*) and black lichen (possibly *Verrucaria* spp.) on the pillars South Bank Wharf. No other species were observed during site visits or from photographic records.

The 2020 benthic survey identified 147 species across 25 sampling stations comprising the phyla Cnidaria, Nemertea, Annelida, Arthropoda and Mollusca. The sample with the highest species richness was taken from within the scheme footprint in the upstream section of the works area. The lowest species richness was observed in a sample in the downstream section of the North Tees Mudflat. The two most abundant species across all samples were *Chaetozone gibber* (2,849 individuals) and *Peringia ulvae* (2,830 individuals). The presence of *Capitella* spp. within the benthic grabs was low (ranging from one to 31 individuals in only seven of the 25 samples), which contrasts with the findings of the 2006 and 2014 survey findings.

The species of conservation interest *S. spinulosa* was recorded at three of the sampling stations, with non-native polychaete *Streblospio benedicti / gynobranchiata* occurring frequently, being recorded in 23 of the 25 samples.

Twenty-two (22) faunal species from the taxonomic groups Porifera, Cnidaria, Arthropoda, Bryoza, Echinodermata and Tunicata were recorded during beam trawl surveys, which is considered comparable with the findings of the 2019 survey undertaken for Northern Gateway Container Terminal. The most species-rich trawl was located at the Tees Dock turning circle, recording 20 species (excluding fish). This trawl was also the most abundant, recording 307 individuals. Brown shrimp *Crangon crangon* and crab *Carcinus maenas* were the two most abundant species.

5.2 Potential Effects

Within their consultation response, Cefas requested further assessment of the effects upon benthic receptors from changes to the dredge and disposal volumes associated with MLV2. In response to Cefas' comments, the following relevant effects with regard to benthic ecology that were screened into the original EIA Report have been considered further within this section:

- Direct loss of habitat and species due to demolition of existing structures and dredging;

- Effects of increased suspended sediment concentrations during dredging; and
- Effects of smothering following dredging.

Given the changes requested as part of MLV2 apply to construction activities only, operation effects are not considered further within this section. Each of the potential effects listed above are considered within the context of MLV2 in turn within the following sections.

5.2.1 Direct loss of habitat and species due to demolition of existing structures and dredging

The EIA Report identifies and assesses the loss of two habitats for benthic species – existing structures that provide space for benthic species to colonise, and areas of intertidal and subtidal habitat within the dredging footprint. Whilst at the time of writing the original EIA Report the information regarding the ecology that the existing structures support was limited, observations indicated that the intertidal sections of existing structures were not heavily colonised. It is noted within the EIA Report that any species attached to structures being removed would not be recovered for release back into the marine environment. Overall, the EIA Report records an effect of minor adverse significance upon benthic receptors with regard to removing existing structures that obstruct the works. Mitigation measures have been embedded into the design of the quay, such as the incorporation of 'verti-pool' features at different heights within the tidal frame. Such features would retain water and provide habitat for benthic species. However, this isn't expected to reduce the significance of effect.

In terms of habitat loss as a result of dredging, the EIA Report identifies that the dredge footprint is within close proximity to the North Tees mudflat, which is listed as a Priority Habitat and is within the Teesmouth and Cleveland SPA and Ramsar site. Despite this, no direct or indirect effect on that area of mudflat was predicted to occur, given that the dredging activities are concentrated within the footprint of the works area on the opposite side of the river channel to this habitat. The EIA Report does note that approximately 2.5 hectares of benthic habitat will be permanently lost within the area of the berthing pocket, where capital dredging and laying of a rock blanket is being undertaken, and that some Priority Habitat mudflat will be lost as a result of the dredging and excavation works. However, the confidence in this habitat classification is low according to Defra's MAGIC interactive mapping tool. This confidence level is supported by reviews of site observations, habitat surveys and photographs, which have identified that areas classified as mudflat are often not actually mudflat. Therefore, such areas are not considered to be of high conservation importance. Despite that, as a conservative estimate, the EIA Report assigns a sensitivity of 'medium' to the receiving environment for the purposes of the assessment.

The EIA Report therefore concludes an effect of minor adverse significance with respect to direct loss of habitat due to the demolition of existing structures and capital dredging activities. No mitigation is identified given the necessity to remove the structures and sediments from within the footprint to deliver the scheme. However, any loss of biodiversity as a result of these activities is proposed to be offset, with details provided within the South Tees Regeneration Masterplan Environment and Biodiversity Strategy.

As noted within **Section 4.2.4**, no change in the number of structures to be removed or extent of direct marine habitat loss is proposed through the amendments requested as part of MLV2. At present, the OSPAR material is not considered to provide suitable marine habitat for benthic receptors and would be removed through excavation and disposed to land. The footprint of direct effects on habitat is therefore the same for both the current method (covered by the licensed activities on the current licence) and the proposed method (requested as part of MLV2). It is therefore considered that the conclusion drawn within the EIA Report remains valid and applicable to the changes requested within MLV2.

5.2.2 Effects of increased suspended sediment concentrations during dredging

The sediment plume modelling undertaken for the original EIA Report predicted that highest concentration of suspended sediment would be between 100-200 mg/L within the immediate vicinity of the dredging vessel (based on the use of a trailing suction hopper dredger (TSHD) or backhoe). The modelling calculated that this concentration would significantly reduce to around 10-20 mg/L within a few hundred metres of the point of release, and again to 0-10mg/L at the extremities of the plume. In all cases, the modelling indicates that sediments suspended as a result of dredging activities is predicted to form a narrow plume within the river channel, with plumes associated with dredging of the berthing pocket confined to the southern bank of the river.

The EIA Report also reviews the sensitivity of the benthic species identified within the area affected by the sediment plume, including the following:

- *S. spinulosa*;
- *A. islandica*;
- *A. alba*;
- *Nephtys hombergii*; and
- *Tubificoides* spp.

All species reviewed were either considered to have a low or very low sensitivity to increases in suspended sediment concentrations. In light of this, as well as considering the temporary and localised nature of the predicted increase in suspended sediment concentrations, the EIA Report concludes an effect of negligible significance with regard to increased suspended sediment concentrations. Therefore, no mitigation was considered necessary.

The updated hydrodynamic and sediment plume modelling presented within the modelling note submitted in support of MLV1 (Royal HaskoningDHV, 2022) accounted for the change in dredge type from THSD to cutter suction dredger (CSD). The sediment loss rate ('S-factor') for CSD is taken as 6 kg/m^3 in line with industry guidance (CIRIA, 2000). In comparison, the S-factor for backhoe (which was taken as a worst case scenario for the hydrodynamic and sediment plume modelling undertaken in support of the original EIA Report - see Appendix 5 of the EIA Report) is $25kg/m^3$, over four times greater than that of CSD.

Noting that the OSPAR material was originally considered within the EIA Report as material to be removed via land-based excavators and disposed to land, and given that the dredge volumes requested under MLV2 are lower than the worst case scenario volumes assessed within the EIA Report (as a result of no temporal overlap between Phase 1 and Phase 2), it is considered that the conclusions of the original EIA Report remain unchanged and applicable to the changes requested under MLV2 – concluding a negligible significant effect.

5.2.3 Effects of smothering following dredging

Even without mitigation, the EIA Report concludes a negligible significance regarding the smothering of benthic receptors due to deposition of suspended sediments caused by dredging and disposal activities. This is because of the temporary and localised nature of the predicted increase in suspended sediment concentrations together with the low to very low sensitivity of species identified within the affected areas.

Considering the OSPAR material was originally proposed to be removed through the use of land-based excavators, the volume of suspended sediment associated with the dredging of this material is expected to be lower than that previously modelled and assessed within the original EIA Report, which modelled sediment dispersion associated with the dredging for Phase 1 and Phase 2 together. This is supported by the updated sediment plume modelling submitted in support of MLV1 (see **Appendix D**), which considered removal of the landside soil within the proposed dredging campaign and concluded that '*both the spatial extent and magnitude of effects under the proposed project variations to Phase 1 only are less than those previously assessed for Phase 1 and 2 of the project*'. As such, in light of this and the low sensitivity of species within the Tees estuary to changes in suspended sediment concentrations, it is considered that the effect of smothering from dredging activities from the changes requested in MLV2 remains negligible.

Whilst there will be an increase in volume of dredged material to be disposed of at sea, a review of available information on species *A. islandica* and *S. spinulosa* (those species listed on the OSPAR List of threatened and / or declining species and habitats) undertaken at the time of writing the EIA Report found that both species had a high resilience to smothering. Specifically, *S. spinulosa* is able to tolerate smothering for up to several weeks, exhibiting immediate recovery once deposition of fine sediment stops. Field experiments conclude that smothering of *A. islandica* by fine sediment has no effect on its growth or population structure, with deposits of up to 30cm of fine sediment unlikely to have a negative effect on this species.

The review also identifies that, whilst smothering of *A. alba* with up to 5cm of fine sediment would temporarily suspend the feeding and respiration of this species, it would be able to relocate to its preferred depth with no mortality. This would represent a temporary effect on growth and reproduction, although the species would recover almost immediately and so is considered to have a low sensitivity to smothering.

Whilst the total volume of dredged material to be disposed offshore and the frequency of disposal events will increase under MLV2, the updated sediment plume modelling submitted in support of MLV1 (see **Appendix D**) concludes that both the spatial extent and magnitude of effects under the proposed project variations to Phase 1 only are less than those previously assessed for Phase 1 and Phase 2 of the scheme within the EIA Report. Despite the Phase 1 and Phase 2 cumulative disposal at-sea volumes being greater than that original assessed as a worst case within the EIA, since each phase will be temporally discrete the overall volume of material to be disposed to sea will be spread over a greater duration.

In light of the above, an effect of negligible significance on marine species and habitats is predicted to arise as a result of the deposition of fine sediments, with no effect in the longer term. As such, the effect is no greater than that assessed within the original EIA Report.

5.3 Conclusion

In light of the above, it is considered that the potential effects upon benthic receptors from the changes applied for in MLV2 are within the scope of what was assessed in the original EIA Report and the further hydrodynamic and sediment plume modelling report prepared and submitted in support of MLV1 (Royal HaskoningDHV, 2022). For this reason, it is considered that the potential effects are no greater than those presented within the EIA Report, as summarised within the **Table 5.1**.

Table 5.1 Summary of findings from the original EIA Report and with consideration of MLV2 with regard to effects on benthic receptors

Topic	Potential Effect	Original EIA Report Conclusion (with mitigation)	Re-appraisal Conclusion
Benthic	Direct loss of habitat	Minor adverse	Minor adverse
	Effects of increased SSC	Negligible	Negligible
	Effects of smothering	Negligible	Negligible

6 Summary

This note provides a review of the findings of the original EIA Report submitted in support of the marine licence application for the scheme and an appraisal of potential effects upon fish, shellfish and benthic receptors in response to comments received from consultees on MLV2. A summary of the assessment of effects associated with dredging and disposal upon fish and shellfish and benthic receptors as a result of the scheme as set out within the EIA Report and consideration of the changes requested in MLV2 is set out within **Table 6.1**.

Table 6.1 Summary of findings from the original EIA Report and with consideration of MLV2

Topic	Potential Effect	Original EIA Report Conclusion	Re-appraisal Conclusion
Fish and Shellfish	Changes in marine water quality due to dredging activity	Minor adverse	Minor adverse
	Direct loss / alteration of habitat and food resources	Minor adverse	Minor adverse
Benthic Ecology	Direct loss of habitat	Minor adverse	Minor adverse
	Effects of increased SSC	Negligible	Negligible
	Effects of smothering	Negligible	Negligible

The re-appraisal of the relevant potential effects set out within **Table 6.1** upon the identified receptors concluded that the effect of changes requested under MLV2 would not result in any material change to the significance of effect recorded at the time of writing the EIA Report with respect to benthic, fish or shellfish receptors. In light of this, it is anticipated that there will be no effect on fisheries. As such, all effects are no greater than those set out in the original EIA Report and the changes requested as part of MLV2 are considered to fall within the parameters previously assessed.

7 References

CIRIA (2000). Scoping the assessment of sediment plumes from dredging (C547).

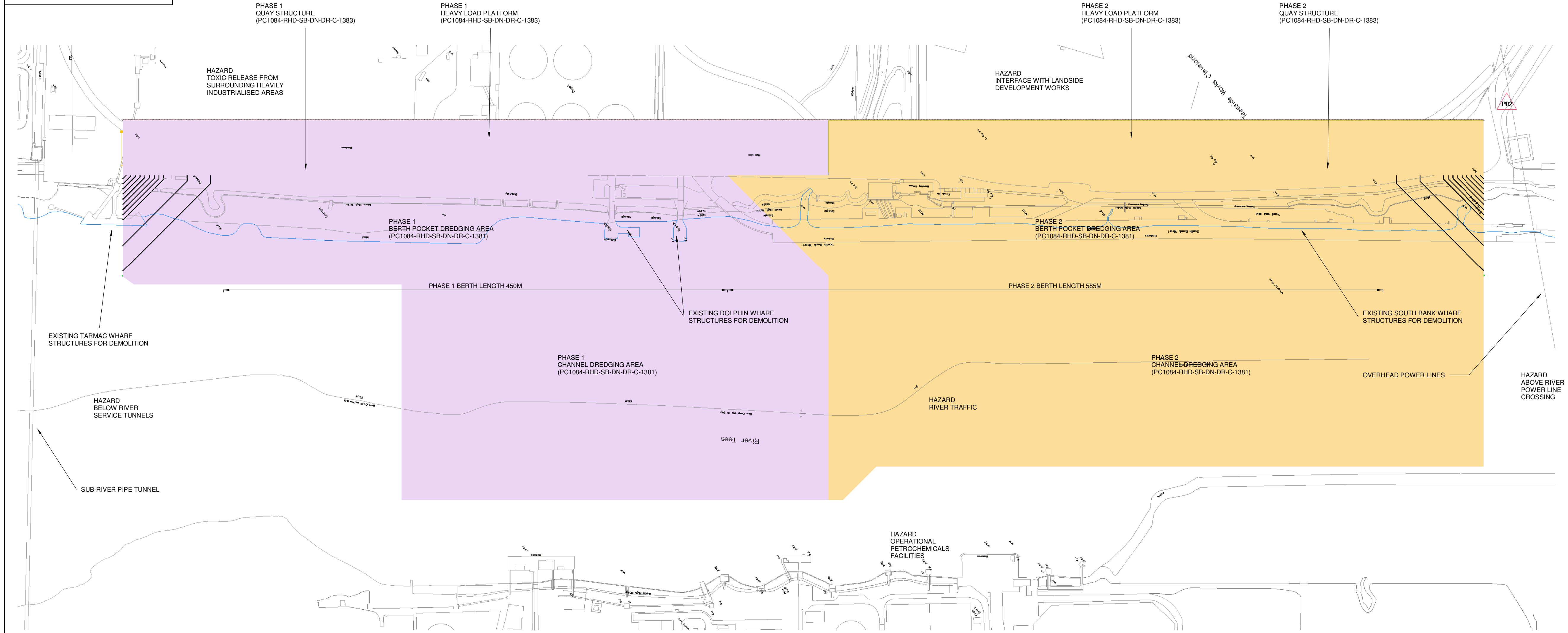
Environment Agency (2022). River Tees at Tees Barrage – upstream fish counts: Monthly counts of salmon and sea trout at Tees Barrage.

Royal HaskoningDHV (2022). South Bank Quay Technical Note: Hydrodynamic and Sediment Plume Modelling. Document Reference PC1084-RHD-ZZ-XX-RP-Z-0001

Royal HaskoningDHV (2020). South Bank Quay EIA Report. Document Reference PC1084-RHD-SB-EN-RP-EV-1100

Appendix A Construction Phasing Plan

PC1084-RHD-SB-DN-DR-C-1380



GENERAL ARRANGEMENT
1 : 2000

SITE PLAN TRUE NORTH
1 : 12000

NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE
2. ALL LEVELS ARE IN METRES RELATIVE TO CHART DATUM (mCD) UNLESS NOTED OTHERWISE

KEY:
- PHASE 1 DEVELOPMENT AREA
- PHASE 2 DEVELOPMENT AREA

REV	DATE	DESCRIPTION	DRW	CHK	APR
P02	11.12.20	FOR REVIEW AND COMMENT	BM	TJR	TJR
P01	19.08.20	FOR REVIEW AND COMMENT	CH	CF	TJR

REVISIONS

CLIENT
South Tees Development Corporation

PROJECT
TEES STUDY

TITLE
CONCEPT DESIGN
GENERAL ARRANGEMENT

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Royal HaskoningDHV
Enhancing Society Together

DRAWN	CHECKED	APPROVED
CH	CF	TJR
DATE 14/08/20	SCALE AT A1 As indicated	REF.

DRAWING No.	SUITABILITY	REVISION
PC1084-RHD-SB-DN-DR-C-1380	S3	P02

Appendix B MMO Response to General Enquiry ENQ/2021/00205

Marine Management Organisation

Marine Licensing
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Mr John McNicholas
Engineering and Programme Director
South Tees Development Limited
Cavendish House
Teesdale Business Park
Stockton-on-Tees
TS17 6QY

Our reference:
ENQ/2021/00205

04 February 2022

Dear Mr McNicholas,

Re: South Bank Quay- Phase 1

Thank you for your enquiry dated 14 December 2021, regarding the above project, where you have requested the MMO consider the suitability of certain material for disposal to sea. This material is currently beyond the boundaries of Mean High Water Springs (MHWS) but upon removal of a top layer of material (which is to be disposed to land), would then be below MHWS, and as such, part of the marine environment.

Please see our response below, which has been compiled following consultation with our technical advisors The Centre for Environment, Fisheries and Aquaculture Science (Cefas):

The MMO considers that the proposed works are feasible under OSPAR. The works have similarities to other works that have previously been licensed in England, for example from port constructions that change the boundaries of MHWS.

The MMO are of the opinion that samples are required to assess the suitability of the material for disposal at sea, and given there is likely to be water ingress, the samples can be taken prior to the inundation of the area. Sampling requirements can be considered further through a request for a sample plan via MCMS.

It is likely that we will advise that samples are taken for the full vertical area of material to be dredged and disposed of to sea and that a full suite of analyses, including polybrominated diphenyl ethers, are carried out, given the location of the Tees. This will be determined on response to the sample plan request.

Please don't hesitate to contact me directly should you wish to discuss this matter further, quoting the following reference ENQ/2021/00205.

Your feedback

We are committed to providing excellent customer service and continually improving our standards and we would be delighted to know what you thought of the service you have received from us. Please help us by taking a few minutes to complete the following short survey (https://www.surveymonkey.com/r/MMOMLcustomer).

Yours sincerely,

Peter Ryalls
Marine Case Officer
Direct Line: 020 3025 8056
Email: peter.ryalls@marinemanagement.org.uk

Appendix C MMO Screening Opinion

Marine Management Organisation

Screening Opinion

Marine Works (Environmental Impact Assessment) Regulations 2007 ("the Regulations")

Title: South Bank Quay

Applicant: John McNicholas- South Tees Developments Limited

MMO Reference: EIA/2021/00049

Contents

1. Proposal

The South Bank Quay development consists of demolition, capital dredging, offshore disposal of dredged material, placement of rock in the berth pocket and construction and operation of a new quay. The original application was screened into EIA and the applicant produced an ES which considered the potential impacts of the project as a whole and two marine licences have been granted to cover a phased approach to the works.

The applicant now wishes to change the capital dredging methodology from a trailing suction hopper dredger (TSHD) and backhoe dredger to a cutter suction dredger.

Project Background

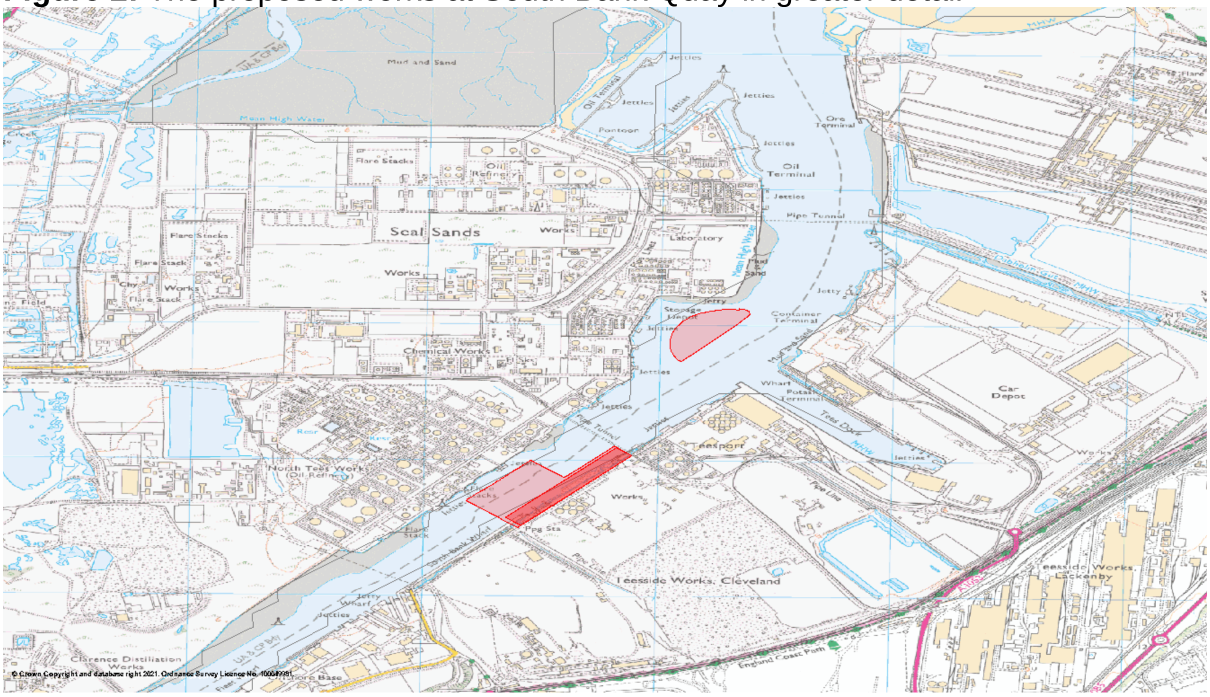
South Tees Development Corporation (STDC) plans to construct a new quay at South Bank in the Tees estuary. This proposal is required to support STDC's proposal for general industry and storage/distribution uses within the South Industrial Zone. The new quay is envisaged to be utilised mainly by the renewable energy industry as well as supporting more general industrial and storage/distribution activities. The new quay will be used as a transportation and assembly hub.
The proposed development is comprised of four parts; the construction of new quays; dredging of the River Tees to provide a berthing pocket, deepened approach channel and a turning area; the setting out of the operational area; and the operation of the site.

2. Location

The South Tees Development is located at South Bank Quay, River Tees, displayed in Figure 1 below.

Figure 1: South Bank Quay, River Tees and the disposal site.

Figure 2: The proposed works at South Bank Quay in greater detail



3. Environmental Impact Assessment (EIA)

The Marine Works (Environmental Impact Assessment) Regulations 2007 ("the Regulations") transposed Council Directive 2011/92/EU (as amended) into UK law for marine licence applications. The regulations aim to protect the environment and the quality of life by ensuring that projects which are likely to have significant environmental effects by virtue of their nature, size or location are subject to an EIA before permission is granted.

The Marine Management Organisation (MMO) considers that the proposed works are capable of falling under Schedule A2 of the Regulations, specifically:

89. *Any change to or extension of development of a description listed in paragraphs 1 to 87 of this Schedule where that development is already authorised, executed or in the process of being executed.*

In accordance with regulation 6 of The Regulations, the MMO must determine that an Environmental Impact Assessment is required in relation to the proposed works, if it is concluded that the project in question is likely because of its size, nature, or location, to have significant effects on the environment; an assessment of the potential impacts is set out below:

EIA Screening Opinion

Moderate impacts were identified regarding cumulative impacts, designated sites and migratory fish species.

Regarding cumulative impacts, the change proposed by the applicant (changing the dredging method) will reduce the amount of time spent dredging, which is expected to reduce the risk of cumulative impacts.

Impacts to designated sites are mainly expected to be through disturbance, however there is the potential for habitat loss as a result of the works. The total area being disturbed by the dredging is estimated to be 32.5ha and 2.5ha of intertidal area will be excavated. Surveys undertaken in 2020 show that (outside of the key wintering season) the area subject to the works is of low value to roosting or foraging birds at high tide. Numbers of birds in the area are significantly lower than the other areas of the Tees estuary.

The impacts to migratory fish species will be mitigated through the applicant limiting the dredging operation to one side of the river at a time. This will reduce both the extent and impact of any sediment plumes that could affect migrating species. Sediment quality testing from 2019 indicates that it is unlikely that disturbance of sediment during dredging will result in risks of physiological effects on fish from contaminant release. The change in dredging technique being proposed by the applicant will result in a reduced amount of time spent dredging, which will further mitigate this risk.

It is therefore the opinion of the MMO that the proposed activity as described is **screened out** of requiring an Environmental Impact Assessment under the Regulations.

It must be noted however that the works, as described will also require a marine licence under Part 4 of the Marine and Coastal Access Act 2009 and sufficient regard must be given to the above points when submitting any application for a marine licence.

Peter Ryalls
Marine Case Officer

02/03/2022

Appendix D Hydrodynamic and Sediment Plume Modelling

REPORT

South Bank Quay

Technical Note:
Hydrodynamic and Sediment Plume Modelling

Client: South Tees Development Limited

Reference: PC1084-RHD-ZZ-XX-RP-Z-0001

Status: S0/P01.01

Date: 19 January 2022

Royal HaskoningDHV
Enhancing Society Together

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Document title:	South Bank Quay
Document short title:	
Reference:	PC1084-RHD-ZZ-XX-RP-Z-0001
Status:	P01.01/S0
Date:	19 January 2022
Project name:	
Project number:	PC1084
Author(s):	Tanja Cooper, Keming Hu
Drafted by:	Tanja Cooper
Checked by:	Keming Hu
Date / initials:	06/01/2021
Approved by:	Nick Cooper
Date / initials:	10/01/2022

Classification
Project related

MANAGEMENT SYSTEM CERTIFICATION
DNV·GL
ISO 9001 = ISO 14001
ISO 45001

Royal HaskoningDHV

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1 Introduction

Royal HaskoningDHV was commissioned by South Tees Development Limited (STDL) to undertake a numerical modelling exercise to inform the Environmental Impact Assessment (EIA) that was prepared as part of the South Bank Quay development project.

The numerical modelling study was reported in **Chapter 6: Hydrodynamics and Sedimentary Processes** of the EIA Report and the accompanying **Appendix 5: Hydrodynamics and Sedimentary Plume Modelling** of the EIA Report and comprised:

- **Hydrodynamic modelling**: An existing 2D North East Regional Tidal Model built in MIKE21-HD was used to provide boundary conditions for an existing 3D Tees Estuary Tidal Model built in MIKE3-HD. The latter model was updated with new bathymetry data and its mesh was refined around the site of the proposed scheme. The model was re-calibrated and then further verified using the acoustic doppler current profiler (ADCP) data newly collected as part of a Metocean Survey undertaken by Partrac in July 2020. The updated and verified 3D model was then used to characterise baseline conditions and predict potential local and estuary-wide changes in hydrodynamics caused by the proposed scheme.

- **Dispersion modelling**: The updated and verified 3D Tees Estuary Tidal Model was used to predict movement of suspended sediment from the proposed dredging and disposal activities by coupling with a sediment plume model built in MIKE3-MT software. The sediment plume model was run for the entire dredging and disposal schedule.

- **Wave modelling**: Since the site is well sheltered from North Sea swell waves, it is locally-generated wind waves that are of more significance to the proposed scheme. To demonstrate this understanding of the baseline wave conditions, an established Tees Bay Wave Model built in MIKE-SW was used to transform extreme offshore waves (1 in 1 year and 1 in 100 year) to the site. In addition, extreme value analysis was undertaken for extreme wind conditions in the Tees Estuary. Locally-generated waves caused by extreme winds were then hindcast using the Tees Bay Wave Model.

Figure 1-1 shows the location of the proposed scheme, as well as the wider study area used for consideration of hydrodynamics and sedimentary processes. The wider study area: (i) extends approximately 18 km offshore to encompass the offshore disposal site Tees Bay C; (ii) covers Hartlepool Headland in the north and Redcar in the south; and (iii) includes the whole of the River Tees up to the Tees Barrage, which is the tidal limit. The proposed scheme at South Bank Wharf is situated approximately 6 km upstream from the mouth of the Tees Estuary.

The previous numerical modelling study covered both Phases 1 and 2 of the South Bank Quay project as a worst case scenario (assuming both phases take place at the same time), although Marine Licence applications were separately made for Phase 1 (MLA/2020/00506) and 2 (MLA/2020/00507). It should be noted that STDL is only seeking to construct Phase 1 of the project during 2022 / 2023. STDL may still construct Phase 2 of the project, however there will be a gap of at least 12 months between Phase 1 and Phase 2.

Royal HaskoningDHV

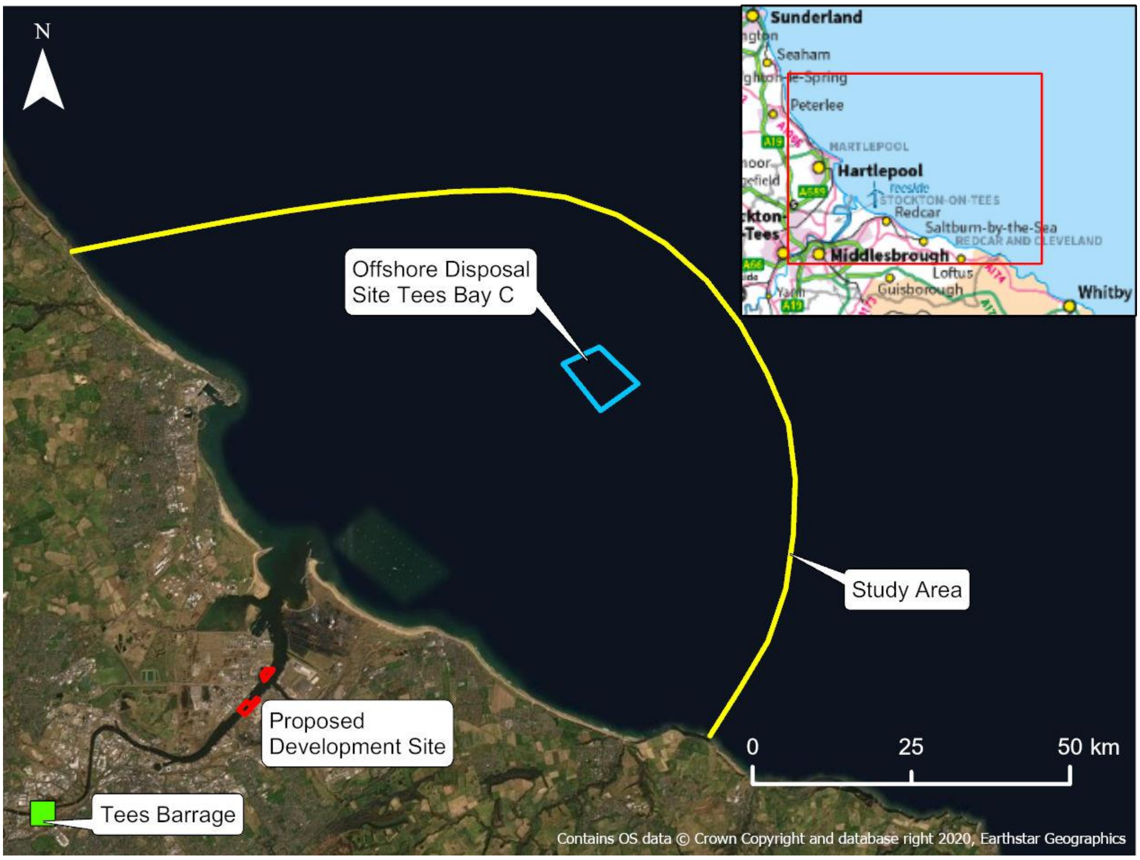

Figure 1-1 Proposed Development Site and Wider Study Area

Following receipt of the Marine Licence for Phase 1 (L/2021/00333/1), STDL is now seeking to vary the originally proposed construction methodology in the following manner. This is required in order to reduce the Phase 1 construction programme so that it can be delivered in adherence to an imposed Marine Licence condition that prohibits dredging in any year from 1st July to 31st August (inclusive) (Condition 5.2.8):

- Change in dredger type from a combination of trailer suction hooper dredger (TSHD) and backhoe dredger (BH) to use of a cutter suction dredger (CSD) by the appointed Contractor – this has the effect of increasing the production rate of dredging (and associated disposal) and changing the potential spill rate of sediment from the dredging process;

- Increasing capacity of the vessel to be used for disposal of dredged material at the offshore disposal site – this has the effect of a reduced number of disposal events, but with each event disposing a greater quantity of material than previously assessed.

- Incorporating into the assessments a better definition of the material type to be dredged based on findings from the Ground Investigation (GI), which has identified more of the 'harder' material and less of the 'softer' material than previously assumed and assessed as a worst case within the ES.

- Incorporating very slight change in the extent of the dredging within the turning area, from a semi-circular to semi-trapezoidal shape.

- Inclusion of currently landside soils (i.e. soils within the riverbank) within the proposed dredging campaign (it should be noted that consultation with the MMO is being undertaken to determine whether this is a feasible approach, however the modelling has conservatively assumed that it will be acceptable to MMO).

The effects of these changes in approach to Phase 1 upon the hydrodynamic and sedimentary regime have been re-assessed using a combination of expert geomorphological assessment (EGA) and sediment plume and disposal modelling. By considering Phase 1 only in the updated assessments, this has the effect of reducing the total volume of material to be dredged and disposed from 1.8 million m^3 (Phase 1 and 2 total) to 1.2 million m^3 (Phase 1 only) and lessening the footprint of the river channel that will be directly affected by dredging (**Figure 1-2**). It should be noted that STDL is still planning on constructing Phase 2 of the South Bank Quay project, however as noted in Section 1, Phase 2 is due to be constructed at least 12 months post construction of Phase 1. No variations to the Phase 2 licence are currently proposed.

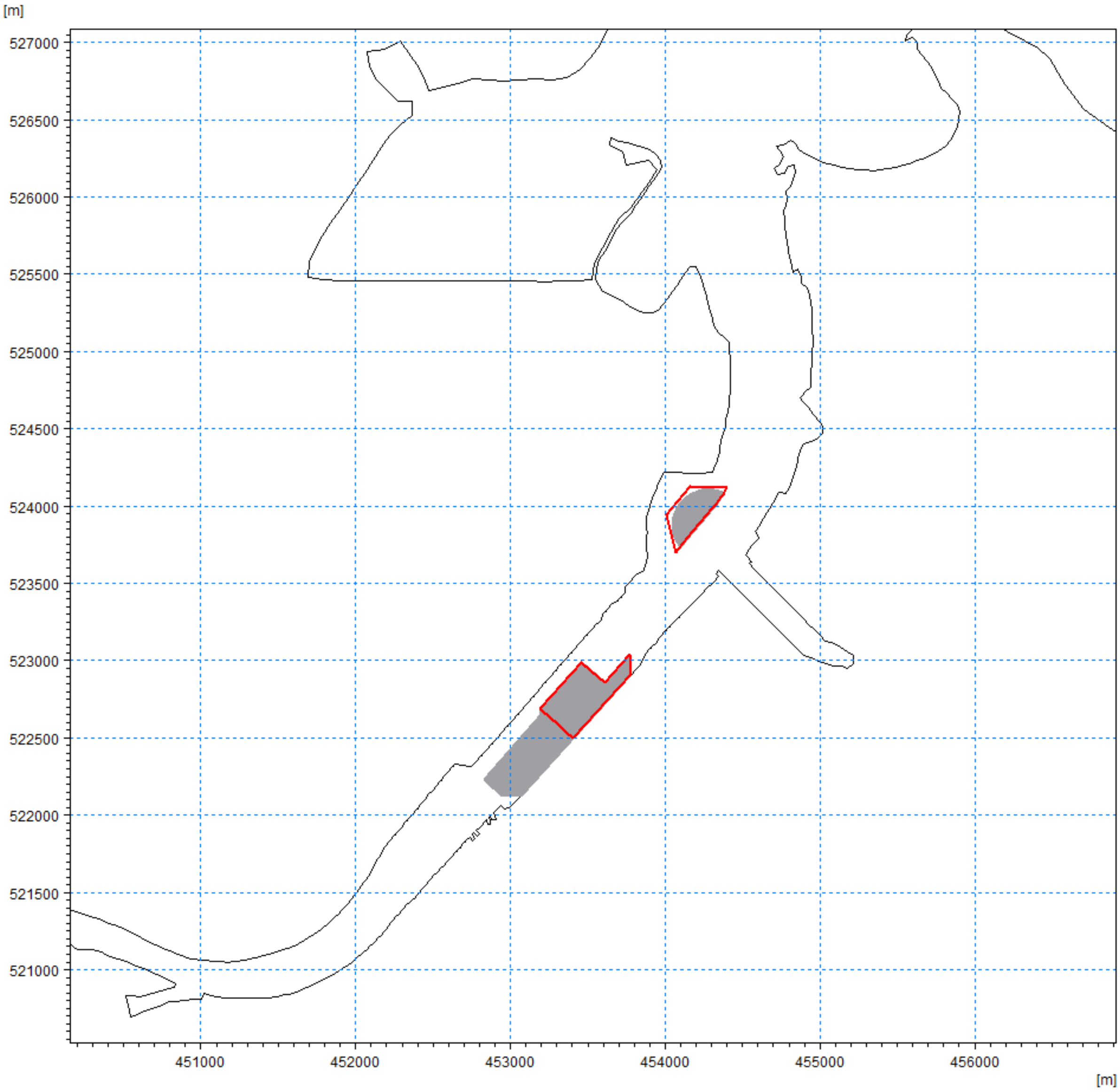

Figure 1-2 Footprint of dredging assessed in the EIA report (grey areas for Phases 1 and 2) and in updated assessments (red boundary for proposed variations to Phase 1 only).

2 Hydrodynamic Regime

The principal findings from the previous numerical hydrodynamic modelling for Phases 1 and 2 of the project were:

- The proposed new quay alignment and capital dredging to deepen the Tees Dock turning area and approach channel and to create a berth pocket will not significantly affect the existing baseline hydrodynamic conditions under any of the three different river flow scenarios considered.

- There will be flow newly occurring in the area of the new quay because it is being set-back from the existing riverbank, but even the peak flows in this area will be low.

- Elsewhere, there will be a general small magnitude reduction in baseline flows varying during different phases of the tidal cycle, but always remaining largely within the reach immediately opposite the new quay. This reduction in baseline flows is caused by both a slight widening of the channel (due to the new quay alignment) and the local deepening of the bed due to the capital dredging.

- The reductions in baseline current speeds in these areas may lead to a slight increase in deposition of sediment. In the main channel the deposition will require periodic dredging to maintain the design depths.

- There is no measurable change caused by the capital dredging at the Tees Dock turning area.

- There are no estuary scale effects on baseline hydrodynamic conditions.

Full details were provided within **Chapter 6: Hydrodynamics and Sedimentary Processes** of the EIA Report and the accompanying **Appendix 5: Hydrodynamics and Sedimentary Plume Modelling** of the EIA Report.

In the updated assessments, proposed project variations to Phase 1 have been considered. Phase 1 would affect a smaller footprint of the river channel compared with the previous assessments for Phases 1 and 2, so any such effects from dredging on the tidal regime during Phase 1 would be lesser than those previously assessed. Also the very slight change in extent of dredging within the turning area from a semi-circular to semi-trapezoidal shape is not deemed at all significant. For these reasons, no updated numerical hydrodynamic modelling has been undertaken.

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3 Sediment Regime

3.1 Background

This section of the report describes the updated sediment dispersion modelling exercise for Phase 1 of the South Bank Wharf development project that was undertaken to investigate the suspended sediment transport effects of the proposed dredging of the channel and the berth pocket in front of the new quay wall, as well as the deepening of parts of the Tees Dock turning area. The sediment transport model was built in MIKE3-MT software developed by DHI.

3.2 Sediment Data

Available soil data indicates that it is expected that the dredging material consists of different soil types. A summary of the expected dredging soil types based on the ground investigation data (Definitive Feasibility Study Basis of Design - PC1084-RHD-SB-ZZ-RP-Z-1303) is presented in **Table 3-1**. A distinction is made between soft and hard material because it is expected to influence the choice of dredging equipment to be deployed.

Table 3-1: Soil Types to be dredged

Soft/hard soil type	Stratum	Top to bottom levels (mCD)	Description
Soft soil material	Tidal Flat Deposits	+2 to -2	Loose to medium dense grey brown very clayey slightly gravelly SAND
Hard soil material	Mercia Mudstone Group	-11 and deeper	Red brown highly weathered MUDSTONE weak with occasional deposits of gypsum
Hard soil material	Glacial Till	-2 to -11	Stiff (locally firm) red brown sandy gravelly CLAY of low plasticity. Gravel is fine to coarse subangular and consists of sandstone, quartzite and mudstone

Based on the ground investigation data, for the sediment dispersion modelling, the following particle size distribution of the two soil types has been adopted as shown in **Table 3-2**.

Table 3-2: Particle size distribution for dredged soil types

Sediment Category	Sediment Size (mm)	Soft material	Hard material
Silt/Clay	0.031	70%	20%
Fine Sand	0.13	10%	5%
Medium Sand	0.3	5%	-
Coarse Sand	1.3	5%	-
Gravel/Cobble	2	10%	75%

3.3 Dispersion Model Setup

The sediment dispersion model built in MIKE3-MT is coupled with the 3D hydrodynamic model built in MIKE3-HD. The computational mesh of MIKE3-MT is identical to the MIKE3-HD mesh described in Section 4 of this report.

The dredging layout for Phase 1 is shown in **Figure 3-1**. The river channel in front of the South Bank Wharf as well as part of the Tees Dock turning area will be dredged to a level of -11mCD. The berth pocket in front of the new quay has a design bed level of -13.6mCD, but the dredge volumes considered in the dispersion model include an extra two metres of dredge material down to a bed level of -15.6mCD to allow for a rock blanket to be installed in the berth pocket.

The sediment dispersion model has been run for a three-month period to cover the full duration of the dredging schedule. Due to the uncertainty of the time when the dredging will take place, the worst scenario in terms of the tides has been chosen, and the model has been run for the period of March to May in which spring tides are slightly higher.

The sediment dispersion model has been setup with four layers in order to differentiate between suspended sediment concentrations (SSC) throughout the water column, e.g. near the sea bed and near the water surface.

In order to simulate the sediment dispersion close to natural conditions, wave disturbance effect has been included in the MIKE3-MT model. Wave condition of 1m and 4.9 sec (Tz) has been chosen in the model settings.

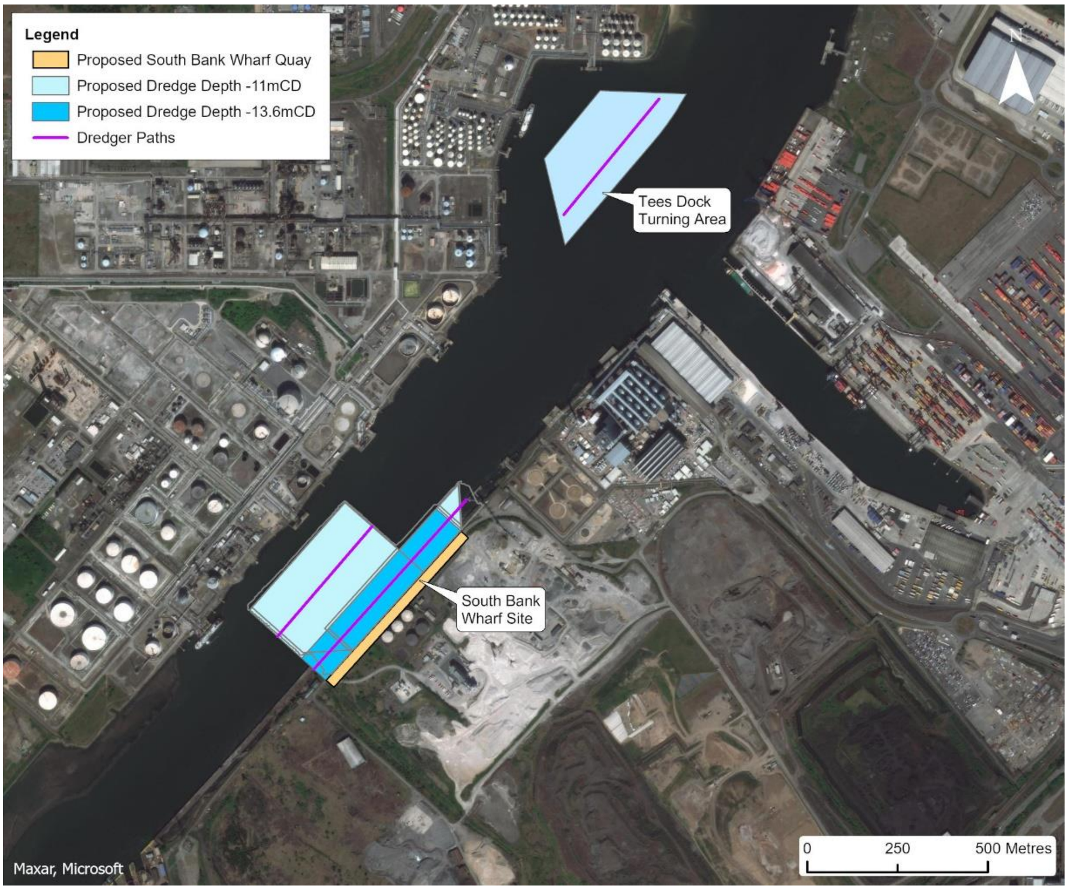

Figure 3-1 Dredging Layout

3.4 Dredging Methodology and Schedule

The dredging method, dredging schedule and details of the sediment release settings for the sediment plume dispersion model are described in this section.

3.4.1 Dredging Method

The sediment will be dredged using a Cutter Suction Dredger (CSD).

All dredged material will be taken to the Tees Bay C offshore disposal site which is approximately 18km (or 10 nautical miles) away from the South Bank Wharf site. This is shown in **Figure 3-2**.

Figure 3-2 South Bank Wharf Dredge Site and Tees Bay C Offshore Disposal Site

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3.4.2 Dredging Schedule

The dredging schedule and quantity for the CSD are described in **Table 3-3**. The dredging will begin with the CSD removing the soft soil material and hard material respectively from the berth pocket, then removing both soil materials from the channel before moving on to removing both materials in the turning area.

A total of 1.2 million m^3 of bed material will be dredged over a period of nine weeks. The simulation covers the entire dredging period and the movement of dredger and transport barges were tracked for the processes of dredging, sailing, disposal and downtime for bad weather, refuelling, and equipment maintenance. **Figure 3-3** shows the sediment release schedules for the dredger at the South Bank Quay site and Tees Dock turning area (i.e. the Phase 1 dredge footprint), whilst and **Figure 3-4** shows the sediment release schedules for the transport barge at the offshore disposal site.

The disposal schedule will follow the same pattern as the dredging schedule in that the barge filled by the CSD will sail to the offshore disposal site once its full capacity has been reached.

Table 3-3: Dredging Schedule Overview

	South Bank Wharf Berth Pocket		South Bank Wharf Channel		Tees Dock Turning Area	
	Soft material	Hard material	Soft material	Hard material	Soft material	Hard material
Vessel load (m^3)	2000	5000	2000	5000	2000	5000
Loading (Dredge) time (minutes)	50	160	50	160	50	160
Sailing time empty (minutes)	80	80	80	80	80	80
Connection time (minutes)	20	20	20	20	20	20
Sailing time loaded (minutes)	90	90	90	90	90	90
Disconnection time (minutes)	20	20	20	20	20	20
Discharging time (minutes)	10	10	10	10	10	10
Operational to service hours (%)	68.45%	68.45%	68.45%	68.45%	68.45%	68.45%
Total dredging cycle time (minutes)	270	380	270	380	270	380
Effective operation hours per week	100	100	100	100	100	100
Number of trips to offshore disposal site per week	22.2	15.8	22.2	15.8	22.2	15.8
Cycle production (m3/week)	133,333	150,000	133,333	150,000	133,333	150,000
Dredging volume (m3)	305,369	460,054	147,136	106,304	142,465	73,171
Dredging time (weeks)	2.3	3.1	1.1	0.7	1.1	0.5

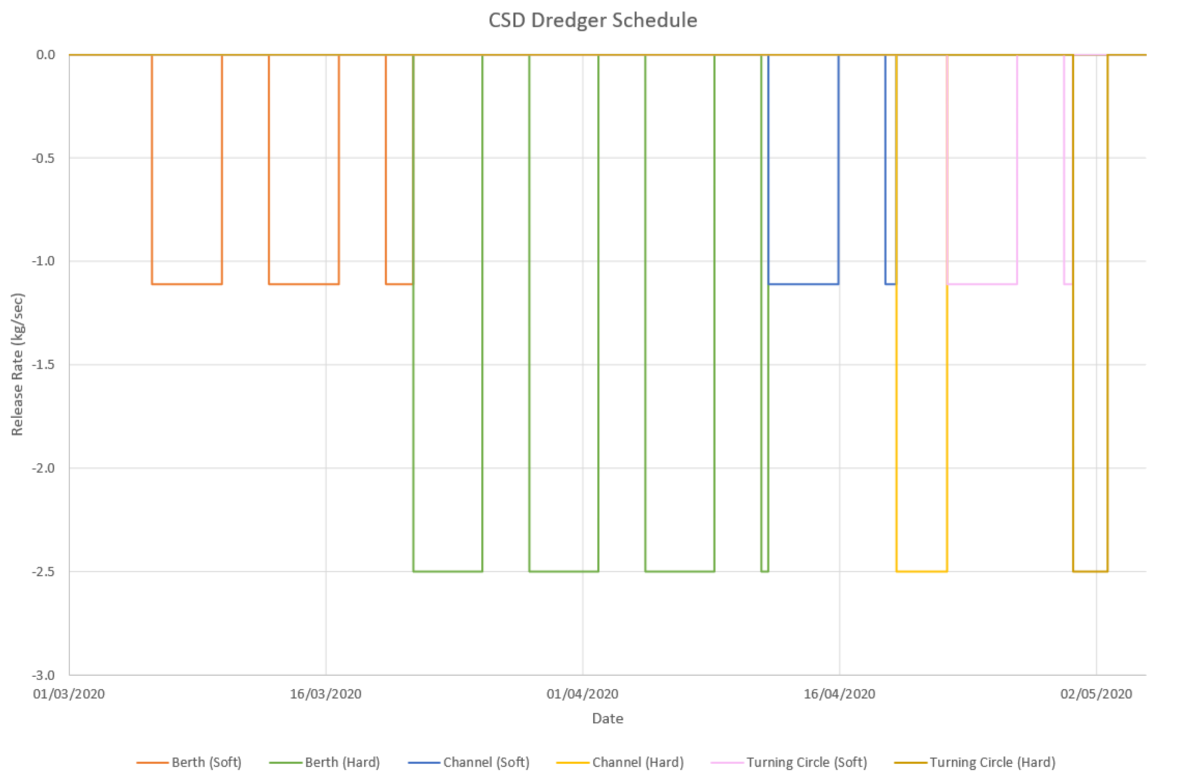

Figure 3-3 Sediment release schedule for dredger

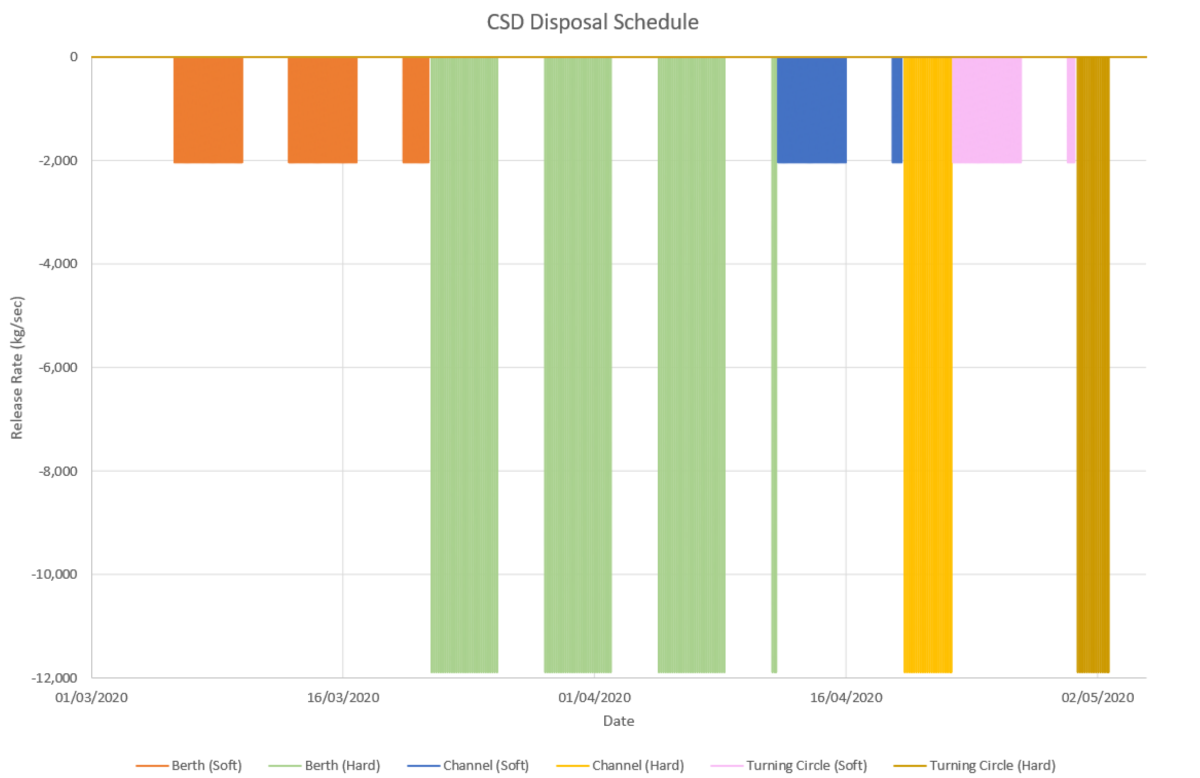

Figure 3-4 Sediment release schedule at offshore disposal site

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3.4.3 Sediment Release Assumptions

The following assumptions have been made for the simulation of sediment plumes arising from dredging and offshore disposal.

The CSD will operate at full capacity, with two barges being deployed for transport of the dredged soil material to the disposal site. The dredger will release material from along a single line along each of the channel, the berth pocket and part of the Tees Dock turning area. This adopted method for material release is a conservative approach for worst case plume effect. The dredger will actually move around the dredging areas along multiple lines which means the sediment release will be more dispersed and thus the sediment concentration will be less than simulated.

At the offshore disposal site, two release scenarios have been considered. The first involves the barges releasing all material at a single point in the centre of the disposal site. This adopted method for material release is a conservative approach for worst case plume effect. Recognising that the barges could actually discharge their loads anywhere within the disposal site a second scenario was adopted where the model randomly generated a release point within the disposal site for each visit.

3.4.4 Sediment Property Representation

The five sediment fractions, critical bed shear stresses and fall velocities used in the sediment dispersion model to represent bed sediments are shown in **Table 3-4**. The critical bed shear stress and fall velocities were calculated using the SandCalc software developed by HR Wallingford.

Table 3-4: Sediment settling velocity and critical bed shear stress

Sediment Grading Type	Sediment Size (mm)	Settling Velocity (m/s)	Critical Shear Stress (N/m^2)
Silt/Clay	0.031	0.000554	0.0847
Fine Sand	0.13	0.00935	0.1548
Medium Sand	0.3	0.0372	0.2025
Coarse Sand	1.3	0.135	0.657
Gravel/Cobble	2	0.1734	1.166

3.5 CSD Dredging and Disposal Cycle

This section describes the CSD dredge and disposal cycle for the two different soil types. The sediment release rate, sediment loss rate and discharge sediment rate are the same for each of the dredge areas, namely berth pocket, channel and turning area. They differ in dredge and disposal duration due to the different volume of material that is being removed.

3.5.1 Soft surface layer

The CSD dredger will dredge the soft surface layer material above a level of -2mCD by operating continuously filling a barge, with two barges being in operation sailing back and forth to the offshore disposal site. The dredger disperses sediment into the water column at a sediment release rate of 1.11 kg/s. The sediment loss rate (the so-called ‘S-factor’) is taken as 6 kg/m^3 for the CSD which follows the CIRIA Guidance (2000).

The CSD will dredge for 50 minutes to load one barge, the barge will then sail for 90 minutes to the disposal site, discharge for 10 minutes with a discharge sediment rate of 2038.333 kg/s. The barge will then take 80 minutes to sail back to site. Disconnecting and re-connecting the barge from and to the CSD will take 40 minutes in total. The total time of one dredge and disposal cycle takes 270 minutes.

The CSD works on 68.45% operational working hours, which allows for downtime due to bad weather, refuelling, and equipment maintenance.

The CSD dredge and disposal cycle for the soft material will take 2.29 weeks for 305,369 m^3 in the berth, 1.1 weeks for 147,136 m^3 in the channel and 1.07 weeks for 142,465 m^3 in the turning area.

3.5.2 Hard surface layer

The CSD dredger will dredge the hard material below a level of -2mCD by operating continuously filling a barge, with two barges being in operation sailing back and forth to the offshore disposal site. The dredger disperses sediment into the water column at a sediment release rate of 2.5 kg/s. The sediment loss rate (the so-called 'S-factor') is taken as 6 kg/m^3 for the CSD which follows the CIRIA Guidance (2000).

The CSD will dredge for 160 minutes to load one barge, the barge will then sail for 90 minutes to the disposal site, discharge for 10 minutes with a discharge sediment rate of 11,891.67 kg/s. The barge will then take 80 minutes to sail back to site. Disconnecting and re-connecting the barge from and to the CSD will take 40 minutes in total. The total time of one dredge and disposal cycle takes 380 minutes.

The CSD works on 68.45% operational working hours, which allows for downtime due to bad weather, refuelling, and equipment maintenance.

The CSD dredge and disposal cycle for the hard material will take 3.07 weeks for 460,054 m^3 in the berth, 0.71 weeks for 106,304 m^3 in the channel and 0.49 weeks for 73,171 m^3 in the turning area.

3.6 Results of Dispersion Model

3.6.1 Background

Results from the updated sediment dispersion modelling for proposed variations to the Phase 1 project are discussed in turn for the river dredging and offshore disposal activities. Note that all modelling plots in the following sections show the elevations in SSC or sediment deposition due to these activities above baseline levels.

For SSC and sediment deposition, maximum 'zone of influence' plots are presented in following sections. These show the maximum values and spatial extents of enhancement in SSC or deposition on the bed from any stage of the river dredging or offshore disposal operations during the relevant phase of the dredging programme. It is important to note that this type of figure does not represent a plume or deposition that would occur instantaneously at any one point in time. Rather, this type of figure shows the maximum areas of the river channel or offshore area that will become affected by a plume or deposition at some point during the nine weeks of dredging or disposal activities (in some areas this will be on a single occasion, in other areas it will be on multiple occasions) and the maximum magnitude of change that will be experienced at that point.

To provide context, plots are first presented for the results arising under the previously assessed conditions for the original Phase 1 and Phase 2 of the South Bank Quay project (reproduced from the EIA Report) and then the equivalent plot is presented for conditions arising under the proposed project variations to Phase 1 only.

3.6.2 River Dredging

The combined maximum ‘zone of influence’ from all stages of the dredging activities associated with the previously assessed Phases 1 and 2 of the project has been plotted in **Error! Reference source not found.** for the near-bed layer and Error! Reference source not found. for the near-surface layer. These figures can be compared against the updated modelling results for the proposed project variation (covering Phase 1 only of the dredging) in Error! Reference source not found. (near-bed layer) and Figure 3-8 (near-surface layer).

For the previously assessed Phases 1 and 2 of the project (**Figure 3-5** and **Figure 3-6**), near-surface effects are generally slightly lower than near-bed effects, and during the dredging, all plume effects are confined to within the river reaches that extend between Middleborough Dock/Transporter Bridge at the upstream end and the Oil Terminal on the north bank at the downstream end. Furthermore, all plumes associated with dredging of the berthing pocket and river channel in the vicinity of the new quay are confined to the right bank (south of centre line) portion of the channel’s width, whilst all plumes associated with dredging of the turning area are confined to the left bank (north of centre line) portion of the channel’s width in the reaches that they respectively affect. No plume effects (and by implication no deposition effects) of a significant level above background values will occur beyond these reaches.

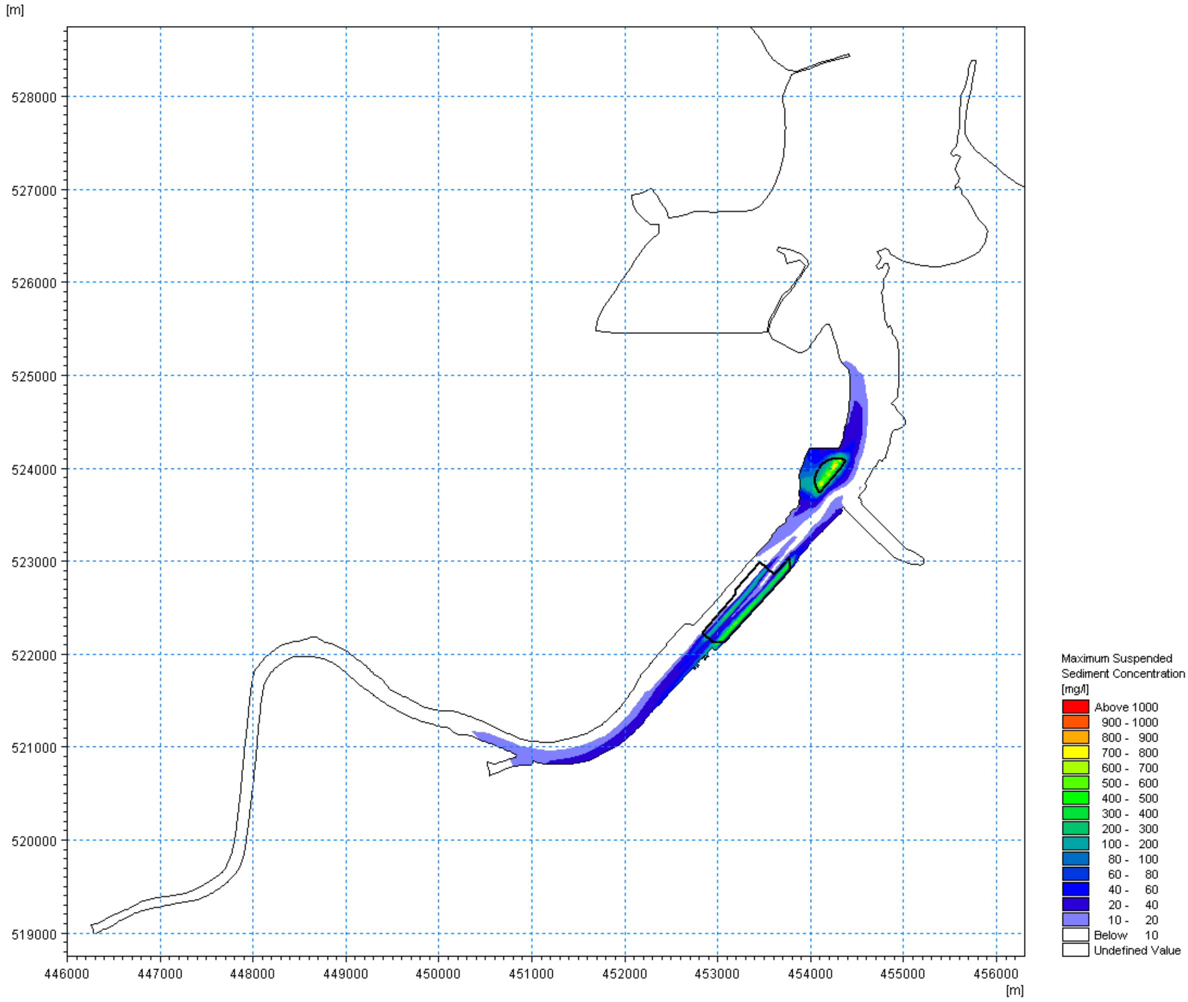

Figure 3-5 Maximum enhanced suspended sediment concentrations (near-bed layer) arising from dredging activities under the previously assessed project [Phases 1 and 2, reproduced from EIA Report]

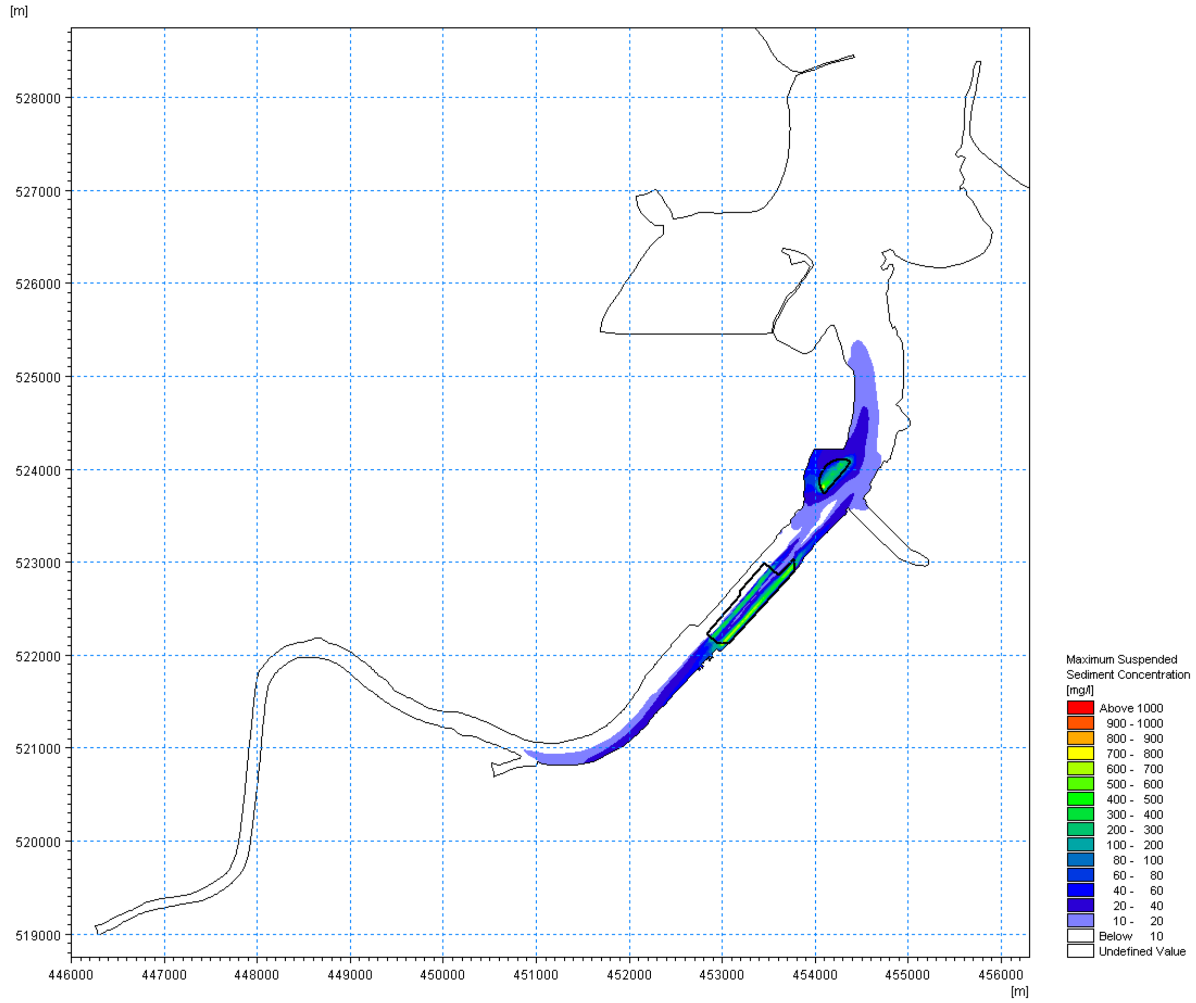

*Figure 3-6 Maximum enhanced suspended sediment concentrations (near-surface layer)*arising from dredging activities under the previously assessed project [Phases 1 and 2, reproduced from EIA Report]

For the proposed project variations, (**Error! Reference source not found.** and **Figure 3-8**) the updated modelling results for Phase 1 only show that both the magnitude and spatial extent of the arising maximum 'zone of influence' are considerably less than that previously assessed for Phases 1 and 2, for both the near-bed and near-surface layers of the water column. This is predominantly due to the lesser volume of material being dredged, the shorter overall dredging programme, the smaller area within which dredging will be undertaken, and the different spill rates of the CSD compared to that previously assessed for the TSHD and BH dredgers.

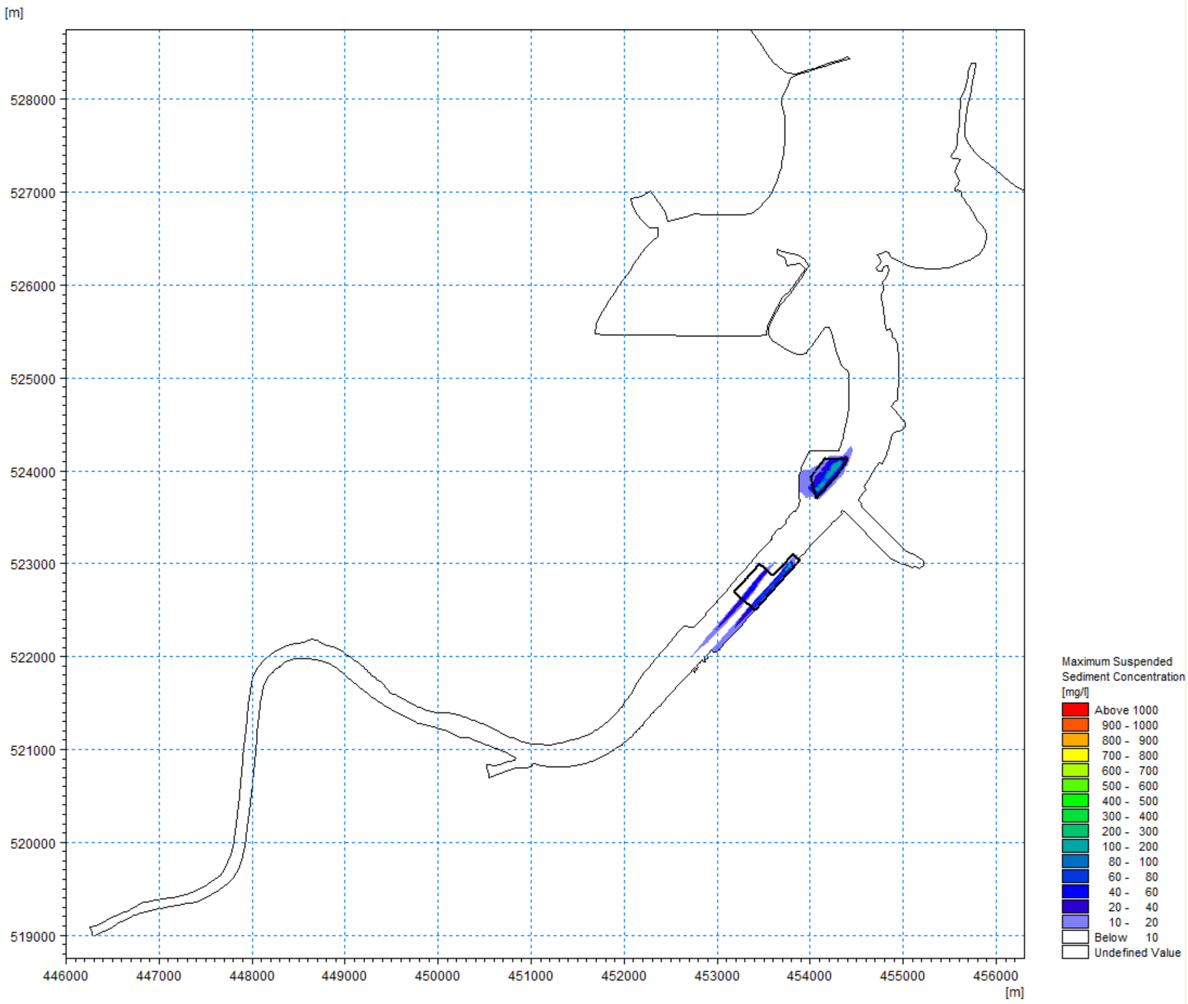

Figure 3-7 Maximum enhanced suspended sediment concentrations (near-bed layer) arising from dredging activities under the proposed project variation to Phase 1 [updated modelling]

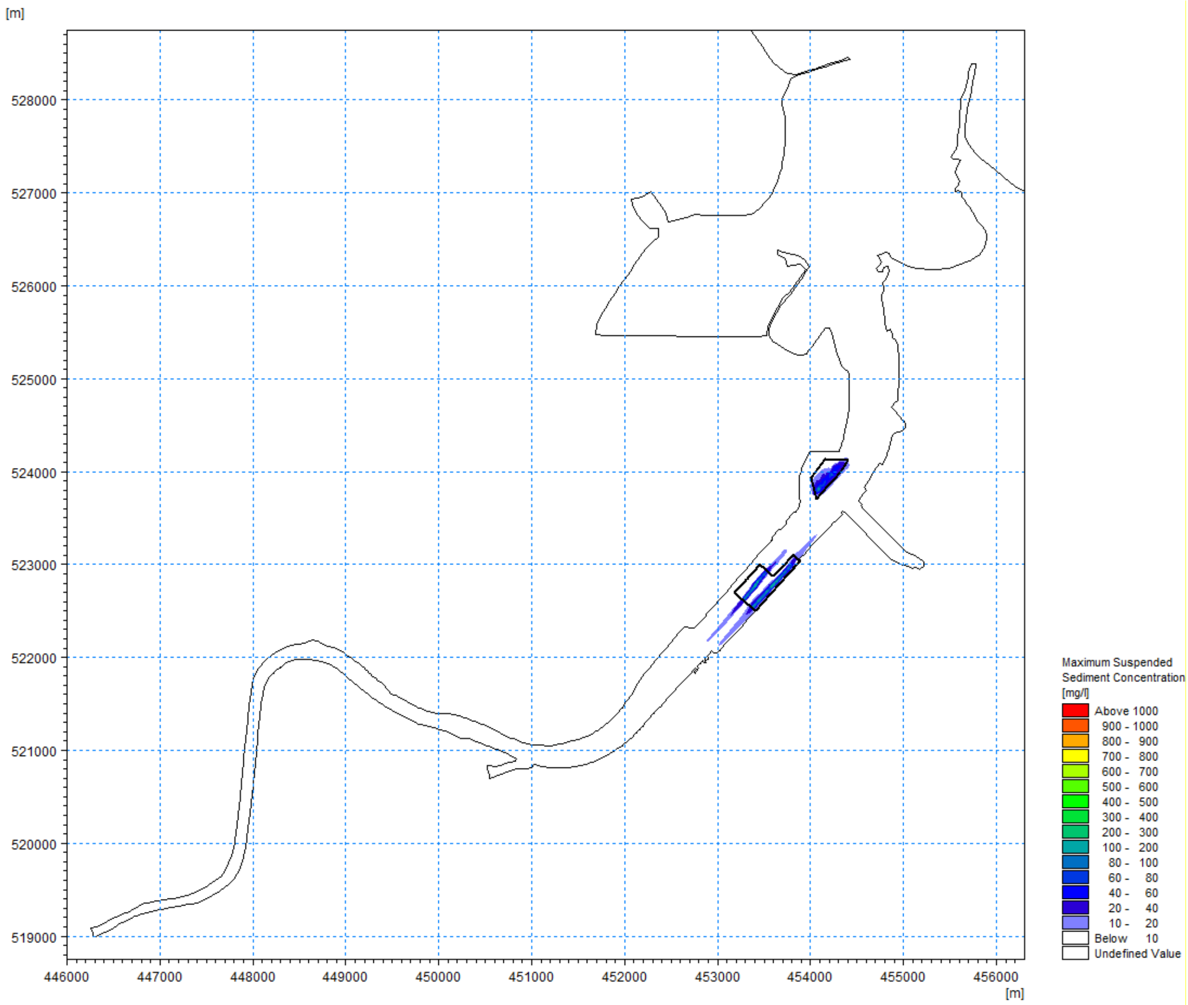

Figure 3-8 Maximum enhanced suspended sediment concentrations (near-surface layer) arising from dredging activities under the proposed project variation to Phase 1 [updated modelling]

For the previously assessed Phases 1 and 2 of the project, **Figure 3-9** shows the maximum changes in river bed thickness caused by the deposition of sediment from the plumes created by river dredging. It can be seen that much of the sediment falls to the bed within the dredged areas (from where it will be re-dredged to achieve the necessary bed depths), whilst the deposition that occurs in other parts of the river is much lower, typically less than 5cm, within the same area of river that is affected by the zone of influence from the sediment plumes.

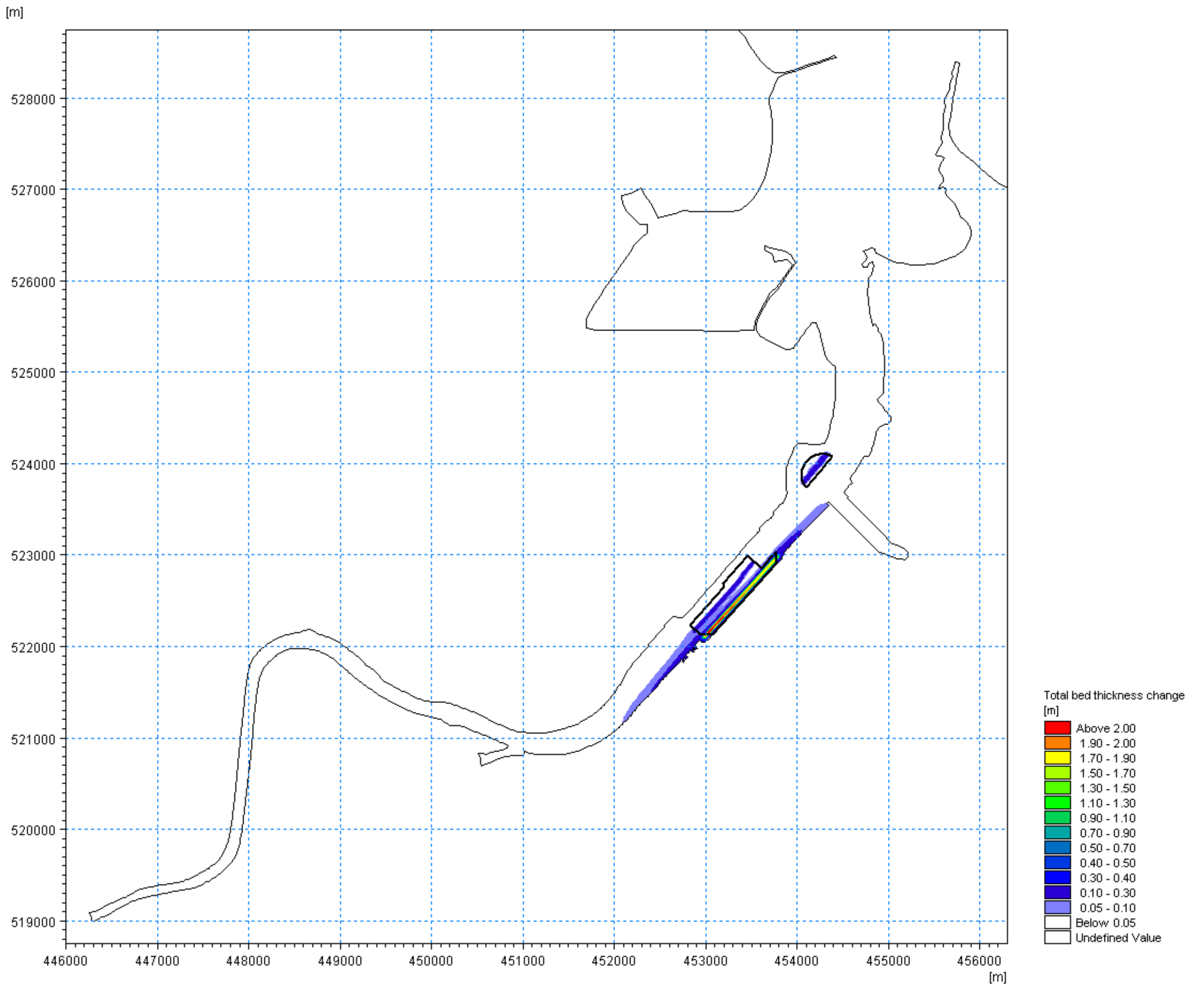

Figure 3-9 Maximum river bed thickness change due to sediment deposition arising from dredging activities under the previously assessed project [Phases 1 and 2, reproduced from EIA Report]

For the proposed project variations, the updated modelling results for Phase 1 only (**Figure 3-10**) show that both the magnitude and spatial extent of the arising maximum river bed thickness change are considerably less than that previously assessed for Phases 1 and 2 of the project. In particular, the changes are confined to within the footprint of the dredged areas, from where the re-deposited sediment will be dredged and removed.

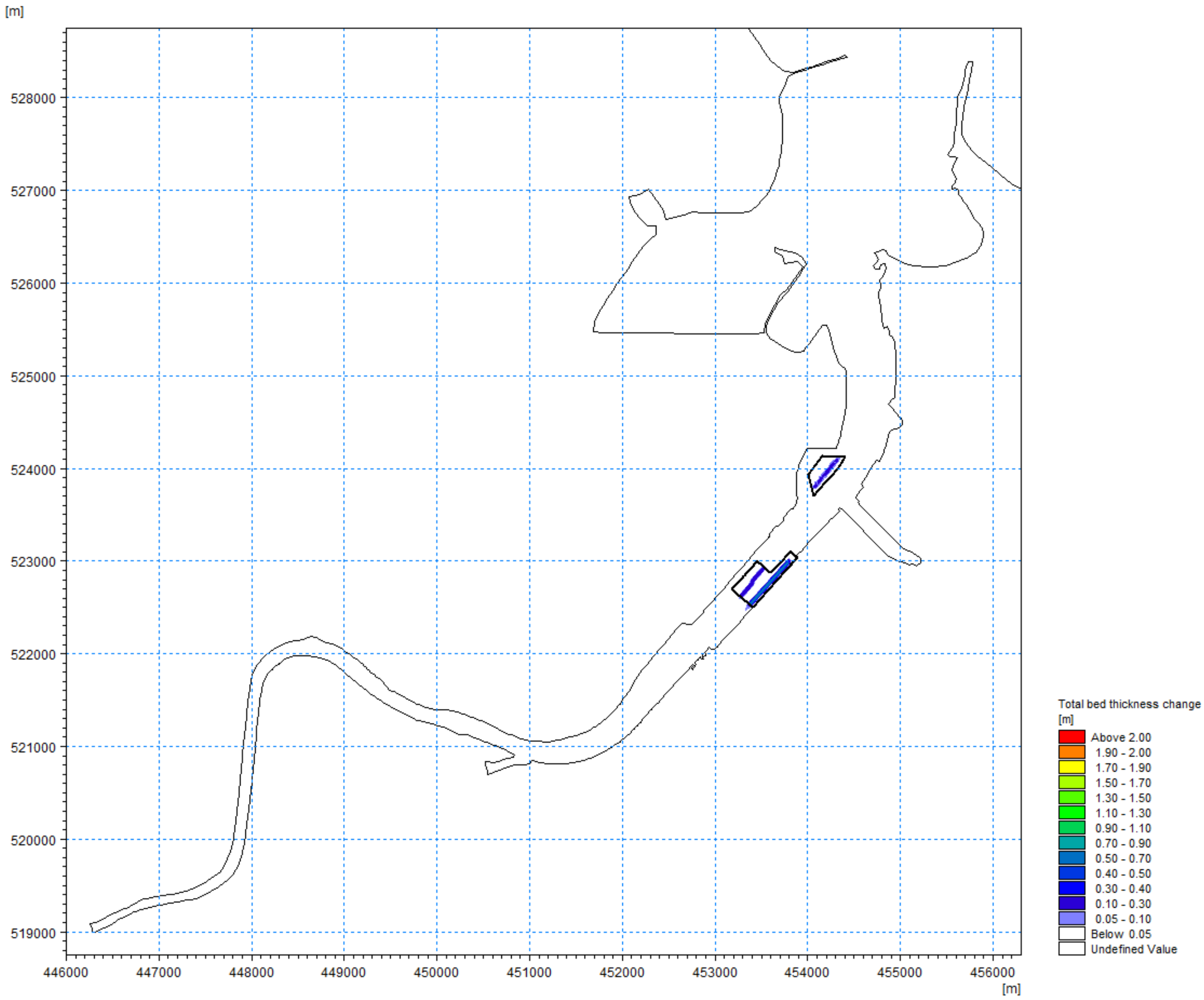

Figure 3-10 Maximum river bed thickness change due to sediment deposition arising from dredging activities under the proposed project variation to Phase 1 [updated modelling]

3.6.3 Offshore Disposal Site

The offshore disposal site is located within a water depth of around 43.5m, approximately 18km from the proposed development site and around 12km from the mouth of the river at its nearest point. The site is licensed for the disposal of dredged sediment and is routinely monitored as part of a national programme. Therefore, plumes arising from disposal activities and subsequent sediment deposition is unlikely to be of concern within the licensed area, or in immediately adjacent sea bed areas.

For the previously assessed Phases 1 and 2 of the project, the maximum ‘zone of influence’ from disposal associated with the dredging programme has been plotted in **Figure 3-11** for the near-bed layer of the water column. It should be noted that this represents a worst case whereby all disposal activities have occurred in the model at a single release point and the potential for coalescence of subsequent depositional plumes is greatest. It can be seen that SSC values are elevated by the greatest amount at the release point (by up to several thousand mg/l), reducing to more typically a few hundred mg/l within a few km of the upstream and downstream boundaries. At the extremities of the plume extent, there are wide zones of relatively low SSC values (<100mg/l). It should be noted that in reality, subsequent disposals will be at different parts of the release site and so the zone of influence is likely to be slightly broader in width and shorter in length than shown in the worst case.

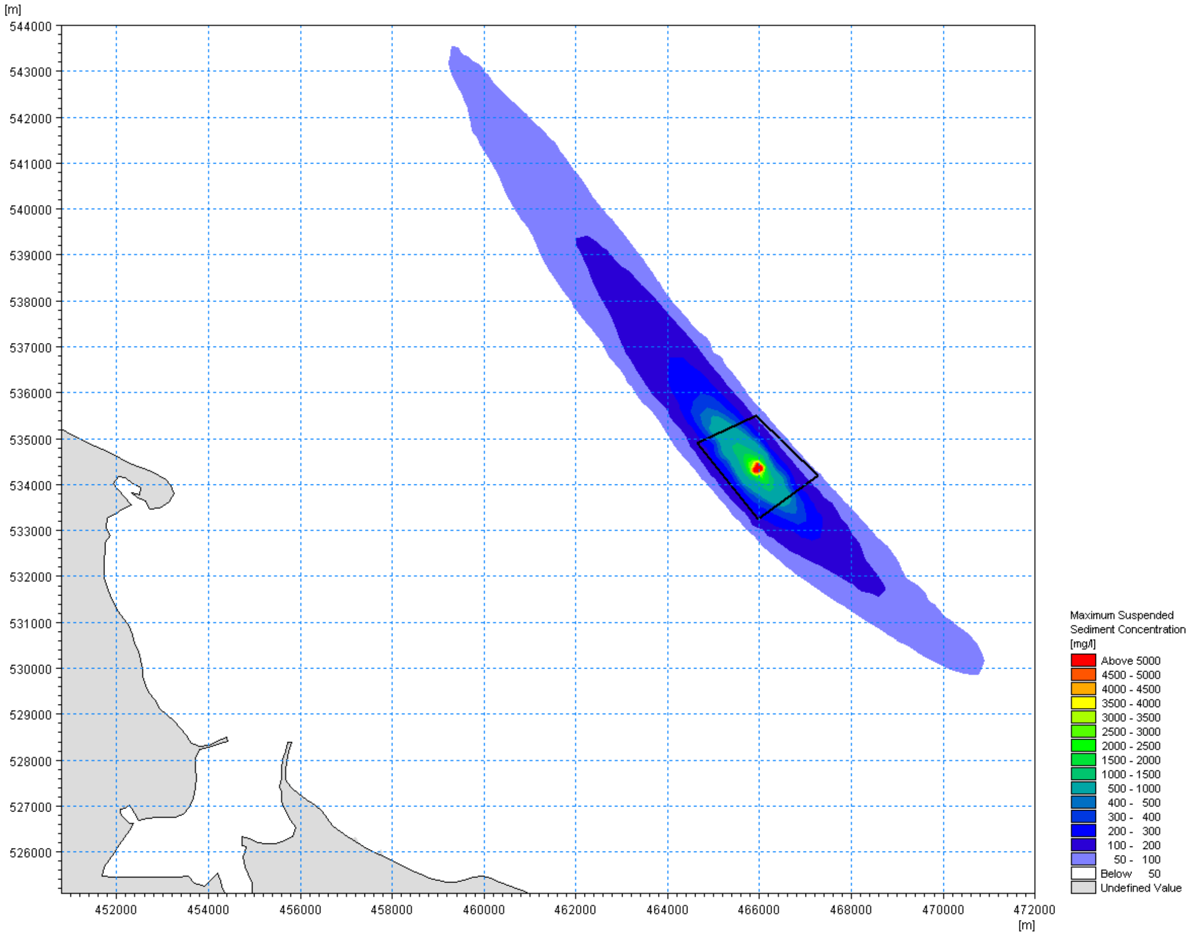

Figure 3-11 Maximum enhanced suspended sediment concentrations (near-bed layer) arising from disposal activities under the previously assessed project with all sediment release at the centre of the disposal site [Phases 1 and 2, reproduced from EIA Report]

For the proposed project variations to Phase 1 only, two scenarios have been modelled. For the first scenario, **Figure 3-12Error! Reference source not found.**shows the maximum 'zone of influence' for the near-bed layer of the water column from all disposals being made at a single central point. This scenario is directly comparable to that modelled for Phase 1 and 2 combined and shown in **Figure 3-11**. In keeping with the results for the river dredging, the updated modelling results show that both the magnitude and spatial extent of the arising maximum 'zone of influence' are considerably lesser than that arising from the previously assessed Phases 1 and 2 of the project. This is predominantly due to the lesser volume of material overall being disposed, the shorter overall disposal programme, a greater proportion of hard material which settles down through the water column quicker, and, for soft material, the barge contains a large quantity of water from the CSD. This means the discharge quantity of soft material by a barge is slightly smaller than previously by TSHD, even though the barge capacity is greater.

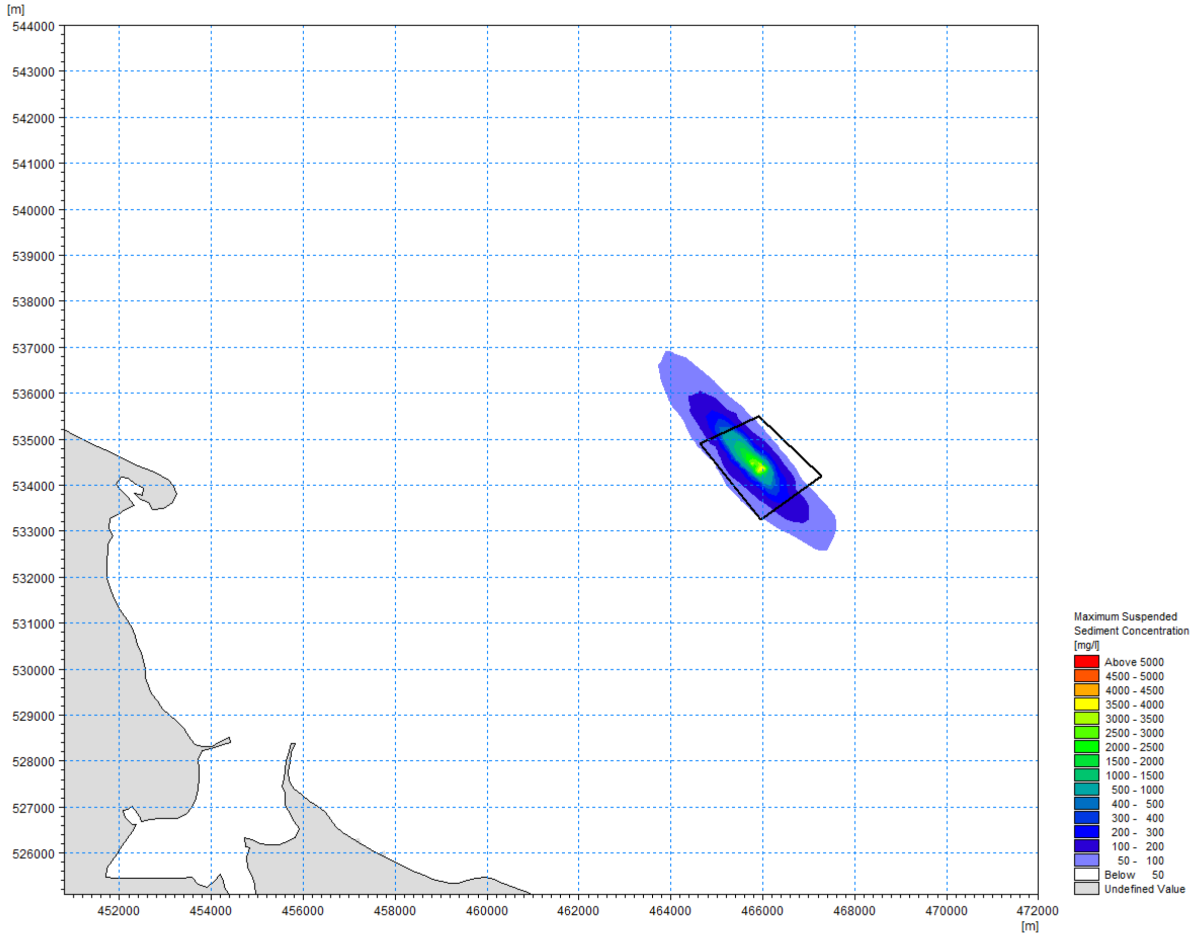

Figure 3-12 Maximum enhanced suspended sediment concentrations (near-bed layer) arising from disposal activities under the proposed project variation to Phase 1 with all sediment release at the centre of the disposal site [updated modelling]

Recognising that in reality it is unlikely all material will be deposited at a single point within the disposal site, a second scenario was modelled for Phase 1 only where the barges could discharge their loads anywhere within the disposal site, using a randomly generated release point within the disposal site for each visit. **Figure 3-13** shows the maximum 'zone of influence' for the near-bed layer of the water column from disposals being made under this random scenario. This produces a squatter, broader maximum 'zone of influence', with higher concentrations retained within the disposal site and lower concentrations spreading beyond its boundaries. Note that the occasional highest values (red zones) occur at times when a disposal activity coincides with high or low water, when tidal currents are slack.

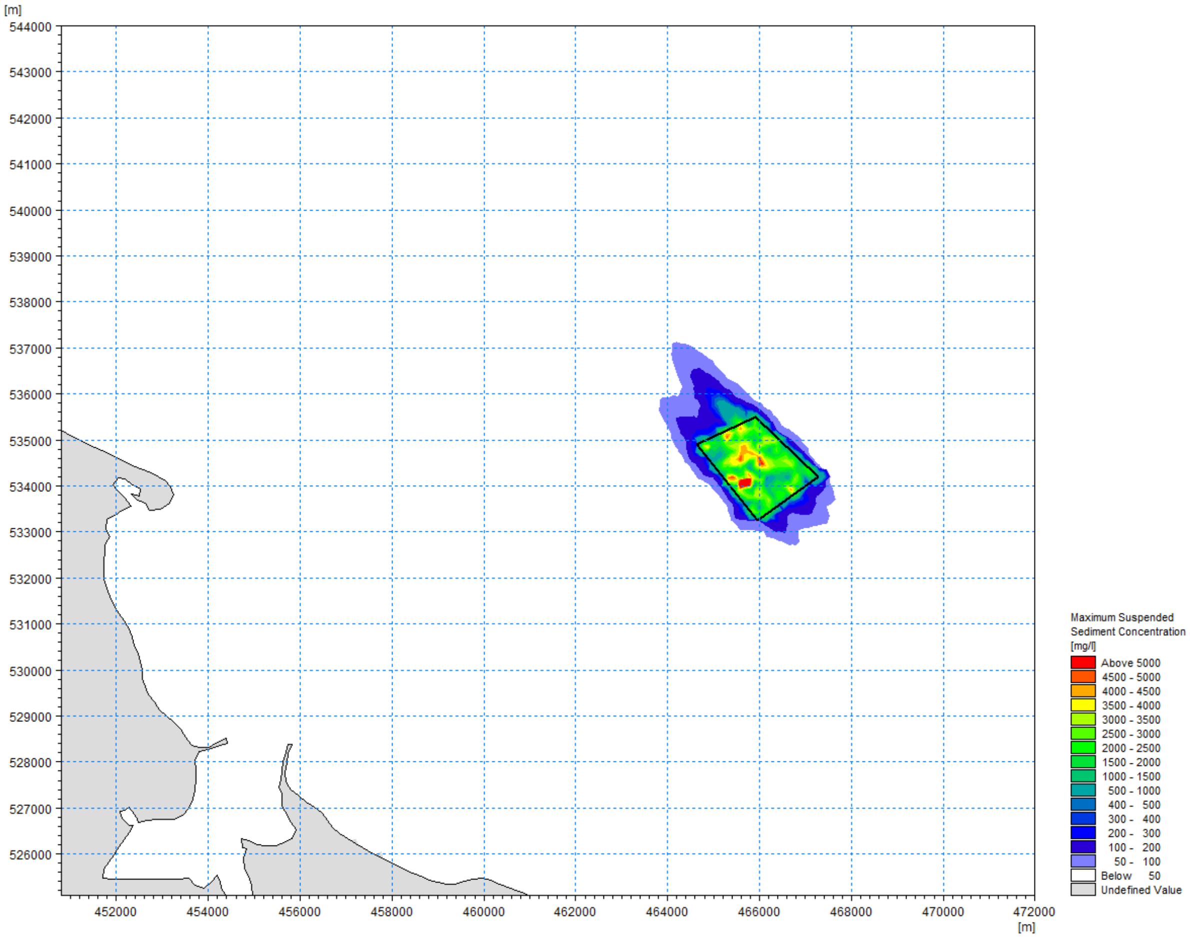

Figure 3-13 Maximum enhanced suspended sediment concentrations (near-bed layer) arising from disposal activities under the proposed project variation to Phase 1 with sediment release at random points within the disposal site [updated modelling]

For the previously assessed Phases 1 and 2 of the project, Error! Reference source not found.**Figure 3-14** shows the maximum changes in sea bed thickness caused by deposition of material from the sediment plume for the worst case considered (all material released at a single central point). It can be seen that much of the sediment falls to the bed within the disposal area, forming a mound on the sea bed. Deposition to the west and east of the disposal site is negligible, whilst to the south and north covers a similar zone to the sediment plume. In reality, disposals will be at different points within the licensed area, and so such a pronounced mound will not form and deposition on the sea bed to the north and south of the site will be much lower than this worst case.

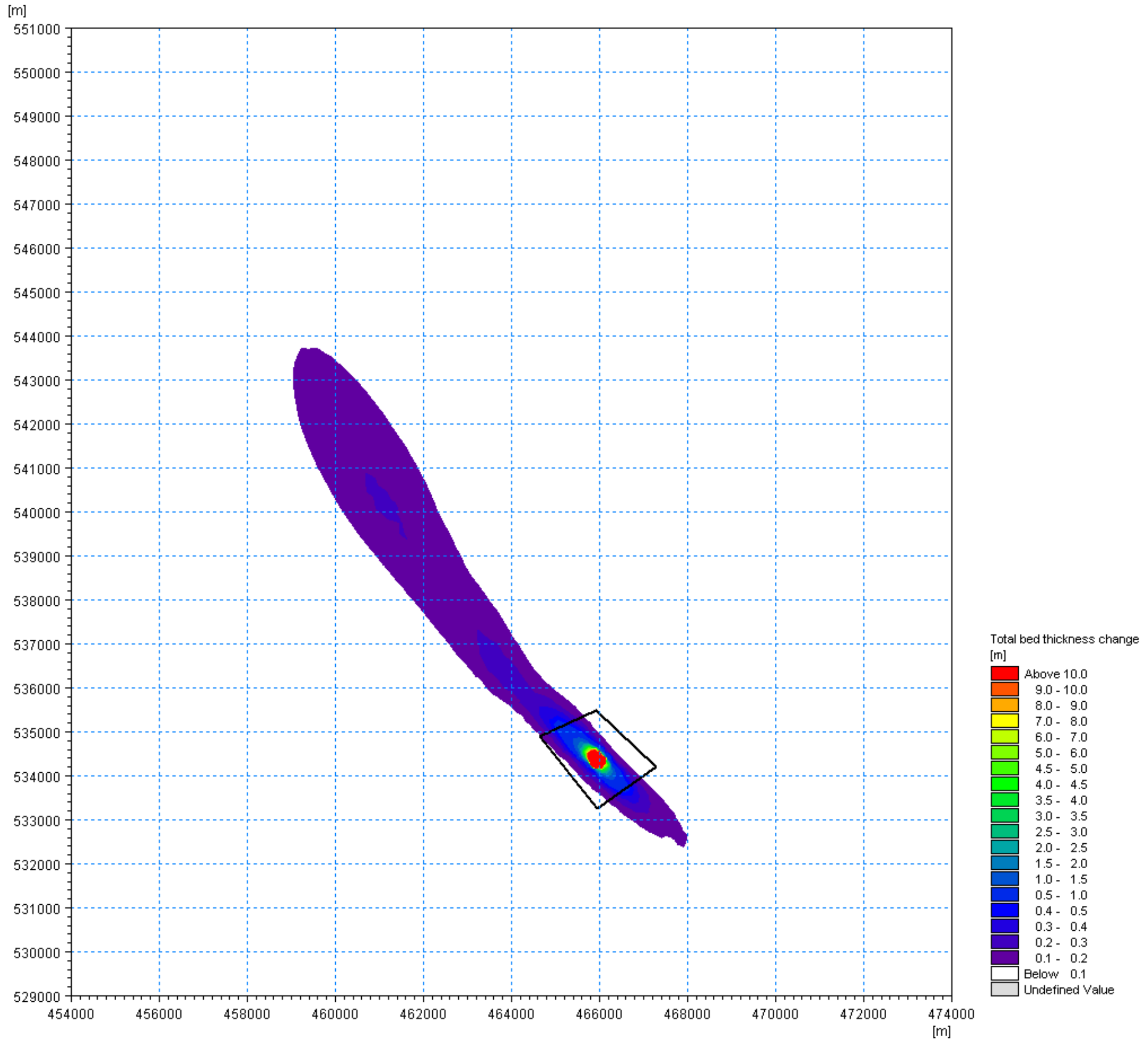

Figure 3-14 Maximum sea bed thickness change due to sediment deposition arising from disposal activities under the previously assessed project with all sediment release at the centre of the disposal site [Phases 1 and 2, reproduced from EIA Report]

For the first scenario modelled for the proposed project variations to Phase 1 only, Error! Reference source not found.Figure 3-15 shows the maximum sea bed thickness change from all disposals being made at a single central point. This scenario is directly comparable to that modelled for Phases 1 and 2 of the project and shown in **Figure 3-14**. In keeping with the results for the plume dispersion, the updated modelling results show that both the magnitude and spatial extent of the arising maximum 'zone of influence' for the proposed project variations to Phase 1 only are considerably less than that previously assessed for Phases 1 and 2 of the project, barely extending beyond the disposal site's boundaries.

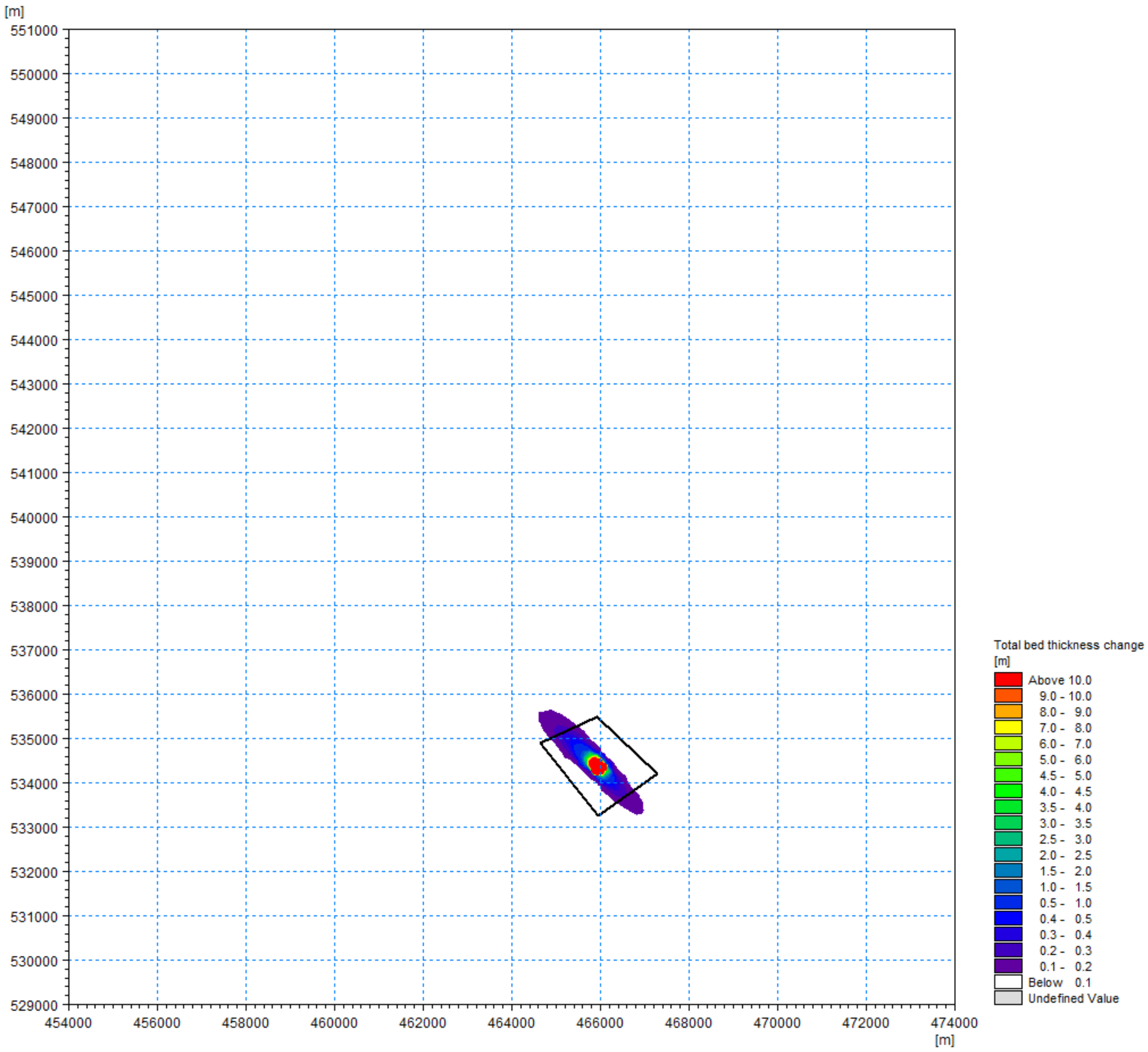

Figure 3-15 Maximum sea bed thickness change due to sediment deposition arising from disposal activities under the proposed project variation to Phase 1 with all sediment release at the centre of the disposal site [updated modelling]

For the second scenario modelled for the proposed project variations to Phase 1 only, **Figure 3-16** shows the maximum sea bed thickness change from random disposals within the offshore site. This produces a squatter, broader maximum effect, with modest change within and little change beyond the disposal site's boundaries.

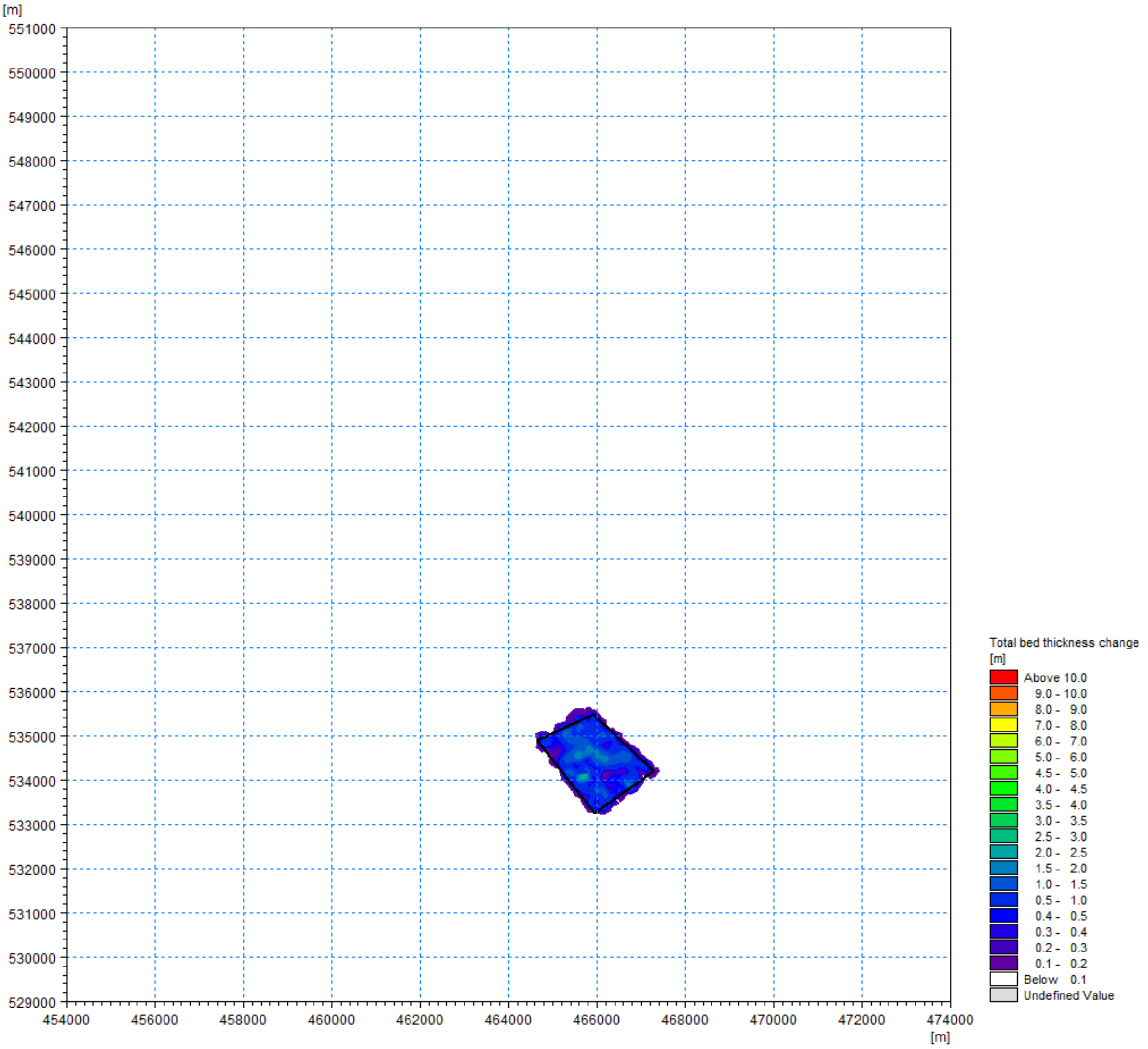

Figure 3-16 Maximum sea bed thickness change due to sediment deposition arising from disposal activities under the proposed project variation to Phase 1 with sediment release at random points within the disposal site [updated modelling]

3.7 Conclusion

The river dredging and offshore disposal activities associated with the proposed project variations will both cause plumes of sediment to form close to the release points of material into the water column. These plumes will disperse under wave and current action and all sediment particles suspended in the water column will ultimately settle to the river or sea bed, causing deposition. However, both the spatial extent and magnitude of effects under the proposed project variations to Phase 1 only are less than those previously assessed for Phases 1 and 2 of the project.

4 Wave Regime

The principal findings from the previous numerical wave modelling for Phase 1 and Phase 2 were:

- The South Bank Quay site is well sheltered from North Sea swell waves;
- Locally-generated waves under extreme wind are of more significance, reaching a height of 0.3m to 0.4m for a 1 in 1 year return period and 0.5m to 0.7m for a 1 in 100 year return period;
- There is no significant predicted effect from the project on local wind-generated waves at the site.

Full details were provided within **Chapter 6: Hydrodynamics and Sedimentary Processes** of the EIA Report and the accompanying **Appendix 5: Hydrodynamics and Sedimentary Plume Modelling** of the EIA Report.

In the updated assessments, proposed project variations to Phase 1 have been considered. Phase 1 would affect a smaller footprint of the river channel compared with the previous assessments for Phases 1 and 2 combined, so any such effects from dredging on the tidal regime during Phase 1 would be lesser than those previously assessed. Also the very slight change in extent of dredging within the turning area from a semi-circular to semi-trapezoidal shape is not deemed at all significant. For these reasons, no updated numerical wave modelling has been undertaken.