3. **Project Description and Methodology**

**Executive Summary: Chapter 3. Project Description and Methodology**

The proposed works are designed to provide a deep-water berth capable of accommodating a 400m long, 15.5m draught vessel alongside the existing Berths 201 and 202 of the container terminal. To achieve this, it will be necessary to deepen the existing berths from depths of -10.2m and -12.2m Chart Datum (CD) to a new dredged depth of -16m CD.

The existing quay structure is neither deep enough nor strong enough to permit the berth to be deepened, and consequently, a new quay wall will have to be constructed. Having considered the relative environmental impact and technical feasibility of a number of different methods of construction, it has been concluded that a steel combi-wall presents the best technically viable solution, without unacceptable navigational and environmental impacts, whilst being economically sound.

The steel piles will have to be installed using percussive pile driving techniques because of the size of piles required and the hard driving conditions known to exist in this location.

The construction works are expected to commence in July 2010 and will take approximately 14 months to complete. The quayside piling will be carried out between 16 September and 31 March to mitigate any potential impact on Atlantic salmon. It is anticipated that up to four piling rigs will be used for this activity although it is unlikely that all four rigs will be operational at the same time.

Following completion of the quay wall, the berth pocket will be dredged. Approximately 182,000m³ of material, comprising a thin layer of soft sediment overlying stiff clay and dense sand, will be removed. If no alternative beneficial use is found, the material will be disposed of at sea at the Nab Deposit Ground.

Following the rebuilding of the quay wall and the dredging of the berth pocket, up to six ship to shore gantry cranes will be erected along the rebuilt quay.

**Project Description**

**Berth Reconstruction**

3.1 The proposed works are designed to provide a deep-water berth at the container terminal capable of accommodating a 400m long, 15.5m draught vessel alongside at all states of the tide.

3.2 The existing quay construction at Berths 201 and 202 comprises a vertical sheet-pile wall tied to a reinforced concrete relieving platform, which is supported via steel bearing piles. The sheet piles extend to a level of approximately -20m Chart Datum (CD), with the associated bearing
piles extending to deeper levels of circa -30m CD at Berth 201 and -20m CD at Berth 202. The current depths of the berth pockets are between -10.2 and -12.2m CD. A typical section through the existing quay is shown in Figure 3.1.

3.3 In order to accommodate vessels of 15.5m draught, the existing berths will have to be deepened. The existing quay structure cannot, however, support any deepening of the berth pocket without significant engineering and piling works. Deepening of the berth without engineering intervention would result in bending stresses in excess of the capacity of the existing sheet piles and would also significantly reduce the lateral restraint to the toe of the wall. This would lead to instability of the whole structure. Consequently, it is proposed to construct a new quay wall seaward of the existing wall over the length of the existing Berths 201/2.

3.4 The new quay wall must be able to accommodate a maintained depth alongside of 16m (CD) with an additional allowance for over-dredge and scour protection. It is, therefore, proposed to construct a steel combi-wall 3-5m in front of the existing quay wall, which will result in the effective reclamation of a maximum of 0.275ha of land, all of which is within the subtidal area. No intertidal will be lost directly as a result of the works. Granular fill material or concrete will be used to infill the gap between the new quay wall and the original quay wall. It is estimated that of the order of 25,000m³ of material will be required for this activity, which may originate from either a licensed aggregate site or as a beneficial use of material made available from other concurrent projects.

Dredging

3.5 Capital dredging to a depth of -16m CD will be required to deepen the existing berths in order to create a new berth pocket approximately 490m long by 60m wide. It is anticipated that dredging will be undertaken by a backhoe dredger and the excavated material will be loaded directly to barges. The volume of material to be dredged is estimated to be in the order of 182,000m³, comprising a thin layer of soft and silty sediments overlying stiff clay and greensand material.

Disposal of Dredged Material

3.6 Unless a beneficial use (see paragraphs 4.9 to 4.11) of the dredged material can be found, it is proposed to dispose of the material at the Nab Deposit Ground, located approximately 8 nautical miles east of the Isle of Wight (Figure 1.3). The total, in situ, volume of dredge arisings will be disposed of over a period of around four weeks. The Nab Deposit Ground is used by both the Ports of Southampton and Portsmouth for current maintenance dredging and has been used for historical capital dredges, as well as smaller harbour and marina facilities around the Solent. The disposal of material is covered in more detail in paragraph 3.6159.

Landside Elements

3.7 In addition to the above aspects, the berth 201/202 works also involve the provision of up to six Ship to Shore Gantry Cranes (SSGC) along the rebuilt berth quay, the relocation of lighting columns within the container storage yard area behind the quay, the relocation of a small electricity sub station and changes as necessary to the security fence around the Container Terminal.
3.8 The SSGC to be provided along the rebuilt quay will be approximately 117 metres high above quay level with their boom up and approximately 85 metres high above quay level with their boom down. This is the same as the largest cranes currently operating along berths 204 to 207.

3.9 A row of 30 metre high lighting columns is currently located approximately 35 metres back from the edge of the berth 201/202 quayline. This row of lighting columns will be removed and replaced with a new row of similar columns approximately 70 metres back from the quay. This change is necessary to both provide a safe working area around the SSGCs and maintain the necessary level of lighting within the container stack area.

3.10 A plan of the berth 201/202 works is provided at Figure 1.2.

**Optimisation of Quay Wall Design**

3.11 In assessing the feasibility of different options of quay wall construction, it has been necessary to consider a variety of factors including environmental and navigation impacts, technical feasibility and commercial and economic factors. ABP has appointed engineering consultants and contractors to advise on the most suitable engineering design and implementation techniques to minimise the impacts of the works.

3.12 Alternative methods of quay wall design have been considered, taking into account known environmental impacts, such as noise and vibration. These include the following, which are discussed below:

- Utilising the Strength of the Existing Quay Wall;
- Cantilever and Anchored Sheet Piled Wall;
- Anchored High Modulus Wall;
- Suspended Quay; and
- Gravity Wall.

**Utilising the Strength of the Existing Quay Wall**

3.13 Investigations were undertaken to determine whether the existing quay wall could be utilised such that the new piles would act compositely with the existing structure. By doing so, the size of piles required would be minimised, which would reduce associated driving energy and piling noise. However, the ability to utilise the existing wall in this way is dependent upon the condition of the existing piles and their ability to perform satisfactorily for the design life of the new structure.

3.14 The existing quay walls are approximately 40 years old, and are therefore at or near the end of their original design life and have already undergone significant repairs to combat the effect of accelerated low water corrosion. Whilst there are presently no obvious signs of structural distress, it is impossible to ascertain the condition of buried elements of the structure. It is, therefore, concluded that a satisfactory degree of comfort cannot be established regarding the long-term durability and likely performance of the existing structure. Consequently, this construction option has been discounted.
Cantilever and Anchored Sheet Piled Wall

Historically, as in the case of the original construction of Berths 201 and 202, interlocking steel sheet piles have been used successfully to form cantilever and anchored retaining wall structures for modest retained heights. None of the currently manufactured sheet piles sections, however, are able to resist the loads associated with the greater retained heights of quay walls that are demanded by modern vessels. For a dredge level of -16m CD, the retained height at Berth 201/202 is beyond the range of conventional sheet piling. This option has, therefore, been discounted.

Anchored High Modulus Wall

An anchored high modulus wall structure uses steel tubes (king piles), usually with interlocking sheet piles between adjacent tubes, to provide the increased strength necessary for the construction of deeper berths. Three different methods of constructing these types of walls have been considered:

- Steel combi-wall;
- Steel combi-wall with concrete pile toe; and
- Contiguous tubular steel pile wall.

Table 3.1 presents a detailed comparison of the environmental, technical commercial and navigational factors relating to each method.

Steel Combi-Wall (Figure 3.2)

This form of retaining wall possesses superior strength characteristics when compared to a conventional single-skin sheet pile wall and is both efficient and economic as a retaining structure for quay walls with a large retained height. King piles of approximately 1.8m diameter and approximately 35m in length would be required to be driven to a depth of around -30m CD and, due to the size of pile and the nature of the ground conditions, percussive piling would have to be adopted. Alternative methods of driving the piles, such as auguring or vibration, have been considered, but have been discounted due to the size and weight of the piles and the high driving resistance expected to be encountered due to the nature of the ground. Consequently there will be a potential environmental impact arising from vibration and from air-borne and under-water noise.

Steel Combi-Wall with Concrete Pile Toe (Figure 3.3)

This type of retaining structure is essentially a steel combi-wall, but consists of shorter king-piles together with reinforced concrete piles, formed internally and extending beyond the base of the steel piles. The steel king-piles form a structural connection with the concrete piles, which extend to the required length that achieves structural stability. It is anticipated that king-piles of approximately 1.8m diameter would be required to be driven to a depth of around -23m CD. The concrete pile toe would be formed by augering the soil below the king-pile toe and filling the void formed with concrete before installing a pre-fabricated steel reinforcement. Bentonite would have to be used to maintain the stability of the void before placing the concrete.
3.19 Whilst the shorter king piles would require less energy to drive, the dense nature of the ground dictates that percussive piling techniques would still have to be employed and, consequently, the noise and vibration impacts presented by the steel combi-wall option would be still present. The risk of bentonite leakage would present a further potential environmental impact.

3.20 The construction of the concrete toe piles would add significant complexity to the construction process and introduce additional technical risks associated with discontinuities within the concrete and inaccurate placement of the reinforcing cage.

3.21 This option has, therefore, been discounted. It offers no significant reduction in environmental impact, but does significantly increase the technical risk and is less economic.

**Contiguous Tubular Steel Pile Wall (Figure 3.4)**

3.22 This type of retaining structure comprises a contiguous line of steel tubes that are linked together via a clutch system. It is anticipated that tubes of between 1.2 and 1.5m diameter would be required to be driven to a depth of around -30m CD. This represents a greater weight of steel than would be used in a combi-pile wall and would consequently be less economical to construct.

3.23 In view of the reduced diameter and contiguous arrangement of the tubes, a patented ‘press-in’ (hydraulic) method of installation was investigated. This method of pile installation, often referred to as “silent piling”, uses hydraulic rams to advance (press) the pile into the ground and requires use of adjacent (previously installed) piles to provide the necessary reaction force. However, the patented hydraulic equipment that is currently available is only suitable for certain types of soil and can only accommodate tubular piles up to a maximum diameter of 1.2m and a thickness of 25mm which is significantly less than the size and thickness of pile that would be required in this instance. Consequently, the piles for a contiguous tubular steel pile wall would have to be installed by percussive means.
Table 3.1 Comparison of methods of constructing anchored high modulus piled walls

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Environmental Impact</th>
<th>Technical Issues</th>
<th>Commercial/Economic Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel combi-wall</td>
<td>Minimum impact on relatively small area of sub-tidal</td>
<td>Can be constructed using mainly land-based equipment</td>
<td>Relatively efficient in construction cost terms when compared to other forms of quay wall structures</td>
</tr>
<tr>
<td></td>
<td>Noise and vibration impact from percussive driving of large diameter tubular steel piles.</td>
<td>Minimises the use of construction materials</td>
<td>Construction period is minimised.</td>
</tr>
<tr>
<td>Combi-wall with concrete toe</td>
<td>Minimum impact on relatively small area of sub-tidal</td>
<td>Can be constructed using mainly land-based equipment</td>
<td>Longer construction period when compared to the construction of a conventional steel combi-wall.</td>
</tr>
<tr>
<td></td>
<td>Duration of noise and vibration impact from percussive driving of tubular steel piles slightly reduced due to reduced length of piles.</td>
<td>Construction of concrete toe introduces additional construction activities and extends duration.</td>
<td>Need for pile augering (drilling) and concreting equipment increases cost.</td>
</tr>
<tr>
<td></td>
<td>Potential impacts from the use/disposal of bentonite solution required to temporarily stabilise augered soil socket during formation of toe.</td>
<td>Requirement to use bentonite to aid construction of concrete toe</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased technical risk from inaccurate placing of reinforcement and risk of discontinuities in concrete arising from collapse/wash-out.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sub artesian water pressures increase risk of wash-out.</td>
<td></td>
</tr>
<tr>
<td>Contiguous piled wall</td>
<td>Minimum impact on relatively small area of sub-tidal</td>
<td>Can be constructed using mainly land-based equipment</td>
<td>Increased steel tonnage when compared to other anchored wall solutions.</td>
</tr>
<tr>
<td></td>
<td>Noise impact from percussive driving of tubular steel piles</td>
<td>Hydraulic (press-in) technique not suitable for the pile size required or soil conditions.</td>
<td></td>
</tr>
</tbody>
</table>
3.24 This option has therefore been discounted from further consideration as it offers no significant reduction in environmental impact.

**Suspended Quay (Figure 3.5)**

3.25 Historically, it has been common practice to construct a suspended quay in front of an existing wall so that the depth at the new berth face can be increased without removing material from immediately in front of the toe of the existing wall and from which the existing structure derives its stability.

3.26 A suspended quay comprises a reinforced concrete deck supported on tubular steel or concrete piles and, in this case, would need to extend approximately 50m from the face of the existing wall in order to retain the stability of the existing berth structure and also to provide a stable side slope to the edge of the berth pocket.

3.27 This option would necessitate extensive dredging of intertidal areas directly opposite Berth 201/202, in order to maintain the area of the Upper Swinging Ground, which is required for turning large container ships using the container terminal. This option has therefore been discounted.

**Gravity Wall**

3.28 A gravity wall depends on its own weight to resist the sliding and overturning forces generated by the retained material. The size of the structure is determined by the need to provide sufficient mass to prevent failure by sliding or overturning and also by the need to limit the bearing pressures beneath the toe of the structure to within the safe bearing capacity of the sub-soil. Two methods of construction are commonly used; concrete caissons and sheet-piled cellular cofferdams.

3.29 Historically, cellular concrete caissons have been installed by constructing them *in situ* and sequentially excavating the material from the base of the cells so that the structure sinks into the ground as construction proceeds, eventually reaching the required level. The relatively shallow quays in the Western Docks were constructed in this manner in the 1930s. This technique has not been used for quay construction for many years, although a similar technique is used for sinking shafts in tunnelling work. However, it can only feasibly be carried out on land and would, therefore, require the construction of a temporary bund using fill material to provide a working platform in front of the existing wall, which would have a significant impact on the marine environment and also require dredging of areas opposite Berths 201/202, in order to maintain the area of the Upper Swinging Ground.

3.30 More conventionally, both caissons and cellular cofferdams are founded on a prepared bed excavated below the design dredge level. In this case, to avoid compromising the stability of the existing retaining structures, the new structure would need to be located some 50m or so riverside of the existing berths. To achieve this would require the reclamation of approximately 2.5ha of the current sub-tidal area, and, without extensive dredging of the adjacent inter-tidal area opposite Berths 201/202, would remove the function of the Upper Swinging Ground.

3.31 In light of this, use of a suspended quay has been discounted from further consideration.
Conclusion on Optimisation of Quay Wall Design

3.32 Of the various construction methodologies considered, only an anchored high modulus piled wall presents a technically viable solution without unacceptable navigational and environmental impacts. Designs which utilise the strength of the existing wall and cantilevered sheet piled walls are not technically viable and, without significant dredging of the adjacent inter-tidal area, suspended quay and gravity structures would prevent large vessels turning in the Upper Swinging Ground.

3.33 Three methods of constructing high modulus walls have been considered, all requiring steel tubes to be installed by percussive means to overcome the hard-driving conditions known to exist in this location. Of the three methods, the steel combi-wall presents the most economical solution with least technical risk, and is therefore the preferred option. It is this option, therefore, that is assessed in this Environmental Statement.

Detailed Description of the Works

3.34 ABP has retained the services of a contractor experienced in quay construction work to carry out a review of the most likely construction methodology. It is anticipated that the construction works will comprise the following activities which are discussed in the following sections and have formed the basis of the environmental impact assessment (EIA):

- Site mobilisation;
- Removal of existing surfacing;
- Rear crane rail piling;
- Quay wall piling;
- Excavation;
- Construction of anchor wall and installation of tie bars;
- Infill works;
- Removal of existing cope;
- Construction cope and front crane beam;
- Construction of rear crane beam, Paving and Drainage;
- Dredging and scour protection;
- Disposal of dredge material; and
- Site demobilisation; and
- Provision of cranes, lights and ancillary works.

3.35 The duration of the construction works is expected to be around 14 months, and the construction programme will commence as soon as reasonably practicable following the issue of the necessary consents. For the purpose of the EIA, commencement of site works is assumed to be July 2012, although the works will have to be tendered in June 2009 to make adequate provision for design and the procurement of materials.
Site Mobilisation Work

3.36 The contractor will establish site offices and a compound adjacent to Berths 201/2. Land-based construction plant and equipment will include crawler-mounted piling rigs, hydraulic excavators, paving machines and general construction plant, which will be brought to site by road. It is anticipated that the piles will arrive by sea and will be stored on a pontoon awaiting use. Marine plant is likely to include a backhoe dredger, work barges with cranes, drilling rigs, disposal barges, tugs and workboats.

Removal of Existing Surfacing

3.37 The existing quayside paving consists of pre-cast concrete slabs which will be lifted and removed as required to facilitate construction.

Rear Crane rail piling

3.38 Piled foundations will be constructed 35m landside of the front crane beam to carry the rear rail of the quayside cranes. The type of piles used for the foundation will be determined during the detailed design stage and based on an analysis of information provided by geotechnical investigation, but are likely to take the form of augered, cast in situ concrete piles. The foundation piles will be installed to a depth that will provide the necessary vertical support to the rear crane beam and crane rail. Depending on the form of anchor adopted and the design characteristics of the main quay wall, the piles supporting the rear crane beam might also be used as the principal anchorage structure for the new quay wall.

Quay Wall Piling

3.39 In view of the required depth, the new retaining structure will take the form of a steel combi-wall. This will comprise tubular steel king-piles, approximately 1.8m in diameter and 35m in length, linked together via intermediate, interlocking steel sheet piles. The new combi-wall will be constructed immediately in front of the existing retaining wall structure. The king-piles are the principal structural element of this type of wall and are likely to be driven to a depth of around 30m CD. The intermediate steel sheet piles will be driven to a lesser depth of approximately 20m CD.

3.40 Because the new wall will be constructed immediately in front of the existing wall, it is anticipated that the piles will be installed by land-based piling equipment comprising crawler cranes equipped with hydraulic piling hammers.

3.41 As detailed in Chapters 12 and 19, the implementation of percussive piling works has been restricted to between 16 September and the end of March to mitigate any impact on migratory salmon. It has been assumed that up to four piling rigs will be employed to reduce the duration of this phase of the works, estimated to be approximately 6 months, although it is unlikely that all four rigs will be operational at the same time.
Excavation

3.42 Material will be excavated from behind the existing wall to a depth of approximately 6m to facilitate the construction of the anchor wall and the installation of tie bars. The arisings will be either stored on site or disposed of off-site depending upon their suitability for re-use as fill material.

Construction of Anchor Wall and Installation of Tie Bars

3.43 It is anticipated that the new piles will be anchored by means of horizontal tie bars that connect to an anchor wall approximately 40m behind the quay. The anchor wall will not be as deep as the main quay wall and can be constructed from either reinforced concrete or from steel tubular.sheet piles.

3.44 The type of anchor wall and anchorage system adopted will be determined largely by the structural characteristics of the proposed main quay wall, which will be identified during the detailed design stage.

3.45 A steel pile anchor wall is unlikely to require piles of the same diameter as those used in the main quay wall and, because the piles will also be relatively short and driven into granular fill material, it is anticipated that the piles could be driven using vibratory techniques.

Infill Works

3.46 The face of the new quay wall is expected to extend between 3m and 5m seaward of the existing quay wall. It will be necessary to fill the space between the new and existing piles with material that is capable of transmitting loads from the existing structure without deformation. The fill material will comprise granular fill material or mass concrete. It is estimated that of the order of 25,000m$^3$ of material will be required which, in the case of granular material, may originate from either a licensed site or as a beneficial use of material made available from other concurrent projects. Granular fill material will most likely be transported to site by sea.

Removal of Existing Cope

3.47 When the existing wall is adequately restrained by the new construction, the existing cope and front crane rail will be removed to facilitate construction of the new cope beam.

Construction of Cope and Front Crane Beam

3.48 The new cope will comprise a reinforced concrete capping beam, constructed along the full length of the new quay, which will tie the top of the new king-piles together and also carry the front crane rail. The capping beam will incorporate an overhang to provide adequate access for vessel mooring operations. Bollards, fenders and access ladders will be installed at appropriate spacing along the length of the quay.

3.49 The top level of the cope will be +6.25m CD (or 3.5m AOD) as per the existing level.
Construction of Rear Crane Beam, Paving and Drainage

3.50 A new reinforced concrete beam supported on piled foundations will be constructed 35m landside of the front crane beam to carry the rear rail of the quayside cranes.

3.51 Paving of the quay apron and between the front and rear crane rails will comprise heavy duty asphalt or reinforced concrete of adequate thickness to withstand quay-side operational loads.

3.52 Within 5m of the quay edge, the existing surface of the berth drains directly towards the cope at a nominal gradient of 1 in 100. Behind this, existing drainage is by means of drainage channels running parallel to the berth with discharge pipes through the quay wall at approximately 60m intervals. The existing drainage system does not incorporate any valves or interceptors. It is proposed to reinstate the existing drainage layout with storm water interceptors installed into outfalls in accordance with Environment Agency pollution prevention guidelines.

3.53 The existing drainage system infrastructure will be replaced in all areas disturbed by the works with a new system comprising channels, gullies, manholes and discharge pipes. The new system will be designed to receive, accommodate and discharge surface water runoff from the area of the works (except the area seaward of the crane rail closest to the quayside) and, in addition, from the adjacent container storage area that currently discharged through the existing quay wall.

3.54 The system shall be designed to accommodate a design storm with an Annual Exceedence Probability of 20% (1 in 5 return period) and shall have a surcharge capacity capable of accommodating a storm with a 1 in 10 year return period without the surcharge water reaching the rear crane rail.

3.55 To provide greater control of the overall outflow, the new surface water drainage system shall be sub divided into a minimum of four sections, each discharging via separate outfalls through the new quay wall.

3.56 The outfalls and drainage system are to be protected from high tides by the use of flap valves or other non-return devices which shall be located in dedicated chambers immediately upstream of the discharge points. A penstock valve will be installed on the downstream headwall of each chamber to allow the isolation of each section of the drainage in the event of contamination entering the drainage system as a result of spillage or leakage.

3.57 Each outfall will be provided with a Class 1 bypass oil separator to BS EN 958 which will be positioned immediately upstream of the penstock chamber.

Dredging and Scour Protection

3.58 The current depth is -10.2m CD at Berth 201 and -12.2m CD at Berth 202. In order to create a new berthing pocket to accommodate the deeper draughted ships, an area approximately 490m by 60m will require deepening to a new depth of -16m CD. The side slopes will be cut to a gradient of 1:3 or as necessary to ensure stability. It is anticipated that dredging will be carried out by a backhoe dredger with the excavated material being loaded directly to barges for disposal.
3.59 The dredging works will be undertaken following substantial completion of the main combi-wall piling, horizontal tie and landside anchor wall construction activities. An overdredge allowance of 0.3m has been made to allow for dredging tolerances.

3.60 In some locations, the berth pocket will be further dredged to a level beyond the design dredge level to allow the construction and placement of scour protection to prevent scouring of the bed by the action of ships’ propellers and bow thrusters. The scour protection will be in the form of graded rock armour typically having a maximum size of 0.75 to 1.0m diameter or a concrete or asphalt mattress placed in the deepened sections of the berth pocket by a barge-mounted crane or excavator.

**Disposal of Dredged Material**

3.61 The physical properties of the dredged material described in paragraph 3.66 make it unsuitable for use as engineering fill material or for any beneficial use identified in paragraphs 4.9 to 4.11. It is therefore proposed to transport the arisings by barge for disposal at the Nab Deposit Ground.

**Site Demobilisation**

3.62 All construction plant and equipment will be removed from site on completion of the works.

**Landside Elements**

3.63 Once the site of the works has been cleared of plant and equipment associated with the above activities, up to six SSGC will be provided along the rebuilt quay.

3.64 In addition, the replacement lighting columns will be installed, which will provide the necessary level of light required by the Docks Regulations 1988. The light fixtures to be provided will be of a design that minimises both upward light and the spread of light to the surrounding areas.

3.65 Amendments will also be made to the security fence around the Container Terminal to enclose the berth 201/202 area within the Container Terminal, and a small electricity sub station will be relocated.

**Dredge Material Characterisation**

3.66 The area to be deepened is within an area that has been subject to previous capital dredging, carried out initially when the berths were constructed and subsequently, in 1997.

3.67 A detailed analysis of the geological strata encountered in the area to be dredged was undertaken based on available information and site investigation works. The project specific site investigations were designed to determine the following:

- Soil properties for dredge, disposal and possible beneficial use purposes;
- Parameters to be used in the modelling investigations;
Possible contamination within the dredged sediments; and
- Stability of side slopes.

3.68 The material to be dredged comprises a thin layer of relatively soft and silty sediments overlying stiff clays and dense sandy material (The Bracklesham Beds). Further detail on this material characterisation analysis is provided in Appendix B. It should be noted that the analysis in Appendix B not only defines the likely dredge methodology and timescale to undertake the dredging works but also the characteristics of the disturbed sediment and character of the material at the point of disposal/use, which have been used to inform the hydrodynamic modelling (Appendix C).

3.69 Part of the area to be dredged has previously been identified as exhibiting elevated levels of Tributyl-tin (TBT), although previous restrictions on the disposal at sea of maintenance dredging arisings from a small part of this area have recently been lifted by Cefas. Since the ES was submitted, ABP has further consulted with Cefas who, having carried out analysis of a number of samples for the full suite of chemical contaminants, have indicated that it is acceptable for the material to be deposited at sea. ABP is currently consulting with Cefas, who will ultimately inform the FEPA licensing decision by undertaking their own sample analysis for the full suite of chemical contaminants, including TBT, to determine the suitability of the material for disposal at sea. The chemical testing that has been undertaken as part of this EIA is presented and assessed in Chapter 9.