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Our Ref: P4762

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For the attention of Mr R Langman / Dr I Selby

Dear Sirs

CONCERNS ABOUT EFFECTS ON THE COASTLINE OF FURTHER DREDGING IN AREA 202, OFF GREAT YARMOUTH

We have now reviewed the consultation responses that have been received regarding the proposed continuation of dredging in Area 202 subsequent to the "Five Year Review" of the monitoring data collected for that Area and the adjacent Area 436. As agreed, we have concentrated on those letters that raised specific concerns about the effects of the dredging in this Area on the coastline and/or on other "physical" effects, i.e. related to changes in waves, tides, sediment transport or the morphology of the seabed, particularly the sandbanks just inshore of the dredging areas.

A number of the letters from consultees have expressed strong concerns about problems of erosion along the coastline of Norfolk, and the possible effects of offshore aggregate dredging in this context. There is a degree of consistency in the letters received on this topic, with several organisations or individuals raising similar issues. We have therefore arranged our response to the concerns raised regarding coastal impacts by considering each topic in turn, rather than by addressing each letter, to avoid repetition of text. The following table summarises the concerns, and shows which organisations/ individuals have raised them.

Issue of concern	Raised by
Proximity of dredging area to coastline	Marinet, SCEG, CCAG
Destruction of roots on seabed	Marinet
Deposition of silt on beaches	Marinet, SCEG
Monitoring of dredge impacts	WDC
Draw-down of beaches	Marinet, SCEG, CESG, Mr R Chenery
Lowering of the crests of sandbanks	Marinet, SCEG, CCAG
Excessive seabed lowering	Marinet, WDC
Dredged areas infilling with beach sand	Marinet, SCEG

Key: SCEG - Scratby Coastal Erosion Group; CCAG - Coastal Concern Action Group;
WDC - Waveney District Council

These topics are now addressed in turn, making reference where necessary to past reports, for example Coastal Impact Studies produced in connection with previous applications for dredging off Great Yarmouth.



Proximity of dredging area to coastline

Some confusion has arisen regarding the offshore distance of Areas 436 and 202. However the distance stated by the Environmental Statement (Marine Ecological Surveys Limited, 2005) and HR Wallingford report EX 5252 (2005) of 7-9 km from the nearest coastline (Great Yarmouth) to the landwards boundary of Area 202 is correct. The 4.7 km quoted by Marinet is inaccurate, and may have resulted from the conversion of the distance offshore, about 7.5km at closest, to miles (about 4.7 miles).

Destruction of roots on seabed promotes erosion

Concerns have been raised over the possible destruction by the dredger of plant roots which stabilise the seabed by trapping and anchoring sediment thereby restricting erosion. However in the licensed dredging Areas 436 and 202, there is no significant amount of seabed vegetation present. We have not had any reports of vegetation being found in cargoes. If there were, the quality of the aggregate would be significantly decreased and therefore hence require expensive and time-consuming sorting operations before being marketable.

NB With reference to the above, issue, we have received the following explanatory note from Marine Ecological Surveys Limited, which may be helpful.

“Some plants with roots such as sea-grasses can occur in very shallow sea water provided the water is clear. However, no sea-grasses would occur offshore or at the depths of the licence area. Other marine plants can occur at those depths but these are marine algae that are characterised by an absence of any rooting system. They attach to solid substrata such as cobbles and again are confined to waters where there is sufficient light for photosynthesis to occur. Conditions at the dredge site are unsuitable either for the attachment of algae or for photosynthesis because of the natural turbidity of the water. No algae or other plants have been recorded on the seabed in the survey area; neither would they be expected bearing in mind the environmental conditions at the site”.

Deposition of silt on beaches

The amount of “silt” present on sand beaches along this coastline varies over time, but predominantly this fine-grained sediment arises as a consequence of erosion of the glacial till cliffs. Such sediments are rapidly dispersed by the action of breaking waves and tidal currents, carried away from the beaches in suspension in the water column and travelling great distances before finally settling in much calmer areas, for example the deep seabed well seawards of the dredging areas being considered here.

Rather than destabilising sand beaches, such fine-grained sediments are cohesive and can, in sheltered conditions, result in beaches turning from sand to saltmarsh, for example in the Ribble Estuary. There is only a minute quantity of such fine-grained sediment present in the sediments that are dredged from Areas 436 and 202, and when disturbed by the extraction process this will tend to preferentially travel offshore rather than towards the shore. We conclude that the presence of silt on beaches along the coastline is more likely to be related to the continuing erosion of unprotected cliffs than to offshore dredging.



Monitoring of dredging areas and impacts

It is our understanding that if the licence renewal is approved, there will be a requirement for continued monitoring under the same terms as the present licence. This monitoring has proved very useful in checking on the effects of the past extraction from Areas 202 and 436, as summarised in HR Wallingford report EX 5252 (2005).

Draw-down of beaches as a result of dredging operations

Marinet claim in their letter that draw-down of beaches on the Norfolk coastline adjacent to Area 202 is a common concern with erosion rates of between 2 and 16 times that of the 1970s mean Norfolk erosion rate of 0.9 m per annum, i.e. rates of 1.8m to 14.4m per annum.

They go on to claim that this beach "draw-down" has been associated with dredging activities, including at Area 202 and further that it has increased significantly since the initiation of dredging operations, with many properties and infrastructure lost to the sea.

There is an apparent but unfortunate confusion here between the specific term "draw-down" meaning the transport of sand seawards from a beach to infill a depression on the seabed and the more general term "erosion", i.e. a measure of the landward retreat of the beach or cliffs. Beach "draw down" can be expected when dredging takes place at depths shallower than the underwater limit of a beach profile, typically estimated as about 7m below Mean Sea Level along this coastline (Halcrow, 1991).

The more general erosion of beaches, on this coastline often leading to recession of the soft cliffs to landward, is more commonly caused by differences in the sediment transport along a coastline than by offshore losses of sediment. It is, in our opinion, entirely misleading and fallacious to equate erosion with draw-down as implied in the letter from Marinet.

An assessment of the likelihood of beach draw-down can be made by consideration of the mobile offshore sandbanks between Area 202 and the Norfolk coastline – namely Cross Sands and Scroby Sands. In reviewing the monitoring data associated with past dredging in Area 436 and 202, see HR Wallingford report EX 5252 (2005), it can be seen that there had been some intensive dredging in the central and southern parts of Area 436, very close to the toe of the seaward slope of the Cross Sand sandbank. Despite this, there is no evidence of those dredged depressions having been infilled as a result of "slumping" of that steep flank of the sandbank. If these dredged depressions are not infilled by "draw-down" from the sandbank, it is surely much less conceivable that sand from the beaches some 7.5km away could have been induced to travel across deep channels and over the crests of intervening sandbanks to infill those depressions. Given, further, than the dredged depressions have largely remained unfilled, there is, in our view, absolutely no evidence to suggest that dredging in Areas 436 and 202 has contributed to coastal erosion by causing beach draw-down.

We do not disagree with the rates of erosion that Marinet quote, but refute their assertion that erosion is occurring "adjacent" to Areas 436 and 202. The beaches nearest these two dredging areas are actually very healthy and were accumulating sediment in early 2005 prior to the writing of HR Wallingford report EX 5252. The most rapid erosion rates quoted by Marinet are, we understand, occurring much further north, at Happisburgh, and are the result of the failure and removal of coastal defences exposing soft cliffs to direct wave action.



Lowering of the crests of sandbanks

An examination of the changing morphology of the sandbanks was undertaken in HR Wallingford report EX5252 (2005) by analysis of the annual bathymetric surveys commissioned by the dredging company as part of the required monitoring in the extraction licence for these two areas. It has always been recognised that preserving the crest levels of these banks is important since they act as a natural breakwater for the soft coastline further landwards. The interpretation of changes in the sandbanks is complicated by their natural variability; the positions and levels on the crests of these banks, and the depths and positions of the channels in between, have constantly altered over many hundreds of years, requiring constant adjustments to navigation routes into and out of the Port of Great Yarmouth.

Comparison of the 1999 and 2005 bathymetry does not suggest either lowering of the crest level of Cross Sands, or a flattening of the gradient of the seaward face of the bank. Indeed, the area immediately to the west of Area 436 was shown to have accreted by up to 10m over that period.

Further north, the channel between Cross Sand and East Cross Sand has gradually moved to the north-east and deepened. The southern end of East Cross Sand has apparently retreated northwards while Cross Sand itself has become wider and higher just landwards of the two extraction areas. These changes are part of a natural pattern of the movement of the banks and channels, in our view, rather than being related to the offshore dredging.

Excessive seabed lowering

Waveney District Council have raised a specific concern regarding the maximum depth of seabed lowering in Areas 202 and 436 caused by the dredging, noting that this has reached about 5m in places. We have considered this point carefully, not least because the original Coastal Impact Study envisaged a maximum seabed lowering of 2.5m. It should be noted however, that even if the licence is extended in time, as requested by the dredging company, the amounts of aggregate removed would still be substantially less in total than envisaged in that Coastal Impact Study.

In the northern parts of Areas 202 and 436, and to the west and further north outside these two areas, the natural morphological processes leading to the migration of the banks and intervening channels has produced changes in seabed levels at least as great as those caused by dredging. From a practical viewpoint, therefore, it would be difficult to determine in these areas whether changes in the seabed levels were due to dredging or to natural variability, and hence make it impracticable to limit the depth of extraction.

More important, however, is the consideration of whether extracting the same volume of sediment from a small area, thus resulting in greater changes in depth, is more or less likely to affect the coastline than dredging to a smaller depth over a larger area. Our view is that the latter strategy is more likely to cause the greatest changes to waves to landward of the dredging area, and this was therefore the assumption made in the original (1994) Coastal Impact Study.



Dredging deeply over a smaller area clearly reduces the range of wave directions that pass over the extraction area on their way to any particular point on the coastline, and the effects of wave diffraction become more important as the size of the dredged area decreases. By extending this argument to an extreme case, if it were possible to extract a specified volume by dredging a very deep hole in an area only a few tens of metres in diameter, there would be no appreciable effect on waves a few hundred metres away because of the effects of wave diffraction.

The concerns about deep dredging in Areas 436 and 202 would primarily be that this might more significantly affect wave conditions locally, and that this together with the inevitable steeper side-slopes of the dredged depression might cause an adverse effect on the sandbanks just to landward of the dredging area. The monitoring data commissioned by the dredging companies, however, indicates that even where extraction has lowered the seabed by 5m or so close to Cross Sand, i.e. in the centre of Area 436 close to its eastern edge, the sandbank shows no evidence of "feeling" the effects of this dredging.

In view of the above discussion, the evidence of no adverse effects on the nearby sandbanks and the advantage of reducing the broader environmental effects of dredging by limiting its spatial extent, we do not see any good reason to restrict the depth of extraction within Area 202 if the licence is renewed. We would, however, support the continued monitoring of this Area and the surrounding seabed as presently required.

Dredged areas infilling with beach sand

Several consultees, namely Marinet, SCEG and Mr R Chenery, continue to have concerns that the dredged depressions are either "attracting" sand from the coastline, or preventing sand from further offshore reaching those coastlines, despite the fact that the monitoring data clearly shows dredged depressions in both areas that have not appreciably infilled with sand, nor extended along the tidal flow pathways as one consultee hypothesises.

The assessment undertaken of the changes in Areas 436 and 202, see HR Wallingford report EX 5252 (2005), was made in the context of similar studies of other extraction areas nearby. In particular, HR Wallingford report EX4576 (2002) reviewed the changes in the seabed in Area 254 just offshore of Areas 202 and 436, and showed that the dredged depressions in this Area were also remaining unfilled. This further demonstrates the lack of any movement of sand towards the coastline from offshore.

The evidence that the sandbanks just to landward of Areas 436 and 202 have not reacted to the dredging, and the "buffering" effect of these sandbanks on the coastline well to the landward of those Areas, provide compelling evidence that the extraction could not be expected to have any appreciable effect on the beaches of Norfolk or Suffolk. There is no clear evidence of beach erosion directly to landwards of the extraction areas, or of these areas infilling with sand from landward or seaward. Our conclusion is that while the strong concerns about coastal erosion are genuine and understandable, there is no evidence that past or the proposed future dredging in Areas 436 and 202 is contributing to this erosion.

The above discussion of the concerns of consultees makes reference to a number of reports available in the public domain, and which we believe have been distributed to local authorities in Norfolk and Suffolk.



The reports referred to are:

- HR Wallingford, 1994. "Area 436 Cross Sands Extension: ARC Marine Production Licence Application. Effects of dredging on nearshore wave conditions and sediment mobility off the Suffolk and Norfolk coast", Report EX3102, November 1994.
- HR Wallingford, 2002. "Area 254: Off Great Yarmouth – Application to extend an extraction licence. Coastal Impact Study", Report EX4576, May 2002.
- HR Wallingford, 2005. "Dredging in Area 202, off Great Yarmouth. A five year review", Report EX 5252, December 2005.
- Marine Ecological Surveys Limited, 2005. Government View Application. Area 202:Cross Sands Extension. An Update of the Environmental Statement – 5 years post-dredging. Report for Hanson Aggregates Marine Limited, December 2005. pp 44.
- Sir William Halcrow and Partners, 1991. "The Anglian Sea Defence Management Study - Stage III", Study Report for NRA Anglian Region, April 1991.

We hope that this letter is helpful in the further consideration of the proposed continuation of dredging in Area 202, and perhaps may have allayed some of the fears of the consultees.

Yours faithfully

Dr A H Brampton
Technical Director, HR Wallingford