TECHNICAL REPORT

ABLE UK LTD.

FINALISING ENVIRONMENTAL ASSESSMENT AT THE TERRC FACILITY
ADDENDUM TO DNV REPORT 2004-1387

REPORT NO. 2005-1024

REVISION NO. 02

DET NORSKE VERITAS

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TECHNICAL REPORT

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Summary:
In 2004 Det Norske Veritas conducted a computer modelling study for Able UK Ltd, covering short and long term impacts on hydrodynamic and sediment transport processes in the Tees esturary following proposed developments connected to the TERRC ship recycling facility. The study formed part of an Environmental Impact Assessment carried out by other consultants.

In the EIA process the regulatory agencies and interested parties have been invited to comment on the Environmental Impact Statement presented. The issues raised, relevant to the DNV study, are replied to and clarified in this report.

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1 INTRODUCTION

DNV were contracted in 2004 by Able UK to conduct a study of the effects on hydrodynamic and sediment transport processes, and subsequent effects on spreading of pollutants and impact on wildlife, for their proposed development at the TERRC dry dock. The study was part of an Environmental Impact Assessment and was reported upon in the DNV Report 2004-1387 "Environmental assessment of dredging operations, changes in hydrodynamics and sediment transport; TERRC facility" /1/.

In the process of consultation involving Regulatory bodies and interested parties, a number of comments were received. The main points related to the work carried out by DNV are discussed in this report.

Some of the comments are included in this report to clearly express the commenters' query.

2 SEDIMENT COMPUTER MODELLING AND INTERPRETATION

Prediction of changes in hydrodynamic and sediment transport processes are complex and understandably clarifications are needed for non-technical personnel to be ensured of the methodology and the results obtained. This chapter provides clarifications to the technical reasoning for the modelling and interpretation of results.

2.1 Inherent sediment modelling uncertainties

It is an appreciated fact in the sediment modelling community that the nature of sediment transport modelling makes it difficult to accurately predict specific sediment accretion rates by the use of computer models. The modelling of cohesive sediments is in particular regarded as unpredictable. The uncertainty stems from the underlying principles and sediment transportation equations which are based on processes that are poorly understood.

This limitation is pointed out by scientists and researchers like A. Chadwick and J. Morfett /17/ ("Hydraulics in Civil and Environmental Engineering"), C. Thorne, R. Hey and M. Newson /18/ ("Applied fluvial geomorphology for River Engineering and Management"). HR Wallingford states: "Understanding of sediment transport leads to better predictions of morphology changes in rivers, on beaches, in coastal and estuarine waters. However, whether they are mud, sand, shingle or a mixture, their behaviour is still not well understood" /16/

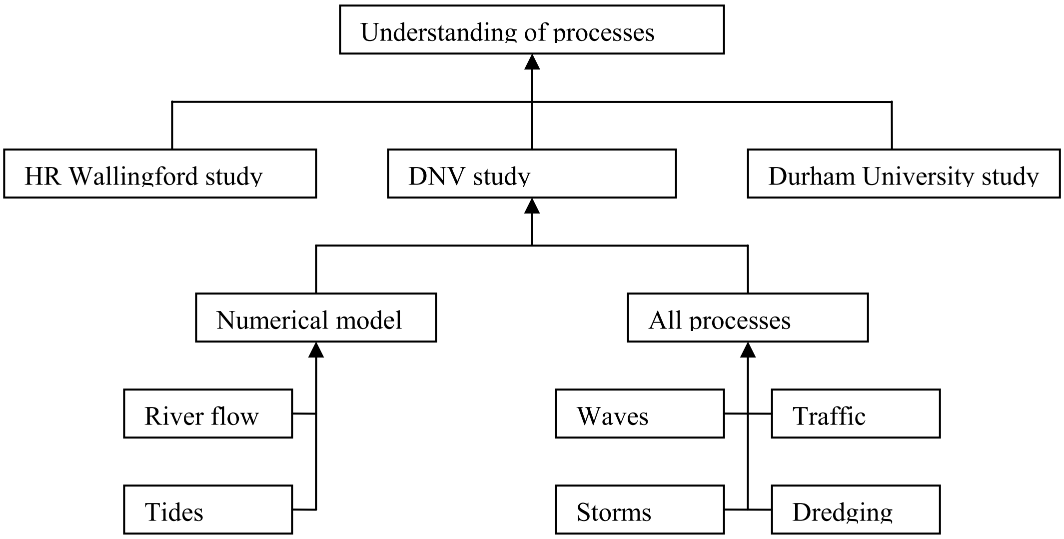
The underlying principles for fluid flow are better defined. More confidence can be placed in the results of the hydrodynamic modelling, such as velocity magnitudes, current directions and shear stresses. DNV Report 2004-1387 Figure 10-1 lists changes in shear stresses as an important parameter to understand the change in erosion and sedimentation for the natural and man-made processes.

2.2 Indicies for understanding the sediment processes

Numerical modelling is one of several indicies for creating an understanding of the basic processes and the changes in these. As defined in the DNV Report 2004-1387 Chapter 10 and

Figure 10-1, the numerical model includes tidal action and river flow only, in order to create an understanding of changes in the basic processes and clarify the relative impacts of each scenario.

Changes due to other more unpredictable natural and manmade processes are included in the discussion in Chapter 10, on the basis of the predicted changes in the hydrodynamic properties such as velocity and shear stress distribution. Introducing all processes including unpredictable events in the computer model would put severe constraints on the stability and applicability of the model. The natural unpredictability in for instance storm events would not aid in clarifying the underlying processes, rather it would mask the processes and preclude an understanding of these.



Indicies for creating an understanding of the estuarine processes

The understanding of the sediment processes in the Teesmouth estuary in general and on Seal Sands and Seaton Channel in particular are supported by findings in studies by Durham University /2/ and HR Wallingford /3/.

2.3 Modelling vs. predictions

An apparent discrepancy has been pointed out between the reported decrease in sediment deposition rates in the DNV Report 2004-1387 Appendix E and Section 10.1, which reads "Seaton Channel, and to a lesser extent Seal Sands, may experience a higher sedimentation rate".

Appendix E contains detailed impacts predicted by the numerical model at seven locations in the Tees estuary.

From Section 5.3 it is seen that the actual modelling results for the clay fraction was dominated by the presence of "false" erosion. Initially, the clay model was effectively lined with clay in all areas, also in areas where clay is not present in reality due to shear stresses in excess of the erosion limit. This "false" erosion was in particular experienced in the narrow areas of Seaton Channel from the Turning circle westwards to Seaton Snook. It also affected certain underwater features caused by various qualities of bathymetry data in some areas.

The subsequent scenarios had a lower channel bed, a higher cross-sectional area, lower velocities and therefore lower shear stresses. The erosion of this “false” clay layer was therefore less in these scenarios, making less clay available in the water column for settling out throughout the entire model. Thus the modelled sedimentation rate is lower for clay in general when the channel is deepened. This effect is seen in the raw data listed in Appendix E.

This fact is taken into consideration when interpreting the modelling results, and it is one of the reasons why DNV does not recommend to base the prediction of impacts on the modelling alone.

The basic effect of the changes in the estuary can be summed up as follows: When the dry dock is closed off, tidal volumes decrease. The whole bay becomes calmer, promoting settling of sediments. At the same time the deepening of Seaton Channel will trap the sand, which comes from outside the Tees estuary, before it reaches Seal Sands. The sediments that do reach Seal Sands, ie. the clay, may settle out more easily due to the lower velocities and shear stresses. The decrease in sand deposition and the increase in clay deposition will result in a finer sediment profile, with subsequent positive effect in bird feeding capacity.

The sedimentation rate in Seaton Channel is expected to increase for both sand and clay. The sedimentation rate for Seal Sands is expected to increase for clay only. The sand is expected to be trapped in Seaton Channel, making less sand available for Seal Sands. The statement that “Seaton Channel, and to a lesser extent Seal Sands, may experience a higher sedimentation rate” is poorly worded, in that it should be specified to apply to clay only, with the opposite effect on sand deposition.

In conclusion, “false” erosion was reported by the modelling as listed in Appendix E; when considering this fact in addition to the full range of estuarine processes the net effect on Seal Sands is a lower sand accretion rate, and possibly more clay.

2.4 Clarification of Scenarios

It is confirmed that the numerical model was run with several scenarios, with the Holding Basing dredged to -9.5 in all of them except for the Baseline scenario where the bathymetry recorded in June 2004 was used. The listed scenarios 1-9 in Chapter 4.1.5 should all have included the phrase “and holding basin to -9.5” but this was omitted from most of the text as this was defined as the same situation for all scenarios.

Seaton Channel was dredged to -8.5 in scenarios 2, 4, 6, 8 and 9, and today’s bathymetry was used for Seaton Channel in the other scenarios. The model was set up with all possible combinations of the dock open or closed, with Quays 10 and 11 dredged and with Seaton Channel dredged. In this way any specific effects stemming from each option could be identified and cross checked.

2.5 Impact of realignment of channel

It has been proposed to shift the navigable channel to the north by 8 to 25 m. It is appreciated that this change in bathymetry would have some impact on the predicted processes. It is seen from the multitude of options already explored that the effect from case to case most likely is small. This sideways shift in the channel does not introduce any new underwater features, it does not change the channel depth, the channel dimensions, or the direction of the channel to a great extent.

It will therefore not change the basic tidal and river flow patterns in the channel in such a way as to render the basic understanding of the changes in hydrodynamic and sediment transport processes invalid.

Any changes in the modelled effects will be related to the widening of the north foreshore of Seal Sands towards Seaton Channel, which will have a more gentle slope than the other scenarios, thus increasing the intertidal area and the area of Seal Sands from that modelled. A larger area of Seal Sands may reduce the settling volume per unit area and thus the settling rate.

2.6 Concluding remarks, modelling and interpretation

We do hope and assume that the readers of our report understand the very important point that the numerical model does not predict specific sediment accretion rates, but it gives indicies as to the changes in sedimentation processes. When the modelling results are collated with other indicies one can produce a picture of the processes in the estuary. DNV has high confidence that the deepening of Seaton Channel will increase its sand trapping efficiency and thereby decrease the sand accretion rate on Seal Sands. That is the important change in the processes in the estuary as a result of the proposed development.

It is therefore our conviction, based on our numerical modelling, our understanding of the natural and man-made processes, and referred with other studies, that the sand accretion rate on Seal Sands will decrease following the deepening of Seaton Channel.

3 IMPACT ON BRITISH ENERGY SITE

The following comments from British Energy were found relevant to the DNV study.

The description of the baseline hydrodynamic condition in Chapter 20 of the EIS apparently takes no account whatsoever of the very large scale cooling water flow abstracted by the power station from the Seaton Channel. This abstraction point is immediately adjacent to the proposed developments. The volume involved is 35.5 m^3/s which is significantly in excess of, for example, "relatively high river inflows" of 25 m^2/s.

Appendix 8 which describes the DNV modelling assessment, also apparently takes no account whatsoever of the scale of that abstraction when assembling or validating the hydrodynamic model. Since the sediment transport model is also based on that hydrodynamic model and apparent omission, little trust can be placed in its output. Since the output of these models has direct bearing on the likely implications of this proposal for our own operations, we are most concerned about the likely impact.

The proposed modifications to Able UK frontage and deepening of the navigational channel will lead to an increased scour of the shore fronting the power station enhancing rates of geomorphological change. This may result in an increased rate of drawdown of the shore fronting our site.

Shipping movements will present an additional hazard to our operations, especially if such traffic is unwieldy or involves hazardous materials. Such traffic may increase the levels of solids in suspension locally (this again being entrained by our CW system) and potentially increase erosional rates on our frontage.

Appendix 8.2 paragraph 1.1.7 says that "...The Channel is currently subject to maintenance dredging...". We believe that the Channel is not subject to any maintenance dredging at present.

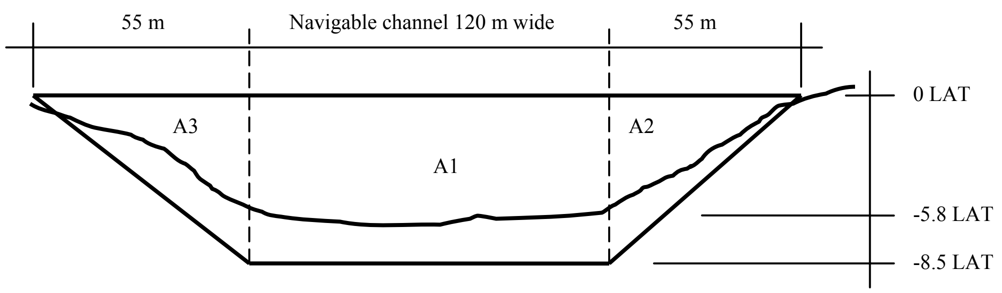
3.1 Modelling

Although the magnitude of the cooling water abstraction was not appreciated at the time of the study, we are confident that the conclusions based on the hydrodynamic and sediment transportation modelling are justified.

As discussed in the DNV Report Chapter 5.3, the computer model was set up with only fluvial and tidal processes to ensure full understanding of the underlying hydrodynamic and sediment transport processes. The other natural and man-made influences such as storms, waves, traffic and dredging were added in the discussion in Chapter 10. This created a comprehensive understanding of the implications of all processes in the estuary.

The findings were supported by other studies carried out by HR Wallingford /3/ and Durham University /2/. These studies describe the observed processes in the estuary and do therefore include the cooling water abstraction.

To put the abstraction into perspective, the net inflow from the 35 m^3/s abstraction is studied. At the most narrow point, at the mouth of Seaton Channel towards the Turning Circle, the channel is 230 m wide at low water, with the middle section 120 m wide and 5.8 m deep. At the sides the channel slopes to 0.



Estimates of channel cross-sectional areas

The cross-sectional area of the channel can therefore be estimated as follows:

$$A_{tot} = A_1 + A_2 + A_3$$

$$A_1 = b \cdot h$$

$$A_2 = A_3 = \frac{b \cdot h}{2}$$

$$A_{tot} = A_1 + 2 \cdot A_2$$

The depth averaged velocity v of Q = 35 m^3/s through the cross sectional area A_{tot} can be estimated as follows:

$$v = \frac{Q}{A_{tot}}$$

Area	**Today's area at h = 5.8 m**	**Future area at h = 8.5 m**
A1	696 m^2	1020 m^2
A2 = A3	160 m^2	234 m^2
Atot	*1016 m^2*	*1488 m^2*
Q	35 m^3/s	35 m^3/s
v	*0.034 m/s*	*0.023 m/s*

A flow of 35 m^3/s produces a depth averaged velocity of 0.034 m/s or 34 mm/s at the narrowest part of the channel as it is today. The corresponding calculations for the new dredged depths of 8.5 m shows a depth averaged velocity of 0.023 m/s or 23 mm/s.

The modelled maximum flows are found to be close to 0.5 m/s at the narrowest point of the channel. The current set up by the abstraction amounts to 6.8% of the natural flow for today's bathymetry, and 4.6% for the new bathymetry.

The significance of this net upstream flow can be discussed. Keeping in mind that the model is used for indicating the relative changes in sediment transport processes, and that indications show low impacts when altering the bathymetry, DNV believes the model results are still valid to provide input to understanding the changes for the sediment regime in the estuary. The net inflow applies to all scenarios modelled, and the relative difference in impact from one scenario to the next will be minimal.

As reflected in the comments received from the Regulators and consultees, the area of most concern is Seal Sands. Any currents created by the abstraction will be confined to the deepwater section of Seaton Channel, thus the omission of this abstraction will not have an effect on currents on Seal Sands.

3.2 Water column sediment concentrations, general effects

With reference to the DNV Report 1 Chapter 5, fig 5-25, the modelling shows little change in water column concentrations for sand, and lower concentrations of clay. This may have a positive effect on the water quality for the cooling water. It is expected, when including other natural processes than tidal and fluvial activities, that Seaton Channel may act as a trap for coarse fractions of sediments, thereby also decreasing the amount of sand reaching the cooling water intake.

The deepening of Seaton Channel will create a larger volume of water for the nuclear plant to draw its cooling water. The upstream current created by the abstraction will have a larger cross sectional area to flow through, and the net velocities will decrease as a result.

3.3 Water column sediment concentrations, dredging

The capital and maintenance dredging operations may produce localised and temporarily increased sediment concentrations in the water column. Fine sediment fractions are found to be more mobile than coarse sediments, which are deposited nearer the dredging site. Please refer to the DNV Report Chapters 5.1.2.1 and 7 for the following.

Data from the Environmental Agency /4/ and Astra Zeneca /5/ show that sediment concentrations on average are in the order of 20 mg/l in Seaton Channel, median values in the order of 10 mg/l. Measured ranges show a standard deviation of 27 mg/l, and maximum values in excess of 300 mg/l. The background sediment concentration is therefore estimated as in the order of 10-20 mg/l with periods when concentrations reach 100's of mg/l.

The dredging modelling shows that backhoe dredging at the base of the proposed bund (DNV Report 2004-1387 fig 7-11) may increase the sediment concentrations at the power station intake by 10-20 mg/l at spring tides. Backhoe dredging at Quays 10 & 11 may increase concentrations at the intake by 10-20 mg/l at neap tides, but up to 100-250 mg/l at spring tides. Dredging of Seaton Channel by the use of hopper dredges creates concentrations of 10-20 mg/l at neap tides, and 10-50 mg/l at spring tides. The simultaneous operation of backhoe and hopper dredges, along Quay 10 and 11 and in the channel, is not found to significantly increase the maximum water column sediment concentrations.

The dredging operations are therefore expected to increase local sediment concentrations appreciably in some cases. The critical dredging operations include dredging of Quays 10 and 11 at spring tides. It is therefore proposed that during spring tides the dredging of Quay 10 & 11 is suspended.

British Energy should be invited to comment on what concentrations of suspended sediments are unacceptable for the safe operation of the nuclear plant. Sediment concentration monitoring may also be suggested.

3.4 Scour

Ref. DNV Report 2004-1387 table 5-3. The extension of Quay 10 and 11 into British Energy land would increase the velocities by 23%, the extension of Quay 10 and 11 only up to the border would decrease the velocities by 25%.

The increase in velocities if Quays 10 and 11 are extended into British Energy land may affect settling of fine fractions, but whether it has any impact by eroding sediments is doubtful. For cohesive sediments there is a "window" between the critical shear stress for deposition and for erosion, and whilst the required water velocity to prevent settling may be low, the velocities to create erosion are far higher, ref DNV Report 2004-1387 Fig. 4-6.

No increased scour is therefore expected, unless Quays 10 and 11 are extended to the immediate vicinity of the intake, in which case mitigating measures such as rock armouring or training walls may have to be considered.

3.5 Ship movements

Until recently, Seaton Channel has been used for navigation, with regular movements of ships, floating out of offshore structures etc. Any negative effects from ship movements should be apparent from experience. The increase in traffic from this proposal is low, with only intermittent towing in of large ships. Any ship movements, including towing operations and berthing along Quays 10 and 11, must adhere to sound navigational practices, in a normal and responsible manner. It must be assumed that the power station cooling water system is robust enough to allow normal traffic in the channel.

4 IMPACT OF DREDGING OPERATIONS ON SEAL SANDS

In general it is referred to the DNV Report 2004-1387 Chapter 7 and to figures 7-1 to 7-20 which show the suspended sediment concentration and deposition for the modelled scenarios i.e. when dredging with a backhoe and hopper dredge in different dredging areas.

The hopper dredge will generate by far the largest suspended sediment concentration and deposition on Seal Sands and especially on spring tide, se figure 7-17 to 7-20 in the DNV report. The hopper dredge will be used when dredging the Seaton Channel. The two figures below show the max suspended sediment concentration and deposition when using a hopper dredge after two days of dredging. The hopper dredge operates along the dredging line (red line) shown in the figures below. After two days of dredging equilibrium is reached meaning that you can just multiply with the actual duration of the dredging operation.

The suspended sediment concentration and the deposition rate are for all sediment fractions taken together. The fraction going into the model was 20% clay, 50% fine silt, 22 % coarse silt, 5 % fine sand and 3 % medium sand.

Figure 4-1 – Hopper dredging, spring tide, max sediment concentrations mg/l

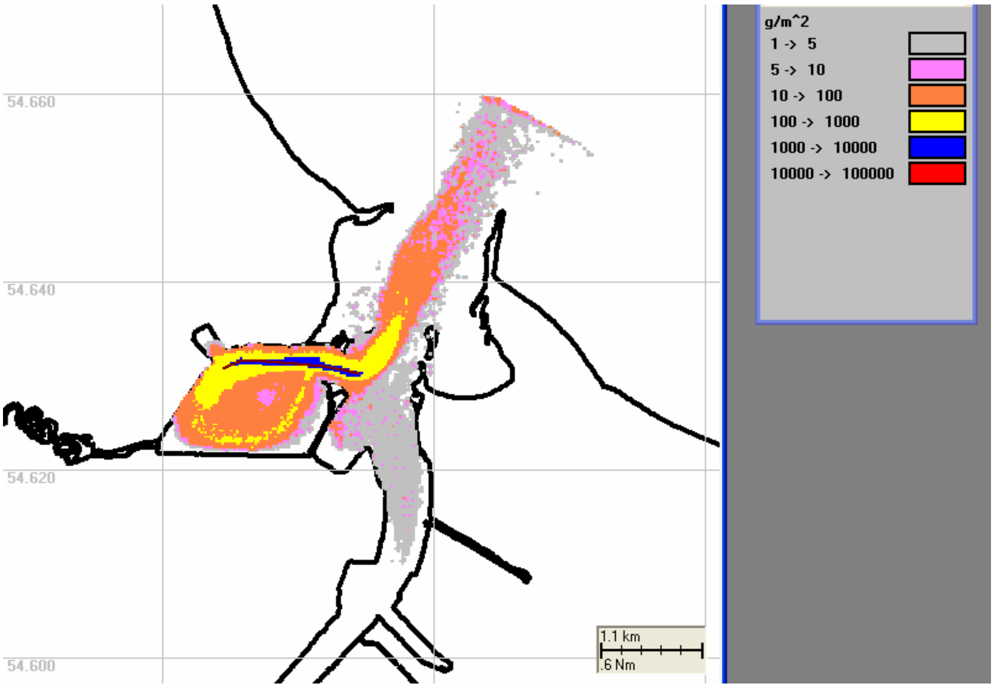


Figure 4-2 – Hopper dredging, spring tide, sediment deposition g/m^2 after 2 days of dredging.

The deposition rate on Seal Sands will be in the range of 5-50 gram/m2 and day. After 12 weeks of dredging this is equivalent to 420-4200 g/m2. The input to the model was that 70 % of the sediment is the fine fraction (clay and fine silt). Taking into account that the fine fraction will be transported longer than the coarser fraction which will fall out of suspension relatively fast, the fraction settling on Seal Sand will mainly be the finer fraction (less than 63 µm).

The question is then which effect will these rates have on the mud dwelling animals. Obviously some smothering will be the case. 4200 g/m2 equals 0.42 g/cm2. Computational Hydraulics and Transportation Ltd. estimates that bulk density of the material to be dredged in Seaton Channel is around 1.5 g/cm3. This means less than 0.3 cm of material will be deposited on Seal Sands. The biological active layer can as a rule of thumb be said to be 5-10 cm, or even deeper for some animals. This is of course dependent on the exact community and will vary with different species. Some species are more or less surface dwelling while others, especially polychaets, are more digging of nature.

The deposited layer of dredging material will be about 0.3 cm after 12 weeks which amounts to about 5 % of the biological active layer provided, if this is taken as 5 cm. It is impossible to discuss the effect on every species on Seal Sand. The short term effect may be that some species, especially filter feeders which are surface living feeding on organic matter in the water column will experience too heavy load of particles and thereby die. The effect will probably be much less for animals living in the sediment (digging animals). In longer terms any animals not capable of dealing with this sediment load will probably come back as new larvae settles and the community will go back to its natural state.

Another question is the amount of organic material transported to Seal Sand. As there was no data available of the organic content in the sediment to be dredged this is an open question. An increase in the organic content may favour a shift in the community by an increase in species which can take advantage of this situation. If the deposited material contains much organic matter it will affect the bottom fauna, dependent of the load. Heavy loads will give a negative effect on the fauna wich will be poorer, because of little or none access to oxygen. Increased bacteria activity due to decomposition of organic material may lead to lower oxygen concentrations which may affect the species composition. This is of course qualitative considerations.

The spreading of pollutants is addressed in the DNV report 2004-1387 chapter 10.3.2. The concentrations of contaminants are generally below recommended risk limits for effects on the ecosystem. The exceptions are for the following PAHs: Acenaphthylene, Anthracene, Benzo(a)anthracene and Benzo(a)pyrene. This means that there is a high probability of effects on the ecosystem due to the measured PAH contamination. These contaminants will most probably be spread to Seal Sand by the fine fraction of the suspended sediment, but as nothing is known about the concentrations of these contaminants on Seal Sand, one simply can't conclude whether there will be an increase in the sediment concentration on Seal Sand. An important fact is that dredging operations have been going on for years so it may be a logical conclusion that contaminants from Seaton Channel have been spread to Seal Sand, although in this case the dredged material can not directly be compared to previous material dredged.

5 LOSS OF INTERTIDAL AREA, REALIGNMENT OF CHANNEL

English Nature, ML. Page 124, section 16.3.13,

The first sentence quotes a total area of 299,937m3 as being lost as "a direct result of capital dredging". How much of this 30ha area is intertidal and how much subtidal? The spatial extent and location of these habitat losses (within Seal Sands SSSI as well as the SPA/Ramsar site) really needs to be properly quantified and assessed. Furthermore, any indirect losses of intertidal margins along the banks of Seaton Channel caused by the new dredged profiles must be similarly investigated.

English Nature, MQ. Page 124, section 16.3.13

This section is confusing. If Seaton Channel runs east-west then why should dredging affect "the west side of the channel"? We need to know the spatial extent of the dredged area and this must include the areas of any stability slopes required. Figure 4-1 does not refer to dredging but to the area covered by the numerical model.

English Nature, MQ. Page 192, section 21.8.15

This loss of intertidal SSSI must be quantified precisely. Also there is no description of the dredged footprint and the spatial extent of any stability slopes towards the southern side of Seaton Channel.

Environment Agency, Seal Sands northern margin

Erosion, dredging or any loss to the northern margin of Seal Sands SPA is unacceptable.

English Nature, MQ. Page 122 Section 16.3.1.

What about the loss of intertidal SSSI adjacent to Quays 9,10 and 11 due to dredging?

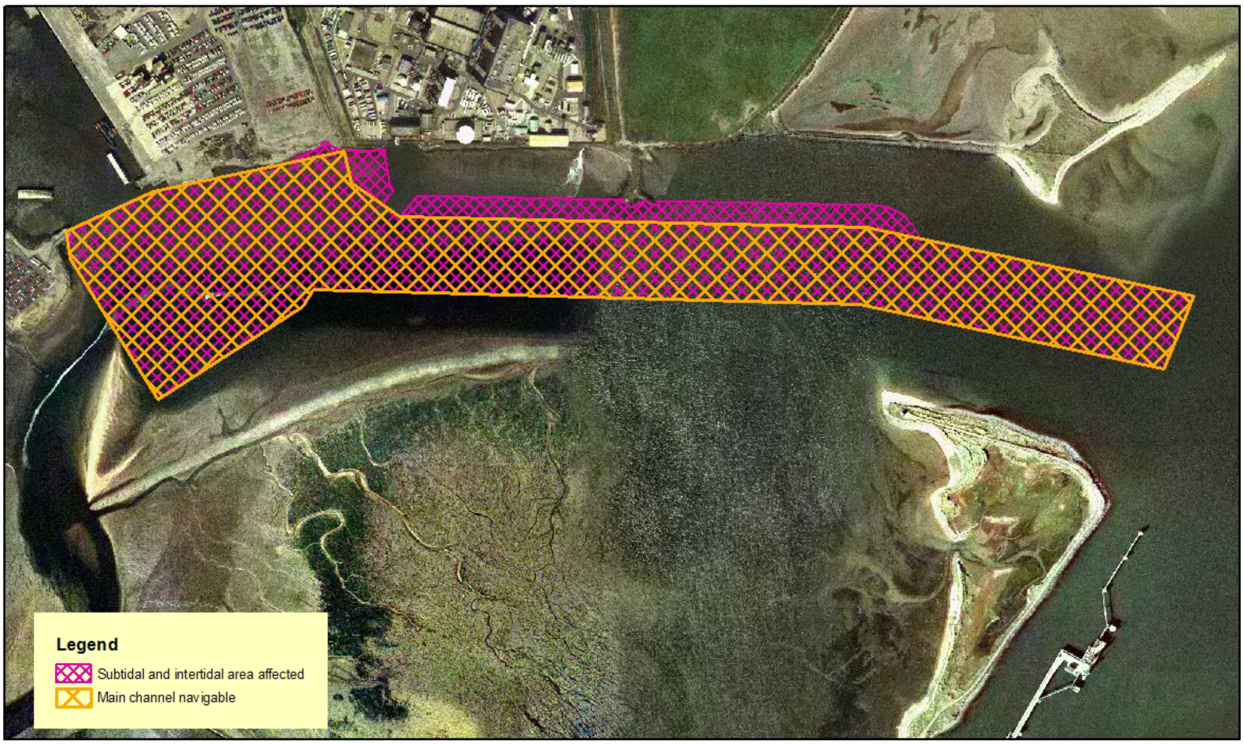
English Nature, ML. Page 309, Section 35.3.6

This paragraph explicitly admits that “Some of the [intertidal mudflat and sandflat] will be removed during dredging”, but once again the extent and location of the loss remains unquantified.

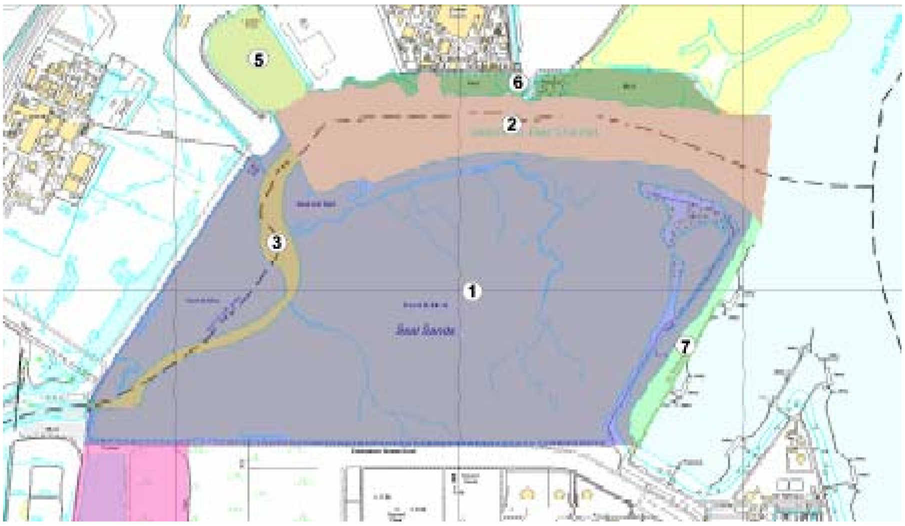
DNV response:

DNV has produced a number of versions of areas affected by dredging activities in Seaton Channel, including general cross section sketches. As the work progressed, it became clear that the Regulators would not accept any loss of area defined as a Special Protected Area (SPA), which in effect means that the northern margin of Seal Sands towards Seaton Channel could not be affected. The Regulators but indicated that a loss of up to 1% of Seal Sands Site of Special Scientific Interest (SSSI) could be accepted, implying that some dredging at the northern shore of Seal Sands along the site of the nuclear power station, past Seaton Snook and further East may be accepted.

Lately DNV has been given access to dredging plans produced by Posford Duvivier /6/. These plans show that if the navigable channel in Seaton Channel is shifted 8 to 25 m northwards, away from Seal Sands, the channel can be deepened to -8.5 m with no impact on the intertidal area of Seal Sands.

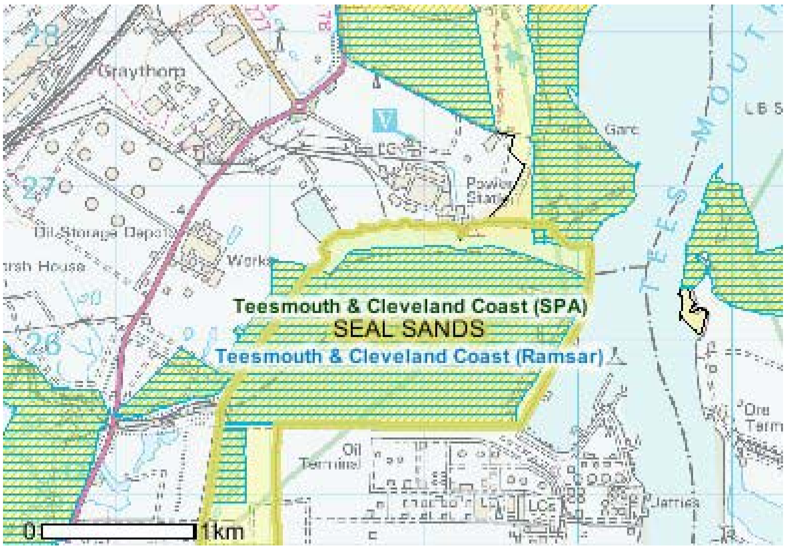


The area defined as affected by the dredging amounts to 17900 m^2, made up of 5600 m^2 at Quay 10 and 11 including the section towards the power station intake, and 12300 m^2 along the power station foreshore eastwards beyond Seaton Snook. This totals 1.790 ha. The baseline area is calculated as 189.40 ha and constitutes intertidal areas of similar type habitat to that which will be lost. The loss is therefore 0.95 %. and does not affect intertidal zones in the area defined as Seal Sands SPA or indeed on Seal Sands northern foreshore.



SSSI Habitat Components	
Area No.	Area (Ha)
Area 1	180.36
Area 2	44.03
Area 3	7.53
Area 4	52.81
Area 6	9.04
Area 7	4.89
Total	298.67

Areas 1 and 6 are of similar type to that which is lost, and constitutes the baseline for assessing habitat loss. /19/



Seal Sands SPA and Ramsar site are defined by the blue line and blue/green hatching, and does not include the northern shore of Seaton Channel where the predicted 1.79 ha loss of intertidal area occurs. /7/

6 SEDIMENT CHARACTERISTICS

English Nature, MQ. Page 123, sections 16.3.9 & 16.3.11

Recoverability is dependant upon several factors one of which is sediment type. Given the significant depth of the Seaton Channel dredge the material comprising the river bed after the dredge may be very different to the material present now ie. fine muds versus keuper marl. Maintenance dredging will then ensure that this remains the case and therefore the substrate may remain changed. This will then affect subsequent colonisation.

DNV response:
Although the assessment is not made by DNV, we agree that the material characteristics may change, affecting the recoverability. Due to lack of data the nature of the sediment at the new level is unknown, and the recoverability of the biotopes may be lower than indicated. With reference to the replies elsewhere, we agree to the conclusion that Table 16.6 specifies, that there will be a "major decline in species richness". It is important to stress that this effect will be limited to the dredged areas, and that other biotope areas that are not dredged are unaffected.

DNV believes all data sources (Environment Agency etc.) have been exhausted, and that any further studies must include deep core sediment sampling. See also replies to RPS queries below.

7 SEASONAL ISSUES

English Nature, MQ. Page 128, section 16.4.2

What are the other seasonal issues in addition to birds e.g. prey species?

English Nature, MQ. Page 128, section 16.3.35

Impacts upon prey species may be maximised during the summer months as this is a period of high productivity in estuarine systems. Also, proposed capital dredge is much larger than maintenance dredges. It is my understanding that maintenance work is not that common in Seaton Channel.

DNV response:

Dredging may impact prey species, ref. DNV Report 2004-1687 Appendix 16.1 Chapter 10.3.2. The effect of seasonality has been evaluated in the EIS Section 16.4.2.

Section 16.3.35 states that dredging activities are common in the estuary as a whole at present, not specifically in Seaton Channel. According to HR Wallingford /3/, Seaton Channel, Tees Turning Circle and the immediate area is dredged with a yield of 106,000 m3/year from 1991-2001, although the exact sediment yield from Seaton Channel is unknown. According to PD Teesport's dredging maps dated 2004 /8/ and current navigation charts /9/, Seaton Channel is currently dredged to a navigable depth.

The basic study of dredging operations carried out by CHT and reproduced in the DNV Report shows the spreading and accretion of sediments when conducting dredging operations at various locations. Any seasonal issues for dredging must be evaluated on the basis of this information. See also reply from PD Teesport below.

The suspended sediment levels are presented in the DNV Report 2004-1387 figs 7-1, 7-3, 7-5, 7-7, 7-9, 7-11, 7-13, 7-15, 7-17, 7-19 and 7-21. Cases cover spring and neap tidal conditions and two options of dredging equipment at four various locations. The spatial plots show the maximum sediment concentrations throughout Seaton Channel, Seal Sands and the Tees Estuary. The discussion throughout Chapter 7 details the significance of the findings. The background suspended sediment concentration is presented and discussed in Chapter 5.1.2.1.

With regards to smothering, the bottom deposition quantities are presented in the DNV Report 2004-1387 figs 7-2, 7-4, 7-6, 7-8, 7-10, 7-12, 7-14, 7-16, 7-18 and 7-21. Cases cover spring and neap tidal conditions, and two options of dredging equipment for four locations. Spatial plots show the sediment deposition in Seaton Channel, Seal Sands and the Tees estuary. The discussion in Chapter 7 provides details on the findings, with full discussions in Chapter 10.3.2. The specified 12 weeks for the dredging operation is according to a quote from a dredging contractor made available via Able UK.

See also Chapter 4 Impact of dredging operations on Seal Sands above.

8 BASIC DATA, FISH

Environment Agency. Marine & Estuarine Ecology, chapter 2.3

Further detail of the assessment of the impact of the scheme on Sprat and Herring runs, potential fish mortality during de-watering and the impact of dredging operations on migratory Salmonids, including proposed mitigation measures. Dredging in April, May and early June must be avoided to prevent adverse impact to Smolt runs. We recommend a condition be imposed to prohibit dredging in this period. These are at their most vulnerable to poor water quality during spring / summer, when dredging is proposed.

An assessment of Salmonid abundance within the Seaton Channel area.

Clarification of the statement in para 16.2.20 that ‘estuarine fish abundance has generally remained the same since 1995".

North East Sea Fisheries, fish species

No mention of the other estuary dependent/temporary resident species such as juvenile/adult bass, dover sole or cod. Or crustacean species found on outer estuary rocky habitat primarily lobster and velvet crab

Loss of intertidal habitat would reduce food availability to juvenile fish

No mention of lamprey (protected under habitat regulations)

Incombination effects with other extractive uses of prey resource bait collectors, cockle, mussel gatherers, etc. mentioned but not quantified

Would like to have seen monitoring of impacts to prey species included in the EIS in the absence of good and contemporary data. Source and methodology of fish assemblage not reference

No specific mention of interaction and impacts on other users such as anglers, bait gatherers, as well as commercial and non-commercial fishermen

DNV reply:

Upon Able’s and RPS’ request DNV has assisted in gathering further information on fish stocks in the Tees estuary.

No reports detailing the abundance of the fish stocks have been found for the Tees estuary, although a thorough search of the Environment Agency, English Nature and other data services has been conducted /10//11//12//13//14//15/.

There are no reported measuring regimes for adult salmon stock abundance for rivers in the North East of England /11/. Assessments of stocks are therefore in general made on the basis of declared catches. Salmonid catches reported in the Tees are increasing, as are catches in the North East region in general.

Conservation limits are set for a number of rivers in England and Wales, including the Tees. The conservation limit indicates the minimum desirable spawning stock levels /10/. If values decrease below the conservation limits, spawner numbers may not be adequate to produce sustainable stocks of juvenile fish. The rate of smolts produced per eggs and the survival rate at sea are taken into account in the conservation limit.

Although the river Tees in 2004 showed the highest adult counts and returning stock estimates recorded, the conservation limits were not met in 2004, and predictions show that the Tees will fail also in 2008. The results are improving, however, from 8 % of the conservation limit in 1996, steadily at 15-20 % from 2001-2003 to 48 % in 2004.

Salmon catches are reported up by about 25 % in the Tees river from 1974-2002 /11/, showing that salmonids are returning to the historically polluted rivers of the North East. For migratory trout, the reported rod catch from 1993-2003 has increased from 17 in 1995 to 62/61 in 2002-03 /14/. The low figures compared to other rivers in the North East. Total rod catches in the NE region were declared as 6,000 and 3,900 in 2002 and 2003, with Tyne and Wear reporting the main bulk of catches. The figures are not believed to reflect fish stocks, rather the low trout fishing effort in the Tees river.

9 SUSPENDED SEDIMENT AND DISSOLVED OXYGEN

Environment Agency, Pollutants, Section 21

An assessment of the potential effect on the dissolved oxygen levels in Seaton Channel from the 12 week dredging operation (section 21).

DNV reply:

The presence of suspended sediments in the water column has little effect on the dissolved oxygen content in itself, but may contain organic matter which again excerts a biological oxygen demand (BOD). The presence of reactive chemical compounds may also excert a chemical oxygen demand (COD).

The BOD of the dispersing sediment is dependent on the organic and nutrient content. No data on the organic content of the sediments in Seaton Channel or the TERRC dock exist. As most of the sediment is of marine origin /3/, the organic content and subsequently the BOD is low. The COD of the sediments is also believed to be low for this reason.

Data for Seal Sands itself have been traced, where three deep cores have been taken /2/. The organic content in sediments from Seal Sands are low at depths below 0.5 m. In upper levels the organic content varies from 10-20%, and is believed to stem from macro-algae such as *Enteromorpha sp.* The cores have been dated, showing that sedimentation on the inner reaches of Seal Sands had a high (~20%) organic content from 1920-1940, and that the middle reaches of Seal Sands received heavier organic loading in the 1940s. Data is therefore inconclusive, but it is generally accepted that the anthropogenic organcic loading, together with the general pollutant loading, has decreased significantly in the latter decates in the Tees estuary.

An increase in turbidity may affect algal growth by limiting light penetration. This can decrease the oxygen production in daytime, but also the oxygen demand at night. A more stable dissolved oxygen content may therefore occur.

DNV proposes that the current sediment monitoring regime in Seaton Channel and in the dry dock is extended to include evaluations of organic content of the sediments. It may also be necessary to monitor the levels of dissolved oxygen in the water column during dredging operations.

See also Chapter 4 Impact of dredging operations on Seal Sands above.

10 CURRENT DREDGING PRACTICES IN THE TEES ESTUARY

DNV approached PD Teesport for their experiences related to seasonal impacts of their dredging activities, amongst other issues. DNV has reverted asking whether specific derived siltation rates are available, but as yet no answer has been given. The DNV queries are shown in normal lettering with the PD Teesport response in italics below:

1: At what times of the year is maintenance (or capital) dredging carried out? Do you avoid dredging at certain times due to wildlife (birds, fish seals ect.) and in that case, have you carried out any studies for this?

Maintenance dredging in Seaton Channel is carried out in accordance with an agreed and approved environmental method statement developed in consultation with English Nature and the Environment Agency. This allows dredging of the inner channel on a rising tide just before high water and the dredging of the outer channel just after high water. This methodology still requires that local water abstractors are informed of operations. The high water window minimises the potential effects on wading birds or hauled out seals. The process is restrictive and does impact on dredging access hence quantity dredged.

2: What amounts of dredging material is currently taken out? According to a report by HR Wallingford from 2002, the annual dredging volumes have decreased in the latter years, and is the current dredging effort adequate to maintain required depths?

Current average annual dredge quantities equate to approximately 2000 cubic metres per annum however the channel although subject to limited maintenance dredging is in places above the nominal dredge depth, in recent years the maintenance volume has been below that average value.

3: What is the current dredging effort in Seaton Channel? It is noted as a navigable channel with navigation buoys in the nautical charts, and we assume the depths are charted regularly. Will the maintenance dredging effort increase when deepening the channel?

The dredge effort is as per Q2 above, the channel is regularly sounded so the annual siltation rate can be derived. Any predicted effect on future dredged effort as a result of deepening the channel would have to be developed and reviewed through use of a robust hydrodynamic model.

4: What effects have you observed on wildlife from the dredging activities? Does the sediment plume seriously affect fish migration, benthic fauna etc? What effects may this have on the food web in the estuary?

We have no specific data on this issue which is best answered through environmental impact assessment.

5: We have predicted that a deepening of Seaton Channel may create a more efficient trap for coarse sediments, thereby reducing the current trend of sand accretion on Seal Sands. This view is supported by HR Wallingford. In your view, is this prediction likely?

As per the previous comments these processes could probably be investigated using a hydrodynamic model based on actual design profiles and accumulated information used to develop the output for the environmental statement or impact assessment, without a full understanding of the proposed works any view would be speculative and not based on real data analysis and therefore not appropriate.

11 REFERENCES

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/5/ Zeneca: "Tees Estuary: 1995 Joint Survey data Vol 1. Neap tide physical and chemical data tabulation".

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/8/ PD Teesport Conservancy Division, Dredging control charts, sounded throughout summer 2004.

/9/ Admiralty Chart 2256 – Tees and Hartlepool Bays

/10/ CEFAS/Environment Agency; "Annual Assessment of Salmon Stocks and Fisheries in England and Wales 2004". Preliminary assessment prepared for ICES, March 2005.

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