

26 HYDRODYNAMIC AND SEDIMENTARY REGIME

26.1 EXISTING ENVIRONMENT

1. Flow modelling by HR Wallingford has shown that the tides at the proposed Inner Gabbard (East) capital disposal ground are very similar to those at the existing Inner Gabbard dispersive site. The tidal range is about 3.1m on mean spring tides and 2m on mean neap tides, with the flow direction predominantly NNE/SSW. A comparison of spring tide currents at the two sites is shown in Figure 26.1.1. The flows are very similar, with peaks at the Inner Gabbard (East) site only very slightly less than at the Inner Gabbard site. These flows are about 1.2m/s (2.4 knots) on mean spring tides and 0.75m/s (1.5 knots) on mean neap tides.

2. Bed levels at the Inner Gabbard (East) site are in the order of 55m below CD, which is about 20m deeper than that at the existing dispersion site at Inner Gabbard. The bed sediments (see Section 22.1.2 below) are mixed and contain all material types from cobbles through to silt and clay. In 55m water depths these would, on the whole, be relatively immobile under most conditions. The net direction of sand transport is generally to the north-east, although the evidence is that there is relatively little mobile sand in the area.

26.2 POTENTIAL IMPACTS DURING THE DISPOSAL PHASE

1. The influence of the disposal of dredged material on the hydrodynamic regime, and consequently sediment movement, would fully take effect on completion of the disposal phase. These effects are, therefore, discussed in Section 26.3 (post-disposal). However, during the disposal phase some of the non-cohesive fine-grained material would disperse; this dispersion has been modelled by HR Wallingford and the findings are presented below.

26.2.1 Details of the dredged material

1. The capital dredging required for the Felixstowe South Reconfiguration is estimated to be of the order of 3.86Mm³ and will occur over a period of about 18 months (see Section 3.1.3). The dredged material would comprise mud, sands, stiff clay, gravels and rock with most of the material disposed of being stiff clay. The mud would be dispersed at the existing Inner Gabbard maintenance disposal site. It is proposed that the clay would be placed at the Inner Gabbard (East) disposal site. There would be a substantial amount of sand and some rock pieces which would also be placed at Inner Gabbard (East). Any gravels will be used in the reclamation operations.

2. The total volumes to be placed at the site are summarised below in Table 26.2.1.

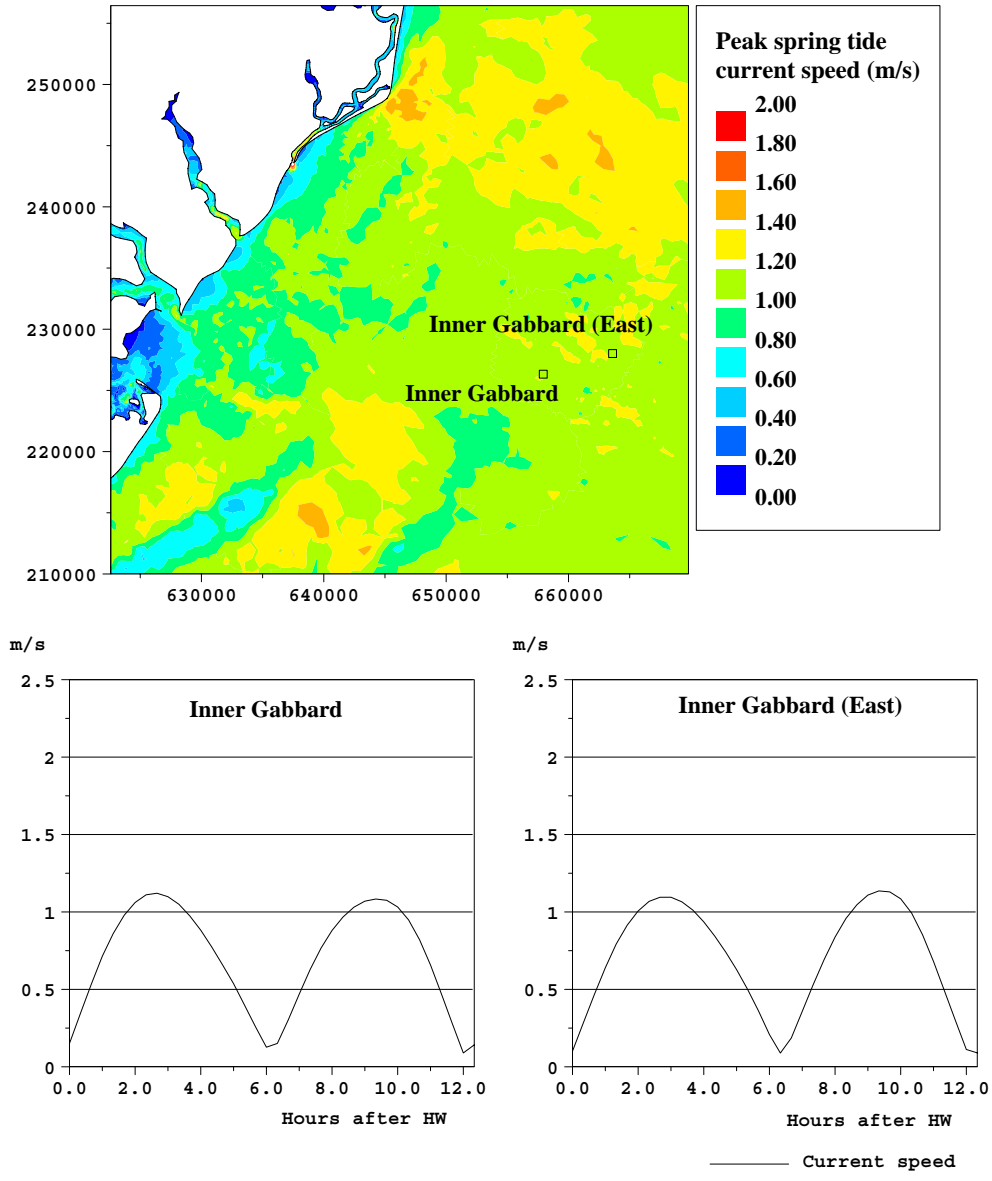


Figure 26.1.1 Comparison of spring tide current speeds at the Inner Gabbard and Inner Gabbard (East)

Table 26.2.1 Total amount of material to be disposed of as a result of the proposed scheme

Dredging Method	Material	Volume placed (m ³)		
			Inner Gabbard (East)	Reclamation
Trailer	Mud	140,000	-	-
	Sand and gravel	-	-	760,000
Mechanical dredging	Sand (with some gravels)	-	170,000	-
	Stiff clay	-	2,590,000	-
	Rock	-	110,000	-
	Gravel	-	90,000	-
TOTAL		140,000	2,960,000	760,000

3. The material placed at the Inner Gabbard (East) disposal site would mostly be placed using barges in 1200m³ loads. The sand arises in lenses within the clay and so placement would consist of mixtures of clay and sand. To a lesser extent rock and debris would also form part of the mixture. The process of placement would (predominantly) result in a layer of clay lumps overlain with sand.

4. In this section the potential impacts of the following effects arising from the capital disposal associated with the Felixstowe South Reconfiguration are examined:

- Impact of dispersion of placed clay from Inner Gabbard (East);
- Impact of dispersion of placed sand from Inner Gabbard (East); and,
- Impact of dispersion of placed silt from Inner Gabbard (East).

26.2.2 Dispersion of capital dredged clay from Inner Gabbard (East)

1. After consultation with CEFAS and representatives of the fishing industry, the Inner Gabbard (East) disposal site was proposed as the most suitable disposal ground for clay. HR Wallingford has previously studied the potential impact of the dispersion of placed clay at the Inner Gabbard (East) site. The short summary provided in this section seeks to outline the main results of these studies and to outline the consequences of the results of the studies for the proposed disposal operations for the Felixstowe South Reconfiguration.

2. The placement of up to 6000m³ of clay has been tested for the Inner Gabbard (East) using bottom dumping. The placements would occur on a cycle time of approximately 5½ hours. The Felixstowe South Reconfiguration dredging would entail smaller placements of up to 1200m³ of clay every 3 hours, using bottom dumping from barges. Because of the lower rate of placement any impact on background concentrations arising as a result of the Felixstowe South disposal is likely to be significantly less than that arising in the modelled scenario.

3. Numerical modelling was undertaken using the SEDPLUME plume dispersion model developed by HR Wallingford. The dispersion model used hydrodynamic results from a regional model of the Outer Thames. The dispersion studies assumed

5% of the placed sediment was released into the water column as fine material with the remaining sediment impacting and depositing on the bed.

4. The results of the dispersion studies indicate that the release of fine sediment into the water column would cause increases in depth-averaged suspended sediment concentration which increase up to up to 15mg/l on spring tides and up to 25mg/l on neap tides. The peak increases in concentration resulting from capital disposal are shown in Figures 26.1.2 and 26.1.3 for spring tides and neap tides, respectively.

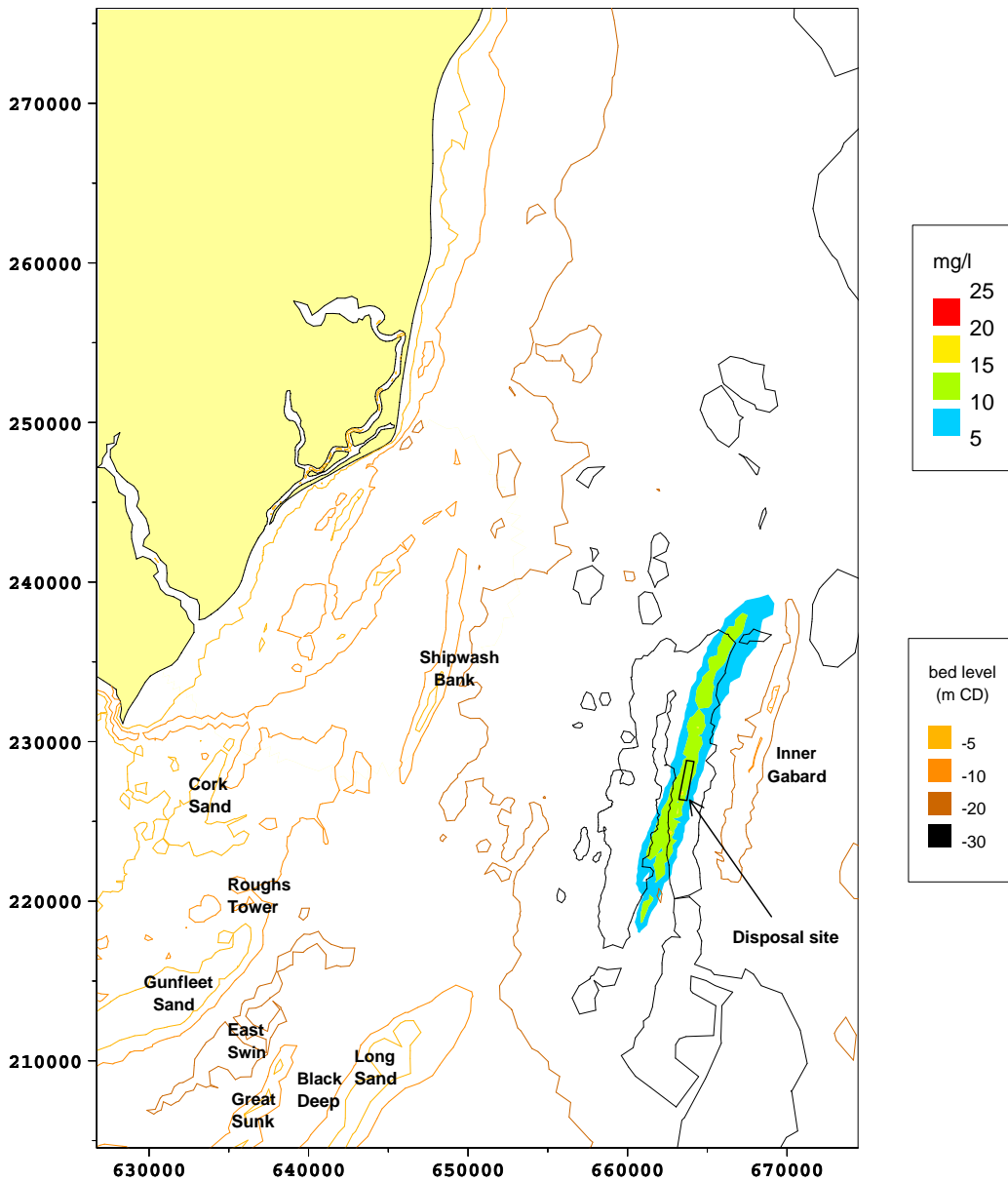


Figure 26.1.2 Predicted peak increases in depth-averaged concentration above background arising from disposal of clay on spring tides

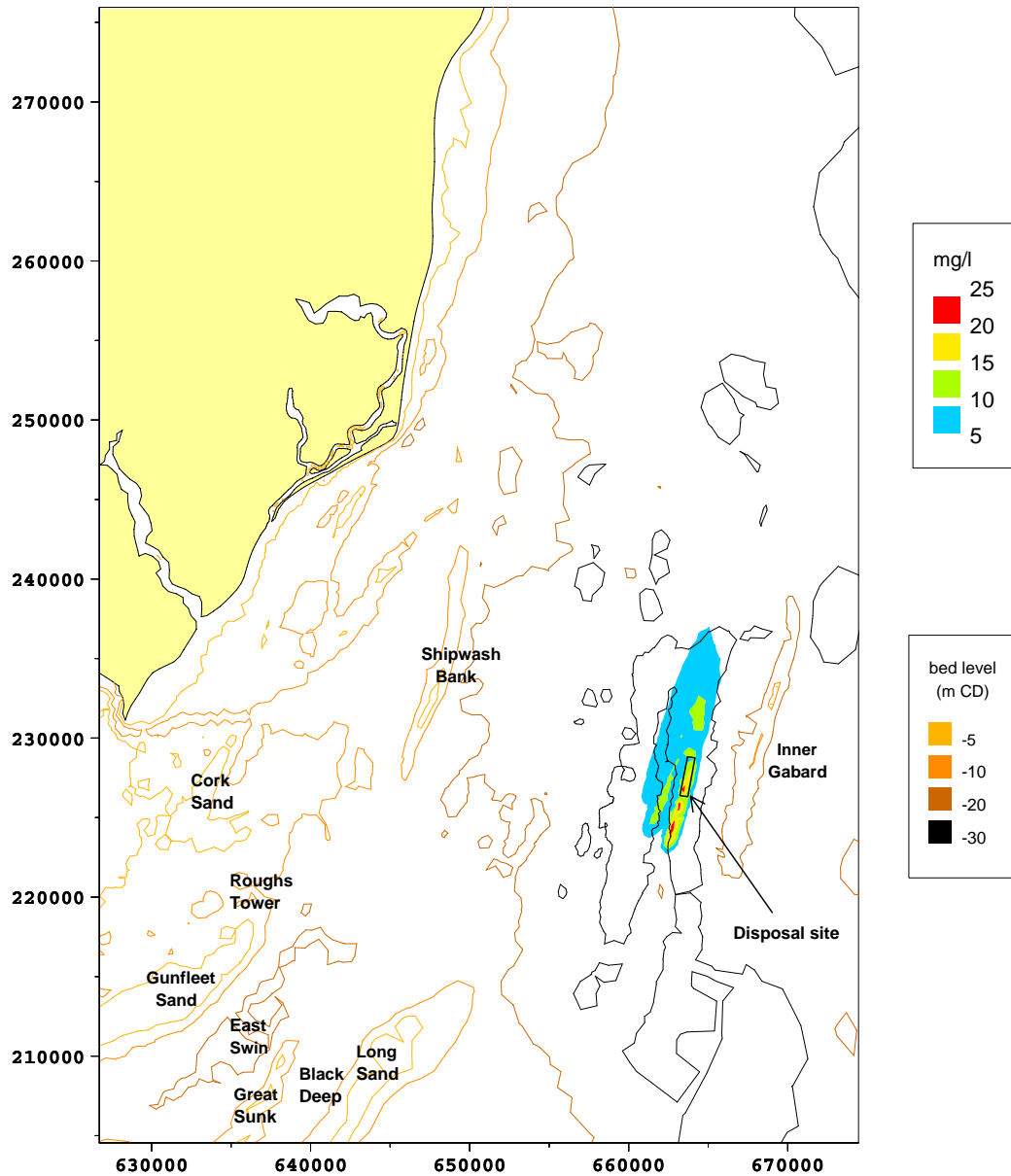


Figure 26.1.3 Predicted peak increases in depth-averaged concentration above background arising from disposal of clay on neap tides

5. Increases in depth-averaged suspended sediment concentration above background of more than 10mg/l are predicted to last for less than 1 hour on every tide. This is illustrated in Figure 26.1.4 which shows the time series of concentration increases at locations (on the streamline of the plume) to the north and south of the disposal site for spring and neap tide releases.

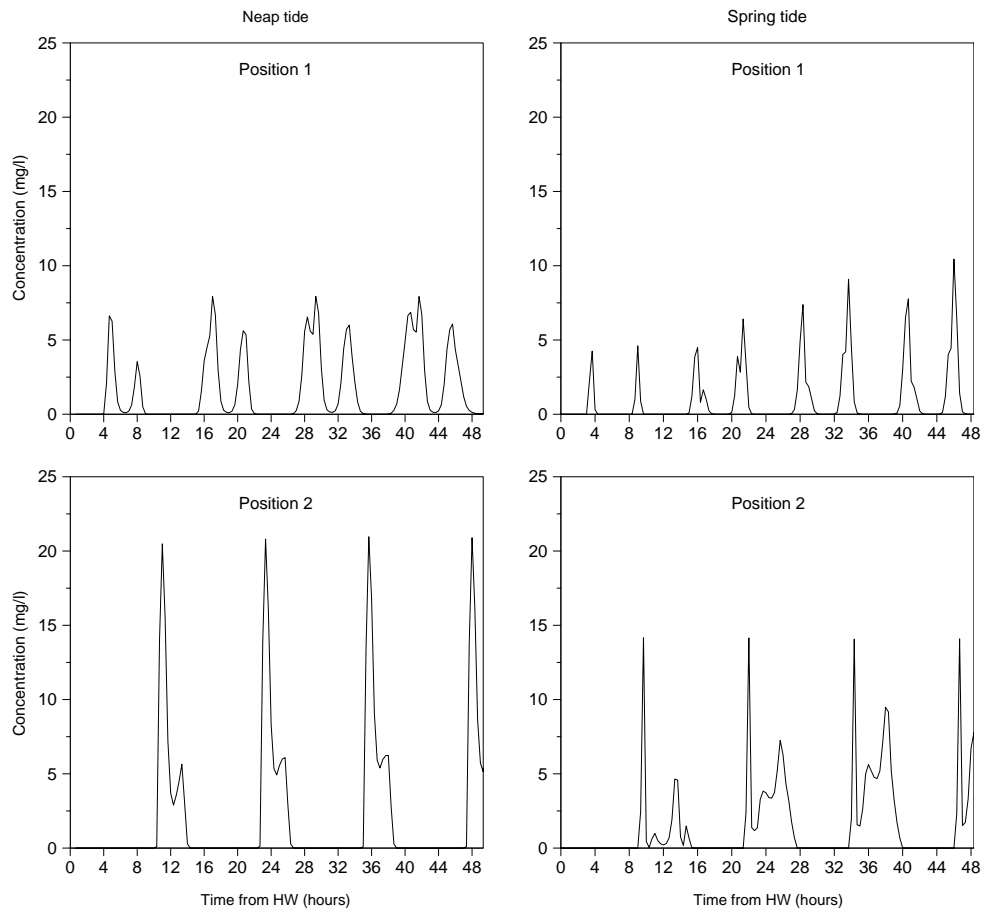
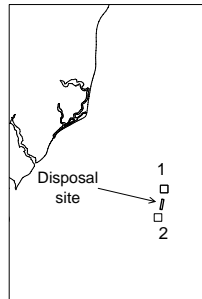


Figure 26.1.4 Time series of increases in depth-averaged concentration above background arising from disposal of clay on spring and neap tides

6. The results of the dispersion studies indicate that the release of fine sediment into the water column would not lead to permanent deposition (other than the placed material at the disposal site). The tidal currents existing in the area are sufficient to resuspend any fine sediment settling on the bed. The exception to this may be in areas of local irregular bathymetry where deposition of sediment occurs at present. Temporary deposition of fine material at slack water arising from these operations is predicted to be a fraction of a millimetre. This is illustrated in Figure 26.1.5 which shows the time series of sediment deposition at locations (on the streamline of the plume) to the north and south of the disposal site for spring and neap tide releases.

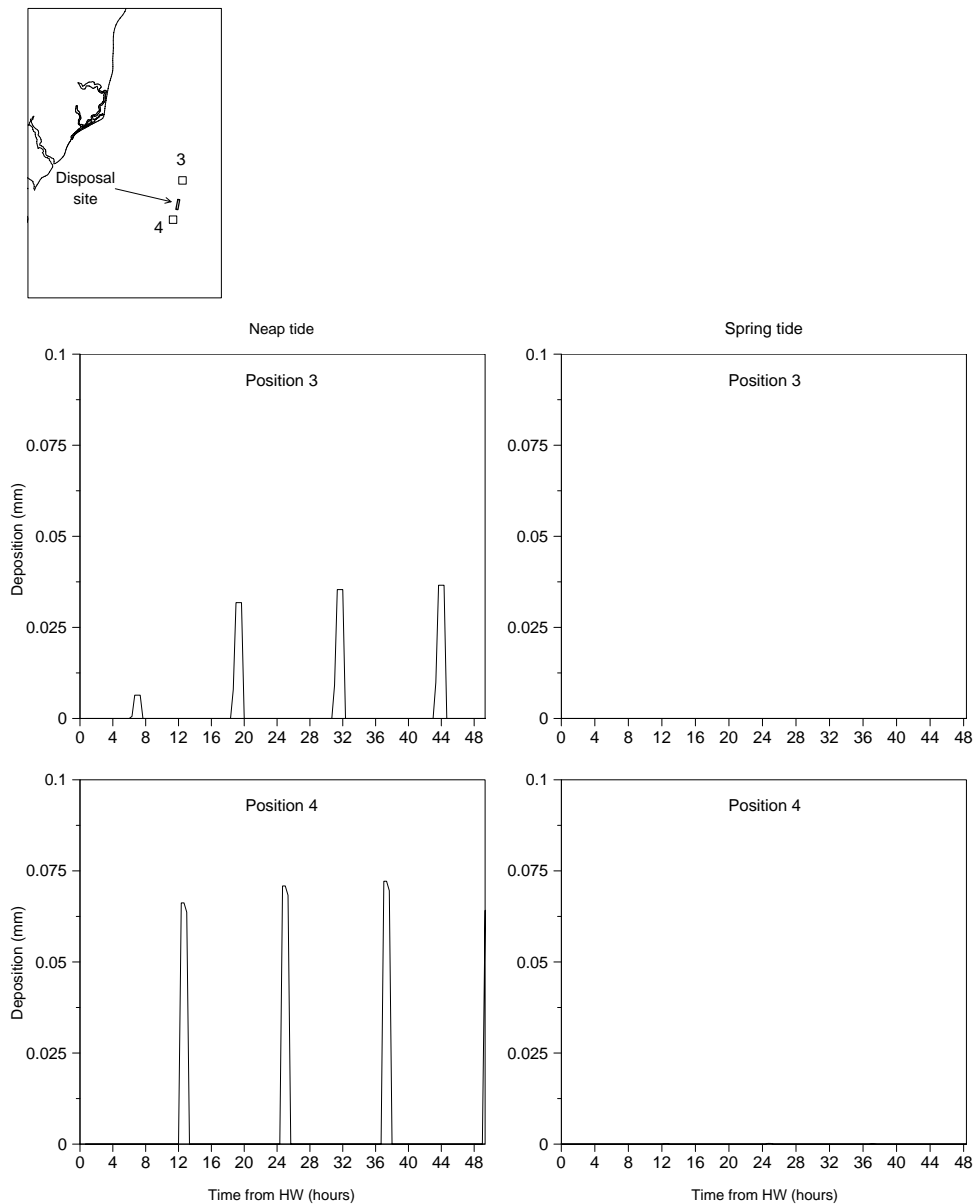


Figure 26.1.5 Time series of deposition of fine sediment arising from disposal of clay on spring and neap tides

7. The plumes from the maintenance disposal at the Inner Gabbard disposal site and the capital disposal at Inner Gabbard (East) would not interact to any significant degree.

8. The potential impact of the longer-term release of fine sediment on suspended sediment concentrations has also been investigated. It has been estimated by the HHA (*pers. comm.*) that the placed clay would erode at a rate of 0.2m/yr. On this basis it was predicted that the increases in suspended sediment concentrations caused by resuspension of the placed clay would be insignificant.

26.2.3 Dispersion of capital placed sand from Inner Gabbard (East)

1. HR Wallingford also undertook studies to identify the effect of placement of sand at the Inner Gabbard (East) site. The short summary provided in this section seeks to outline the main results of these studies. Full details of the studies undertaken are provided in Supporting Document 1-4.

2. The aim is to retain sand within the placement at Inner Gabbard (East) rather than to enhance its dispersion. This is to avoid potential impacts on licensed dredging areas and ecologically sensitive areas outside of the disposal site but also, by placing a mixture of sediment types, to create a more diverse habitat within the site itself.

3. The process of placement would (predominantly) result in a layer of clay lumps overlain with sand. Although the presence of these lumps would shelter the overlying sand particles there would be an associated increase in turbulence that would tend to offset any sheltering effect. Sand, therefore, therefore be expected to disperse rapidly from the site as long as it is not trapped by overlying placement of clay.

4. In order to minimise the dispersion of sand, a series of placements should be made at the same location, creating localised mounds of clay/sand (and to a lesser extent rock) a few metres high.

5. The sediment dispersed from the disposal area would be in suspension, although primarily in the bottom few metres of the water column. This means that the material would be widely dispersed and on depositing at slack water would form a thin layer of sand over a wide area before being resuspended on the next tide. The depth of (temporary) accretion occurring at slack water would be a fraction of a millimetre and would not, therefore, cause smothering of the surrounding seabed.

6. The rapid nature of the dispersion of placed sand would remain throughout the operations.

7. It is also proposed that gravel would be disposed of at the Inner Gabbard (East) site. This would arise as a matrix with the stiff clay and during the dredging of some of the sand. This gravel would not disperse at the site but would be relatively immobile and would remain within the disposal site. The implications of this for marine ecology is addressed in Section 27.3.3.

26.2.4 Dispersion of capital silts/muds at the Inner Gabbard

1. The dispersion of silt at the Inner Gabbard disposal site is currently practised by the HHA for the disposal of maintenance dredged silt material arising from 4 or 5 campaigns annually. The annual disposal of silts currently amounts to roughly 2Mm³ annually and no adverse impacts have been reported as a result of this practice.
2. In order for the 'capital' silts to behave in a dispersive manner when disposed at the Inner Gabbard, it is proposed to mechanically disaggregate the material. This method has been adopted for the disposal of material associated with the Trinity III Terminal (Phase 2) Extension. A review of the bathymetric data from the post-disposal monitoring of the Inner Gabbard is currently being undertaken; however, on first inspection of the data it appears that the site may have accumulated some material. The nature of the material and the degree of accumulation will be fully investigated during the review of the monitoring data. During the dredging, it was noted that a significant quantity of shell was dredged and it may be that this material has accumulated at the site (HHA, *pers. comm.*).
3. Until the data from the Trinity III Terminal (Phase 2) Extension monitoring programme has been fully reviewed (and, therefore, it is possible to determine the nature of the accumulation) it is assumed that the disaggregation of capital silt is an appropriate method for the dispersive disposal and that the (possible) accumulation at the site was due to the 'chance' dredging of an area of denser material.
4. The disposal of an extra 140,000m³ of silts arising from the capital dredging associated with the Felixstowe South Reconfiguration, over the period of one year, would therefore be expected to have a negligible impact. Should the review of the Trinity III Terminal Extension disposal monitoring data reveal another outcome (such as the accumulation of muds) consideration will be given to the placement of the capital muds at the Inner Gabbard (East).

26.3 POTENTIAL IMPACTS DURING THE POST-DISPOSAL PHASE

26.3.1 Effect of capital placement at the Inner Gabbard (East) upon tidal currents

1. HR Wallingford have previously undertaken studies to identify the potential impact of the disposal of placed clay at the Inner Gabbard site. The short summary provided in this section seeks to outline the main results of these studies and to outline the consequences of the results for the proposed disposal operations associated with the Felixstowe South Reconfiguration.
2. The studies were undertaken (at the request of CEFAS) based on the conservative assumption that, in time, other capital placements might be made at the site. The scenario investigated was for a much larger overall placement of 40Mm³ with mounds up to 8m high and a footprint over an area 2.5km by 2km. Any impacts resulting from this (series of) placement(s), therefore, would be many times smaller for the proposed Felixstowe South capital disposal (around 2.5Mm³).
3. The studies found that the impact of the placement of 40Mm³ on tidal currents was negligible outside of the proposed capital placement area. As the placement

arising from the dredging for the Felixstowe South Reconfiguration would be smaller than that modelled, it can be assumed that this would be true for this placement also.

26.3.2 Effect of capital placement upon wave propagation

1. The studies found that the water depths at the Inner Gabbard (of the order of 30m) were too deep to produce any changes in the way waves are refracted in the vicinity of the site or to produce changes in the dissipation of wave energy through friction in the vicinity of the site. As this is true of the water depths at Inner Gabbard, it would apply more strongly to the greater water depths (approximately 50m) of Inner Gabbard (East).

26.3.3 Effect of capital placement on bedload sediment transport

1. The studies concluded that the placement of clay would effectively block the net movement of any local bedload transport, but that there is little bedload sediment transport through the area of the Inner Gabbard site. Therefore, any resulting local accretion would be minimal, as would any change to sand transport in the streamline of the placement. This conclusion also applies to the Inner Gabbard (East) site.

26.3.4 Effect of capital placement upon plumes resulting from the dispersion of maintenance material

1. The modelling for the Inner Gabbard disposal site considered the effects of the placement of capital material on the dispersion of fine maintenance material. The disposal of maintenance dredgings at the Inner Gabbard (East) site is not proposed and, consequently, this aspect does not apply.