22 OFFSHORE DISPOSAL OF DREDGED MATERIAL

22.1 Introduction

22.1.1 As discussed in **Section 3.1**, the total quantity of material to be dredged during Phase 1 and Phase 2 of the proposed scheme would be approximately 1,122,000m^3 for the open quay. The construction of the solid quay would involve capital dredging of approximately 814,000m^3.

22.1.2 Use of capital sands and gravels is proposed if the solid quay option is progressed and for habitat enhancement. Further options for the beneficial use of the dredged arisings have been investigated but, to date, no viable options have been forthcoming. These opportunities will continue to be investigated.

22.1.3 In the absence of other use proposals, and taking into account the fact that contaminated material cannot be disposed offshore, it is proposed that the following maximum quantities of dredged material would be disposed at the capital offshore dredged material disposal site in Tees Bay (Tees Bay C) if the open quay option is progressed (this represents the worst case):

- 615,000m^3 of clay and mudstone; and,
- 326,000m^3 of sand and gravel. For the solid quay, all sand and gravel could be used and would not be disposed offshore.

22.1.4 The Scoping Opinion (**Appendix 4.2**) states that over 1 million tonnes of material was deposited in Tees Bay C in 1999, but since then it has received only 74,903 tonnes of material in total.

22.1.5 Although the proposed scheme involves the use of dredged material for habitat enhancement measures within Bran Sands lagoon, the volume of material required is minimal in comparison to the overall volume of material proposed to be dredged. The assessment of potential impacts with regard to offshore disposal, therefore, has been based on a worst case assumption of all material (with the exception of the contaminated silts overlying the geological materials) being deposited offshore.

22.1.6 This section discusses the issues relating to the disposal of material arising from capital dredging.

22.2 Modelling of the dispersion of capital dredged material

22.2.1 HR Wallingford undertook an assessment of the potential dispersion of capital dredged material associated with the proposed dredge and disposal operations at Tees Bay C. The assessment of the release of sediment from the offshore disposal site included consideration of a series of dredging scenarios used to simulate the release of fine sediment from capital dredging. Three types of sediment release at the disposal site were assessed; fine sediment (mean grain size less than 63µm), sand sized sediment, with grain sizes up to 1mm, and material coarser than 1mm. Although the contaminated silts would not be disposed offshore, the modelling has included assessment of the fine sediments on a precautionary basis, in order to provide a worst case assessment of the potential impact on water quality (i.e. increase in suspended sediment concentration and dispersion from the disposal site).

Fine sediment

22.2.2 The in-situ sediment with the highest proportion of fine sediment used in the dredging plume assessment (reported in **Section 5**) was silty sand with an assumed 30% fines content. This material was assumed to be dredged by a TSHD. The HR Wallingford dredger production model was used to calculate the fine sediment content of the 7,850 Tonnes Dry Solids in the hopper of the TSHD taken to the disposal site. The proportion of fine sediment was calculated as 5% of the load (i.e. 390 TDS).

22.2.3 The distance from the dredge site to the disposal site suggests a load would be placed at the disposal site every 264 minutes, with the disposal operation taking 10 minutes. For each placement the sediment would be expected to descend rapidly through the water column, entraining water as it descends. This dynamic plume phase restricts the release of fine sediment into the water column to 5-10% of that found within the placed load (Land and Bray, 1998). For the purposes of the assessment, 10% losses of fine sediment from the dynamic plume was assumed.

22.2.4 The remaining disposed material would descend to the bed and 'pancake' out. In time, the fine sediment in this material would be expected to be winnowed out and transported away from the disposal site; however, the rate of sediment losses from the site due to this process would not exceed that during the initial placement phase.

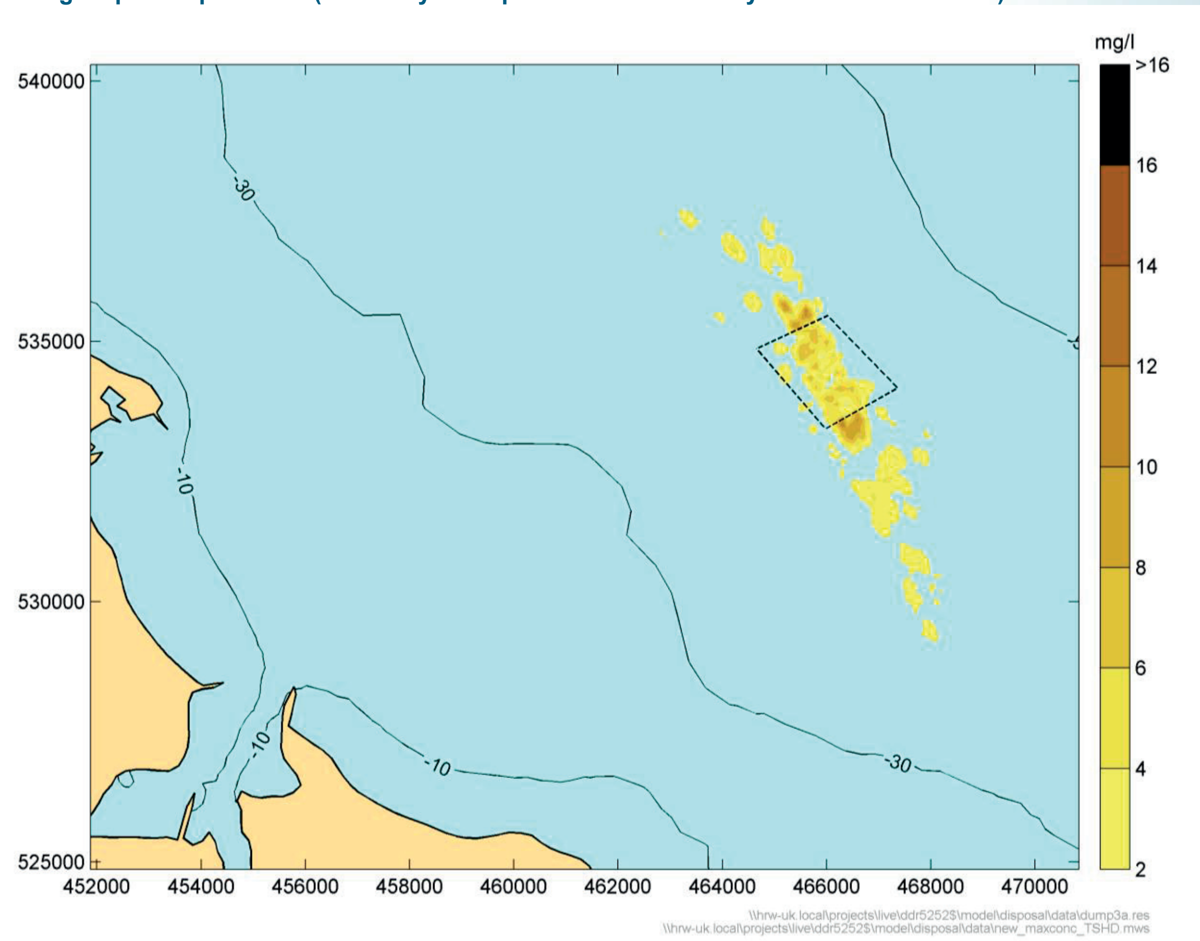
22.2.5 The Tees Bay C disposal site is outside the domain of the hydrodynamic model used for the EIA studies reported in **Section 5**. Therefore, to provide information on current speeds in order to predict the extent of the fine sediment plume expected to arise from disposal operations in the offshore area, a set of current observations made by a bed frame adjacent to the disposal site over a period of 14 days were mapped onto a regional model mesh. The use of the observed currents meant that establishment and calibration of a specific detailed model of the area around Tees Bay was not required. The bed frame data is described in HR Wallingford (1998) (**Appendix 22.1**) and further detail of the use of the data in generating a suitable flow field is provided by HR Wallingford (2005) (**Appendix 5.2**).

22.2.6 The fine sediment dispersion from disposal operations was modelled by the Lagrangian particle tracking model, SEDPLUME-RW(3D). A source term of 60kg/s of fine sediment was included in the model for 10 minutes every 264 minutes, in order to represent each disposal event. The model was run for 14 days.

22.2.7 **Figure 22-1** shows the maximum excess (i.e. increased) suspended sediment concentration predicted by the simulation. Plotting the maximum plume concentration shows the largest concentration experienced at any time in the simulation but does not account for the duration of the presence of the additional sediment. This should be recognised when interpreting the potential impact of the sediment plume (i.e. the maximum concentration shown would disperse).

22.2.8 Maximum concentrations of 6-10 mg/l are shown inside the boundary of the disposal site itself and within 1km beyond the boundary of the site. Occurrences of excess sediment concentration in the range 2-4 mg/l are shown to be confined to an area within 5km of the boundary of the disposal site.

Figure 22-1 Maximum depth-average excess suspended sediment concentration from sediment released during disposal operations (boundary of disposal site indicated by the black dotted line)

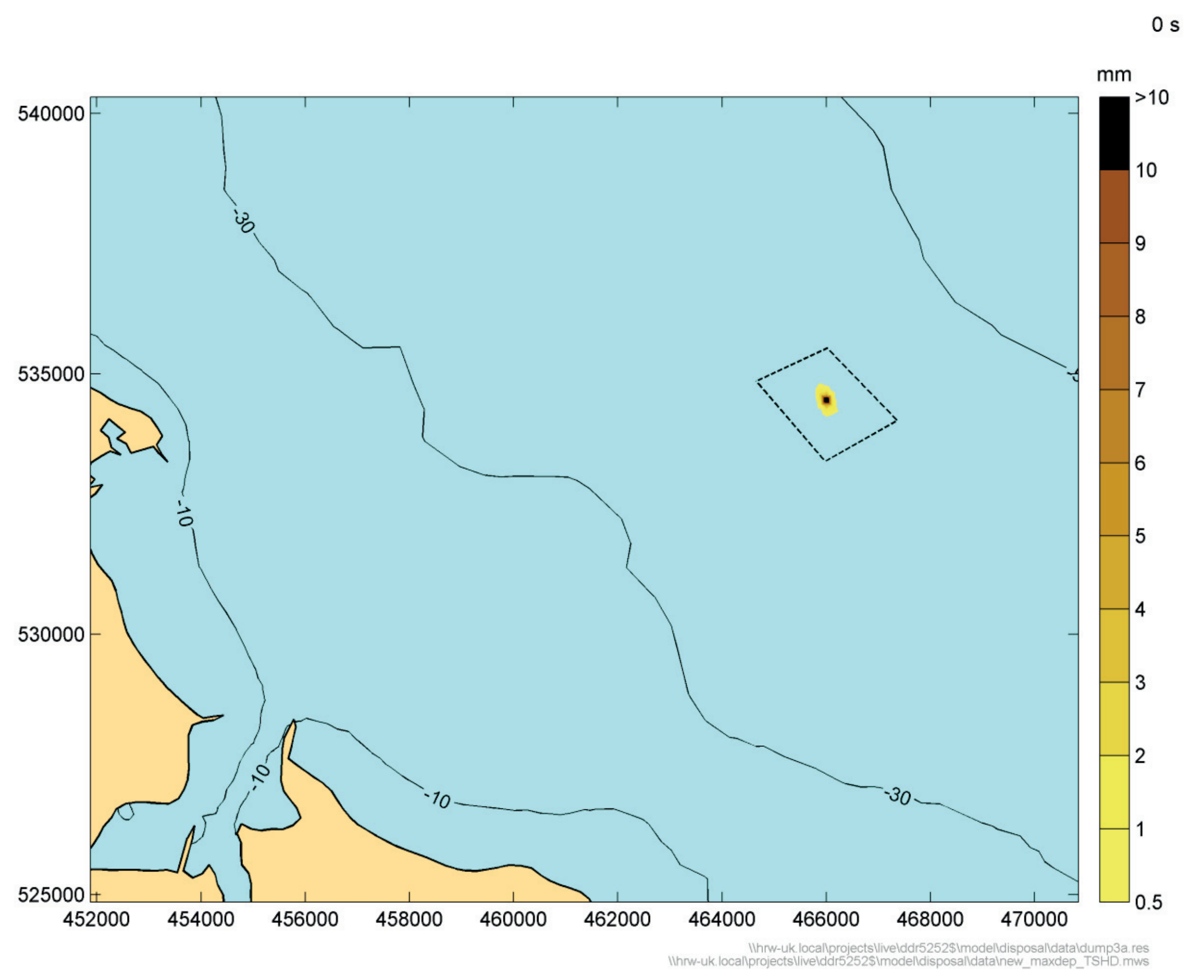


22.2.9 **Figure 22-2** shows the maximum depth of sediment deposition from the fine sediment released during the dynamic plume phase of the disposal operation. Deposition is predicted to be entirely within the disposal site. In the longer term, this material would be expected to be dispersed, along with the other sediment at the site. Note that this maximum deposition may indicate either a temporary deposit during slack water or an accumulation, although this is immaterial to understanding the potential impact beyond the boundary of the disposal site.

Sand size sediment

22.2.10 The TSHD is calculated to make 32.5 dredge/disposal cycles per week, with 7,850 TDS to be deposited on each cycle. Barges associated with the CSD are calculated to make 44.5 trips per week, with each containing 5,430 TDS. The dredger production model suggested that the load for either dredge plant would comprise approximately 50% sand sized material.

Figure 22-2 Maximum depth of sediment deposition from sediment released during disposal operations



22.2.11 Evidence of sediment dispersion rates from the disposal sites (**Appendix 22.1**) gathered as part of MAFF funded research (HR Wallingford, 1998) suggested a rate of sandy sediment dispersion from the sites of 100-200m^3/tide for calm conditions to more than 1,000m^3/tide for periods of storm waves. The anticipated placement rate for the proposed dredge material disposal is estimated as 80,000m^3/week for either the TSHD or the CSD – equivalent to 5,900m^3/tide. Of this sediment, approximately 50% (2,950m^3/tide) would be sandy material. This is a significantly higher input rate than the observed rate of sediment dispersion. Consequently, it would be expected that most of the sandy sized material placed initially would be retained at the disposal site and an observable change in bed conditions would occur, particularly over periods of low wave activity. In the medium term, the known dispersive nature of the disposal site would remove the sediment, although at a lower rate than stated above for calm and during period of storm waves, driven by tide and wave forces.

Coarser size sediment

22.2.12 It is anticipated that 30-40% of the material to be disposed would be of coarser grain sizes, greater than 1mm. Considering the typically low tidal current speeds found at the disposal site, it is expected that this coarser material is likely to be generally immobile and, therefore, would remain within the disposal site. Storm waves may bring this material into near-bed suspension, but the low tidal current speeds would not transport this material type away from the site.

22.2.13 Clay and mudstone that may be deposited as lumps of material, would very gradually erode over time.

22.3 Predicted effects

22.3.1 The disposal of material offshore has the potential to have an influence on the following environmental topics:

- Fish populations and fisheries.
- Benthic ecology.
- Commercial navigation.

22.3.2 It does not have the potential to have a significant influence on any other topics areas. Hence the above topics only are considered below.

Implications on fish populations and fisheries

22.3.3 The assessment of the dispersion of fine sediment from the Tees Bay C disposal site (**Section 22.2**) shows that there would be a minimal effect on water quality beyond the boundary of the disposal site. The peak increase in fine sediment concentration represents a precautionary assessment, and the effect on water quality would be of a low magnitude and temporary.

22.3.4 It is predicted that there would be a short term accumulation of sand on the seabed at the disposal site, with a longer term accumulation of coarser sediments. The sand would, over time, disperse away from the site and would be worked into the seabed.

22.3.5 Overall, it is concluded that there would be **no significant impact** on fish and fisheries interests as a result of the offshore disposal of dredged material and no mitigation measures are considered to be required.

Implications for benthic ecology

22.3.6 In 2010 CEFAS undertook the 'SLAB5' dredged material disposal site sampling survey at a number of disposal grounds around England and Wales, including Tees Bay C (Bolam *et al*., 2011). The study concluded that the macrofaunal communities within the disposal site appear to be altered (relative to those outside), but that disposal activity has not had significant impacts on either the total number of taxa per grab or the total number of individuals (Bolam *et al*., 2011).

22.3.7 The proposed disposal of dredged material at the site would be significantly greater than the rate of input of material to this site over recent years. Hence the disposal would be expected to result in an impact on the benthic ecology (smothering) at the disposal ground due to the predicted accumulation of material on the seabed (in particular coarser sands, gravel, clay and mudstone).

22.3.8 The short term impact of the disposal would be expected to smother the seabed within the footprint of the deposited sediment. Any impact, however, would be confined to within the boundaries of the disposal site, and any longer term erosion and dispersion of material from the site would not be expected to have a detectable effect on the seabed outside of the disposal site.

22.3.9 Overall, the potential impact would be of **negligible** significance given that impact on marine ecology would be confined to the disposal area (an area designated for the disposal of dredged material). However, there would be a loss of the benthic community within the footprint of the material that would accumulate on the seabed. Areas of sand and gravel deposition would be expected to recolonise over time; however, clay and mudstone deposited at the site would not be expected to become significantly colonised with infauna due to the nature of the sediment.

Implications for commercial navigation

22.3.10 During the disposal operation, the TSHD or disposal barges would transport dredged material from the dredge area to the Tees Bay C disposal site. Consequently, there is potential for conflict with other vessels using the navigation channel.

22.3.11 The potential impact of dredging activity has been assessed as part of the assessment of the impact of the construction works as a whole on commercial navigation, as reported in **Section 16**, and mitigation measures proposed. The disposal operations are linked to the dredging task and would require regular movements of dredging plant between the dredge site and the disposal site, via the navigation channel. The numbers of vessels transiting through the channel at any one time would be low (i.e. a TSHD or barge), and **no significant impact** is predicted as a consequence. The management measures described in **Section 16.5** apply to all construction activity and, therefore, would encompass vessel movements associated with the disposal of dredged material.