10 Water and Sediment Quality

10.1 Introduction

The following chapter assesses the likely impact of the proposed works on the marine environment of Botany Bay resulting from the changes in water and sediment quality.

This assessment has been informed by hydrodynamic, sediment transport, sediment deposition (siltation) and contaminant tracer modelling undertaken by Cardno (see **Technical Appendix C**). The assessment has also used data gathered by Worley Parsons to characterise the physical properties, types, concentrations and the bioavailability of contaminants present in the dredged sediments (see **Technical Appendices D1** and **D2**).

10.2 Scope of the Assessment

The physical and chemical characteristics of water and marine sediments can be affected by dredging, as it can:

- reduce the amount of available light (i.e. increase light attenuation) as a result of increased concentrations of suspended sediments (turbidity). This is particularly important as it limits photosynthetic biota such as seagrass;
- directly affect key water quality parameters used as indicators for declining ecosystem health such as pH and dissolved oxygen (DO);
- result in sediment deposition and the build-up of sediments on the seabed coating key benthic habitat with sediment;
- impact groundwater, affecting levels, flows and quality; and
- cause the mobilisation of nutrients and toxicants present within disturbed sediments. These nutrients can cause algal blooms, whilst the toxicants can:
  - cause direct mortality to aquatic biota;
  - impede the ability for biota to withstand or avoid other stressors (natural or anthropogenic); and
  - bioaccumulate, and therefore affect organisms or humans that may consume plants or animals that have taken up those toxicants.

The extent to which these effects may occur is dependent on the type of sediment being dredged, the presence and concentration of toxicants, and the method of dredging.

It is also recognised that although a backhoe dredger provides one of the most accurate methods in terms of limiting sediment dispersion it would still result in:

- disturbance of the sediments by the excavator backhoe;
- sediments being washed from the backhoe during descent and recovery;
- sediment and dirty water spilling from the bucket during slewing to the disposal barge;
- overflow operations generating sediment plumes;
- a sediment impact from the removal of the anchoring spuds; and
- splashing during barge loading.

The above issues are the subject of assessment in this chapter.

This chapter has been prepared in response to the Director General's Requirements (DGRs) (see **Technical Appendix A**) specifically relating to the following water quality issues:

- "*likely impacts on water quality, including suspended-sediment dispersion and re-suspension, and identification of methods for sediment containment;*
- *effects of the development on:*
  - *siltation;*
  - *groundwater;*
  - *the stability of any structures adjacent to the dredge area; and*
  - *commercial and recreational fishing and aquaculture, aquaculture leases and oyster farming;*
- *operational impacts including impacts associated with ballast water management; and*
- *taking into account the Commonwealth Water Quality Guidelines for Fresh and Marine Waters 2000 and associated guidelines."*

A number of associated issues have also been raised by other statutory agencies that are relevant to this chapter. They include:

- the potential for pollution (and the consideration of pollution management controls); and
- ensuring the works meet the relevant water quality objectives for Botany Bay.

Several of these issues are also addressed in Chapter 9, Spoil and Contamination. Impacts on the condition and health of recreationally fished and aquaculture species have been given further specific consideration in the ecological assessment (see **Chapter 11, Ecology**).

10.3 Legislation and Planning Policy

The legislation and planning policy set out in **Chapter 9, Spoil and Contamination** remain relevant to this assessment. Consideration has also been given to the following legislation and planning policy.

NSW Protection of Environmental Operations Act 1997

This Act includes objectives to manage and control water pollution in NSW. Under Section 120 of this Act it is illegal to pollute (cause or permit pollution of) waters, including marine waters.

Water pollution is defined as '*introducing litter, sediment, oil, grease, wash water, debris and flammable liquids into waters or placing such materials where they are likely to be washed or blown into waters'*. This assessment has given consideration to these requirements and the need for licensing.

Georges River – Botany Bay System: Statement of Intent 2003

In 2001 the Healthy Rivers Commission presented its final report on the Georges River – Botany Bay System. Following this, the NSW Government issued its *Statement of Intent* in response to the above report. This *Statement of Intent* represents the Government's commitment to integrate the strategies and actions required to '*achieve improved administrative, social and economic outcomes for the Georges River and Botany Bay System*'. The *Statement of Intent* identifies specific actions, timeframes and responsible agencies.

The *Statement of Intent* identifies responsibilities for the protection of the health of Botany Bay, including preventing actions that conflict with the following environmental values and management goals:

- the protection of visual character;
- the protection of aquatic and riparian ecosystems;
- the protection of human consumers of cooked fish, shellfish and crustaceans;
- the protection of primary and secondary contact recreation[1]; and
- to restore important natural processes/biodiversity and protect desired public uses for southern Botany Bay.

This Statement of Intent also refers to the need to use the trigger values set out in the Guidelines for Fresh and Marine Water Quality 2000[2] as 'indicative values for the initial phase of an adaptive approach to water quality and ecosystem management'. These limits are set out in **Table 10-1**.

Water Management Act 2000

The *Water Management Act 2000* (WM Act) establishes a framework for managing water in NSW. The Act creates:

- mechanisms for protecting and restoring water sources and their dependent ecosystems;
- improved access rights to water; and
- partnership arrangements between the community and the Government for water management.

One such mechanism is a Water Sharing Plan (WSP). This is a legal document prepared under the *WM Act*. These plans establish rules for sharing water between the environmental needs of the river or aquifer, water users, and also between different types of water uses such as town supply, rural domestic supply, stock watering, industry and irrigation. The Kurnell Peninsula and Botany Bay fall within the Greater Metropolitan WSP.

Under the WM Act there is a requirement to obtain aquifer interference approval where there is penetration of, interference with, or obstruction of flow to an aquifer. In the case of the proposed works borehole records obtained across the project site (see **Technical Appendix L**) have not recorded any groundwaters within the surficial dredged deposits or at the depths where the piled bores would be drilled to support the dolphins (see **Chapter 4, Proposed Works Description**) would be installed. As such, the proposed works would not interfere with an aquifer under the terms or provisions of this Act.

[1] Primary contact comprises activities undertaken in the water (such as swimming), secondary contact comprises activities undertaken on the water (such as boating, fishing etc.).
[2] The document refers to the limits of the ANZECC, 2001 which are consistent with the above limits.

10.4 Method of Assessment

10.4.1 Overview

The assessment of the potential dredging impacts on the physical and chemical characteristics of water and marine sediments has involved the following stages.

- Identification of the extent of Botany Bay and the surrounding area (including associated shoreline areas) that potentially could be impacted as a result of changes to water and sediment quality.
- Identification of the current marine and groundwater quality and sediment characteristics of the study area.
- Identification of the recreational, commercial and environmental receptors sensitive to changes in water and sediment quality.
- Simulation modelling of a number of scenarios to predict the potential dispersion and deposition of sediment and the potential bioavailability and toxicity impacts of tributyltin (TBT).
- Assessment of the magnitude of potential impacts on identified sensitive receptors.
- Identification of mitigation, in the form of modifications to the dredging operation and/or the implementation of management controls.
- Evaluation of the residual effects with the proposed mitigation and management commitments in place (if required).

10.4.2 Guidelines and Standards

This assessment has used the standards and limits set out in the Commonwealth *Guidelines for Fresh and Marine Water Quality 2000* as a basis on which to determine any impacts on water and sediment quality. It has also made reference to the licencing requirement of the *Protection of the Environment Operations Act* (POEO Act) *1997* and the actions of the Georges River – Botany Bay System: Statement of Intent.

10.4.3 Study Area and Timescales

The study area for this assessment includes all of Botany Bay and extends towards the mouth of the Georges River at Taren Point (see **Figure 8.1**). The assessment has considered the likely impacts that would occur during the proposed works and any impacts that would affect the environment in the long-term.

10.4.4 Baseline

Identification and description of the existing environment has involved reviewing previous data collected from Botany Bay[3] and appraising impact assessments conducted for recent development within the area. Relevant references are provided throughout this chapter.

[3] Cardno, Taylor, and Treloar (2007) and Sydney Ports Corporation/URS (2003).

10.4.5 Modelling

The likely impacts of the proposed works on local water and sediment quality is dependent upon how the dredged sediments would suspend and disperse within the water column and settle out over a given area. To understand this, modelling simulations have been used to predict these effects. These simulation predications have considered the existing bathymetry (seabed depth), hydrodynamics and wave and water current conditions within, and immediately outside the mouth of, Botany Bay (see **Chapter 8, Hydrodynamics and Coastal Processes**).

In each and every instance the modelling is conservative as:

- it assumes locations within the dredge footprint that are close to the sensitive receptors to the south;
- it presents the results based on 95th percentile outputs (which assume there only being a 5% probability of the results exceeding the provided results); and
- it assumes deposition to occur as a result of dredging for the full 23 weeks in the locations shown in **Figure 10-1** without accounting for the fact that the dredger would move further north during the works removing sediment from other locations[4].

The modelling simulations have predicted the effects of dredging, overflow operations and the placement of reusable sediments in the Bay (see **Section 4.4.9**). Accordingly, it has predicted:

- sediment dispersion near the surface (to simulate overflow operations) and near the seabed (to simulate dredging);
- the area of sediment deposition and its corresponding depth; and
- the concentration of TBT in deposited sediments post-dredging.

Modelling the dispersion and deposition of sediment has involved the assessment of three simulation scenarios representing:

- dredging the fixed berths (where no overflow dredging is permitted);
- dredging the sub berth and turning circle (where overflow dredging is permitted); and
- dredging the approaches (where overflow dredging is permitted).

The three modelling simulation scenarios have been specifically selected to represent locations within the dredge footprint in closest proximity to Silver Beach and Kamay Botany Bay National Park. The modelling simulation scenarios are shown in **Figure 10-1** and can be described as occurring:

- along the western limit of fixed berth #1 immediately adjacent to the Kurnell Wharf;
- within the turning circle, just seaward of the fixed berths; and
- on the eastern limit of the approaches close to the Kurnell Peninsula headland.

Simulations depict the proposed dredging schedule discussed in **Section 4.4.4**. The model represents a range of typical (yet conservative) hydrodynamic, wave and current conditions within Botany Bay. Dredging and overflow 'spill' rates included in the modelling simulations are as described in **Section 4.4.6**.

[4] This is due to the method adopted to calculate deposition as described in **Technical Appendix C**.

Physical and chemical analysis data collected by Worley Parsons (see **Technical Appendices D1** and **D2**) have been included as inputs for each modelled simulation scenario to predict the dispersion and deposition of sediment-bound TBT.

10.4.6 Sediment Dispersion

The assessment of sediment dispersion has used the calculated mean distribution of fines[5] within each area of the dredge footprint (see **Table 9-3**). Particle sizes larger than fines (defined as sand, gravel and cobbles (see **Table 9-2**)) are predicted to settle within a few metres of the dredger/hopper, whilst the process of flocculation[6] has not been modelled because most the fines are silts rather than clays and concentrations are low except at the plume generation locations where turbulence would quickly break up the flocs[7].

Two outputs have been produced from the sediment dispersion modelling.

- Plan plots, that show concentration contours near-surface and at the seabed. The surface plots have been used to assess the potential impacts of light reduction, whereas the seabed plots (only shown in **Technical Appendix C**) have been used to assess potential effects at depth.
- Time-series plots (only shown in **Technical Appendix C**), present the predicted suspended sediment concentrations at the aquaculture lease area to the west of the Kurnell Wharf and immediately offshore of Silver Beach (representative of the seagrass beds that occur in this region), this being the closest ecological sensitive area to the proposed works.

10.4.7 Sediment Deposition

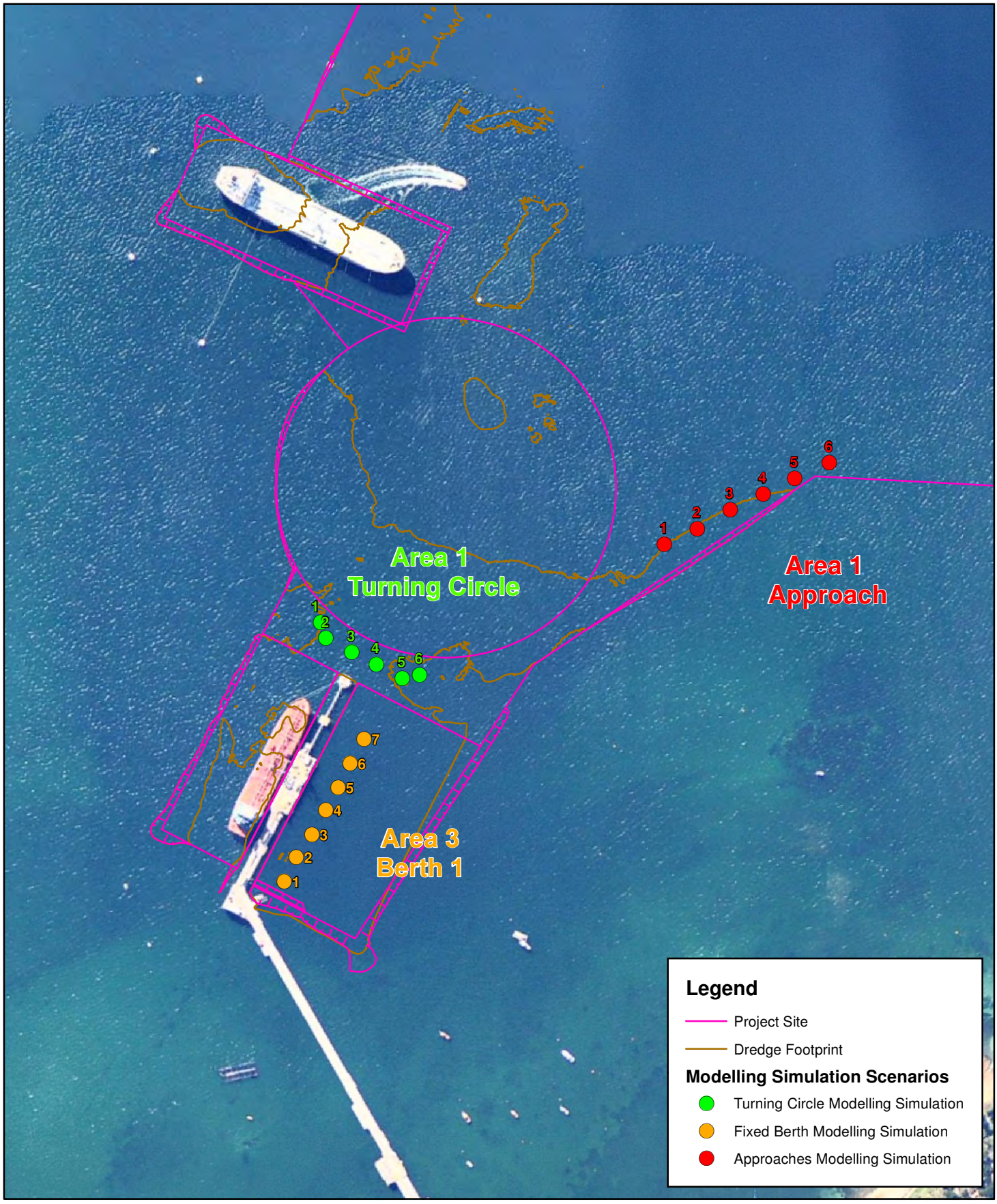
The magnitude and extent of sediment deposition that would occur over the 23-week dredging program has also been modelled. This has been achieved through aggregating the outputs from the three sediment dispersion modelling simulation scenarios and applying an appropriate settlement rate relative to the total volume of dredged sediments.

As noted above, the result is an overestimate because some of the dredging would occur further north than modelled. However, it does (conservatively) describe the siltation depths that would be expected as a result of the proposed works.

10.4.8 TBT Concentrations in Deposited Sediments

Calculations have been undertaken to assess the sediment-bound concentrations of TBT in deposited sediments. These calculations have been made using the outputs of the sediment deposition data (see **Section 10.6.2**) and extrapolating the sediment quality testing data gathered by Worley Parsons. A method regarding this work is included in **Technical Appendix D3**.

[5] As estimated by Worley Parsons (see **Technical Appendices D1** and **D2**)
[6] Where very fine colloids (which in this case represent clay particles) come out of suspension in the form of flocs
[7] Flocs are the formed where materials come out of suspension (akin to flakes).



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Source: Aerial Photography - Nearmap Hypertiles 2012.

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MODELLING SCENARIO LOCATIONS

URS

BOTANY BAY, NSW.

Figure: **10-1**

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10.4.9 TBT Concentrations in the Water Column

Modelling has been undertaken by Cardno (see **Technical Appendix C**) that considers the potential dispersion of dissolved TBT within the water column resulting from the disturbance of highly contaminated sediments within the project site during their removal. As shown in **Chapter 8, Spoil and Contamination**, these sediments are sufficiently contaminated to result in the creation of concentrations of TBT that exceed the water quality limits shown in **Table 10-1**.

10.4.10 Evaluation of the Magnitude of Impact

The magnitude of any potential impacts have been based on the threshold limits set for ecological protection and the protection of aquaculture resources included within *Guidelines for Fresh and Marine Water Quality* 2000. These are summarised in **Table 10-1**.

Table 10-1 Threshold Limits

Criteria and Standard	Limits
TBT	
Interim Sediment Quality Guidelines (ISQG)[8] to Provide Ecological Protection	
ISQG-Low	5 µgSn.kg^{-1}
ISQG-High	70 µgSn.kg^{-1}
Water Quality Trigger Limits for Toxicants to Provide Ecological Protection	<0.006 µgL^{-1}
Water Quality Trigger Limits for the Protection of Aquaculture (Saltwater Production)	<0.01 µgL^{-1}
Suspended Sediments	
Condition of Consent[9]	
Suspended Sediments (as an exceedance of background concentrations)	<50 mgL^{-1}
Trigger Limits for the protection of Aquaculture (Saltwater Production)	
Suspended Sediments	<10 mgL^{-1}
Protection of Recreational Water	
Visibility Reduction[10]	Not less than 20%

10.4.11 Assessment of Significance

The modelling has been used to indicate if there would be an increased risk of impact to the identified sensitive receptors (see **Section 10.5.4**) due to exceedances of the above threshold limits. In such cases, consideration has been given to the need to either undertake additional monitoring, include mitigation, or both.

[8] The ISQG low and high values correspond to the effects range-low and -median used in the US National Oceanic and Atmospheric Administration (NOAA) listing (Long *et al*. 1995). The low value provides an indicative trigger that there is a potential for adverse biological effects. The high value indicates the expectation of an adverse effect on biota.

[9] Included as a condition of consent for the Port Botany EA and Energy Australia Cable Crossing EA, where *All Dredging Associated with the Project Shall be Undertaken in Manner that does not cause turbidity…to exceed the background turbidity by more than an equivalent suspended solid concentration of 50 mgL^{-1}'.*

[10] Visibility is assessed by using a secchi depth, which is the depth at which a plate-sized black and white disk, when lowered in to the water, disappears from view.

10.5 Existing Environment

10.5.1 Sediment Characteristic

The bullet points below provide a summary of the characteristics of the dredged sediments as discussed in **Chapter 9, Spoil and Contamination** and the supporting **Technical Appendices D1** and **D2**.

- The proposed dredged sediments generally comprise sand, with some fines, occasional silt and gravel, and very occasional clay (see **Table 9-2**). The exception is within the fixed berths where muddy deposits and peat occur.
- The presence of TBT across the dredge footprint restricts the disposal and reuse of the dredged sediments onshore (see **Figure 9-4**).
- The sediments have the potential to generate acid sulphate conditions (see **Section 9.5.2**).
- Concentrations of TBT within the sediments are sufficiently elevated to exceed the ISQG-high threshold limit set for ecological protection (see **Table 10-1**).
- The highest concentrations of TBT have been used to assess both short and long-term toxicity effects.
  - Testing that simulates and predicts the water quality impacts of dredging has confirmed that the sediment-bound TBT is at sufficient concentration within parts of the project site that it would exceed the water quality limits set for ecological protection and aquaculture (see **Table 10-1**).
  - The toxicity testing has confirmed that there would be no reproductive impacts or long-term toxic effects to benthic organisms as a consequence of TBT release (see **Section 11.6.6**).

10.5.2 Ambient Conditions

Suspended Sediments

Within Botany Bay the suspended sediment concentration varies due to natural fluctuations in hydrodynamic, wave and water current conditions. During calm conditions, concentrations are typically recorded on average[11] at $5mgL^{-1}$. However following heavy rainfall, a high concentration of sediment enters the Bay from the Georges River (and to a lesser extent the Cooks River). Whilst this causes suspended sediment concentrations to vary across the Bay, average[7] sediment concentrations are estimated to reach 25 mgl^{1}. These concentrations can also be validated by the continual monitoring of the Bay undertaken by the Sydney Metropolitan Catchment Management Authority (SMCMA).

TBT

TBT was used as an antifouling agent in paint by an estimated 70% of the world's shipping fleet until an international ban preventing its application in 2003 followed by a ban preventing its presence in 2008. Due to the regular and frequent movement of ships into and out of Botany Bay for many years, TBT has been found in sediments taken and sampled from areas of high shipping activity[12].

[11] Cardno, Lawson, and Treloar (2007)
[12] URS/Sydney Ports Corporation (2003)

In 2002, a survey of toxicity to wild oysters determined that bioavailable TBT (i.e. TBT dissolved within water) was greater at sites close to the Port Botany Container Terminals compared to other parts of the Bay. Other recorded instances of toxic effects of TBT on oysters were noted:

- at the seawall at the front of the Patrick Stevedore Container Terminal, on the northwest side of Brotherson Dock;
- on the seawall at the end of Molineux Point;
- at the end of the third groyne from the west end of Silver Beach; and
- at the southern breakwater at the entrance of Cooks River[8].

Two years later in 2004, the Natural Heritage Trust collected TBT data at the aquaculture site west of the Kurnell Wharf[13]. This confirmed that concentrations of TBT in the sediments were below measurable detection limits.

Further information on the impacts of TBT-contaminated sediment in the marine environment is included in **Section 10.6.3**.

10.5.3 Hydrogeology and Groundwater

Botany Bay

Under Botany Bay there are substantial Quaternary deposits to far greater depths than on land (ranging between from 20 m depth around the outside of the Bay to 100 m within the central part of the Bay close to the shipping channel). The deposits provide a depression and low point which has caused the Bay's formation. The deposits contain clay lenses. In the case of the project site there is a substantial clay lens approximately 20 m below the seabed that is at least 7 m in thickness as confirmed through the borehole records in **Technical Appendix L**.

Groundwaters are absent from the project site to the depths where dredging or piling would take place (also confirmed through the borehole records), with any deeper groundwaters found within the Quaternary deposits locally isolated from the marine waters through the clay lens.

There is some capability for groundwater to exchange with the marine water at the shoreline, as confirmed through salinity measurements from bores drilled around the Bay. This exchange/interface is limited due to the stability in hydraulic pressure and gradient between the marine and groundwaters at their interface at the shoreline.

Surrounding Land

On land groundwater occurs within the surficial Quaternary unconsolidated sediments that overlay the Hawkesbury Sandstone (see **Chapter 9, Spoil and Contamination**). These Quaternary deposits are up to 35 m in thickness around the project site, with 15 m of saturated sand occurring on average.

The groundwater forms an unconfined to semi-confined aquifer in a formation known as the Botany Sands. The groundwater has been used as a water supply since the 19th century. It is still used by industry as well as to irrigate parks and golf courses across central Sydney.

[13] Natural Heritage Trust (Coasts and Clean Seas) Project (2004).

The groundwater balance within the aquifer is heavily influenced by rainfall and abstraction rates. Groundwater flow is generally towards Botany Bay from the surrounding land and is largely influenced by the strike and dip of the underlying Hawkesbury Sandstone. On land, the groundwater is encountered at shallow depths (less than 2 m).

The quality of the Botany Sands aquifer is variable. Salinity levels are generally low (ranging from 130 to 600 μScm^{-1}), except close to Botany Bay where some saline intrusion occurs (as discussed above). However, the salinity at the point of intrusion is not excessive and still within limits that reinforces the conclusion that there is limited (hydraulic) connectivity between the marine water and groundwater at the shoreline. The pH of the groundwater varies between 3.9-8.9. This is due several reasons, one of which is the peat lenses that occur within the Quaternary deposits found in the region.

Whilst there is a limited connectivity between the marine and groundwaters at the shoreline, the fact that the proposed works would occur a minimum of 800 m offshore, backed by there being no significant impact on the marine waters (as modelled and discussed above) would preclude there being any impact on, or risk to, groundwaters.

10.5.4 Sensitive Receptors

From the modelling it is clear that there are a number of areas that could be impacted by the dispersion and deposition of sediment as set out below.

Aquaculture

The closest active aquaculture areas are oyster farms located within Quibray Bay, Towra Point and Woolooware Bay, all of which are located west of the project site (see **Figure 17-1**). Further sites are located within the Georges River. A leased, yet inactive, pearl oyster farm is located 100 m south of the limit of the fixed berths. There is the potential for this site to be activated in the future under the terms of the lease, which at present prevent its use for farming oysters for human consumption.

Protected Areas

There are several protected areas associated with the intertidal areas and shoreline of the Bay. Those of relevance to this assessment include:

- extensive seagrass beds located along the southern shoreline, which also contain a range of threatened biota (see **Chapter 11, Ecology**);
- Towra Point Nature Reserve;
- Towra Point Aquatic Reserve;
- Cape Banks Aquatic Reserve;
- Taren and Dolls Point; and
- Kamay Botany Bay National Park (including Bare Island).

10.6 Impact Assessment

10.6.1 Sediment Dispersion

There is potential for sediment plumes to be created and to impact the marine environment of Botany Bay as a result of the following actions.

- *Operating the dredger.* This would disturb the seabed. Additional sediments would be released through lifting the sediments through the water column and loading them onto the hopper.
- *Filling the hoppers.* Where overflow dredging is proposed sediments would escape with the water that is allowed to flow out of the hopper (see **Section 4.4.6**).
- *Reusing the sediment*. Discharging the sediment by opening the hopper would result in sediment dispersing over the areas where reuse is proposed in Botany Bay (see **Section 4.4.9**).

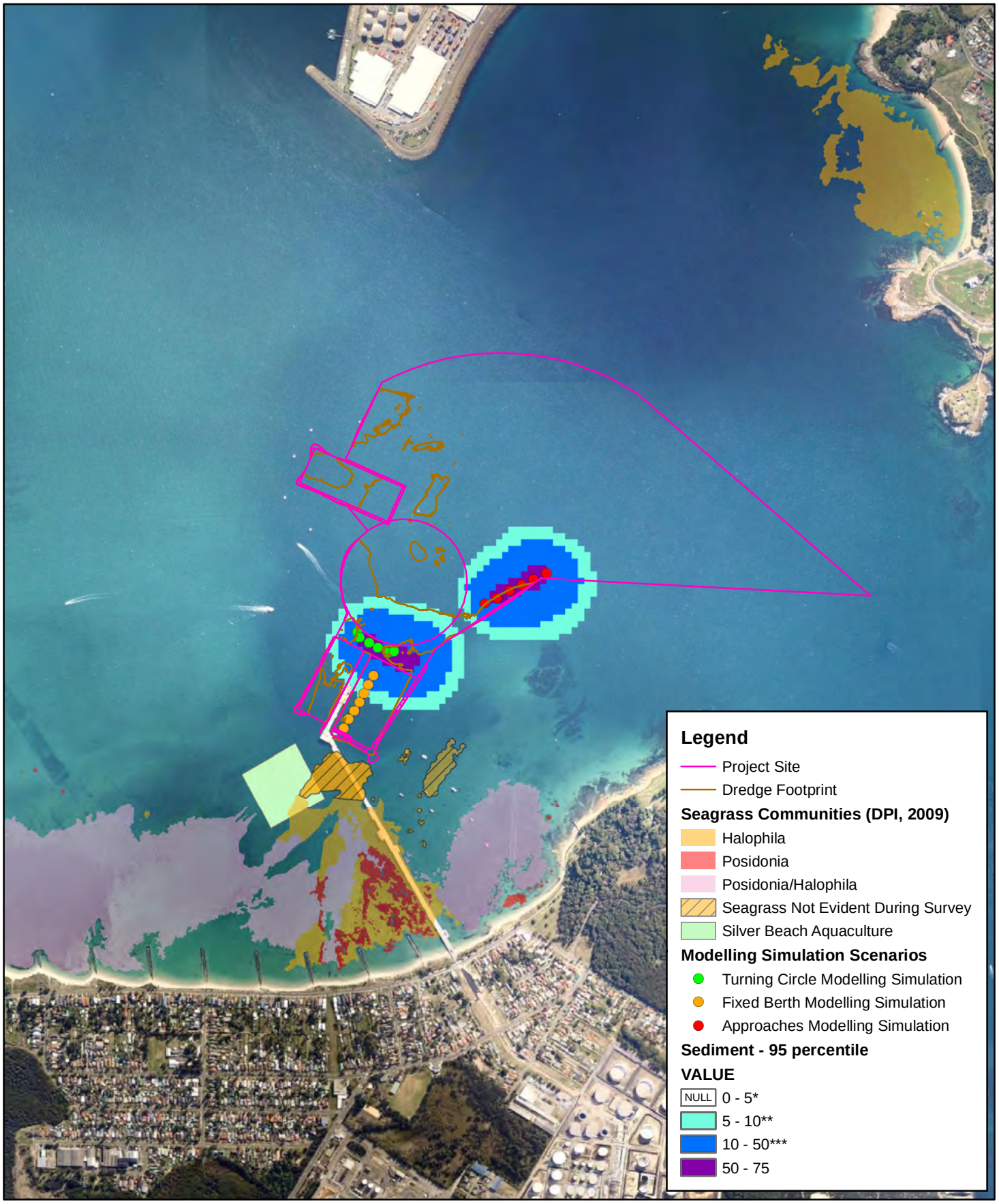
Potential impacts from sediment dispersion have been assessed by considering modelling simulation outputs in relation to the threshold trigger limits for suspended sediment of 10 mgL^{-1} and 50 mgL^{-1} (see **Table 10-1**) against a mean background suspended sediment concentration of 5 mgL^{-1} (see **Section 10.5.2**).

Figure 10-2 illustrates that the generation and dispersion of suspended sediments is the result of overflow operations taking place under the turning circle and approaches modelling simulation scenarios. The measured minimum and maximum distance of each threshold limit relative to the two modelling simulation scenarios is shown in **Table 10-2**.

The process of dredging (excluding overflow operations) is predicted to generate little sediment (5 mgL^{-1} or less). As such, it would have little contribution to the background concentration as shown by the supplementary plots within **Technical Appendix C**.

Table 10-2 Sediment Dispersion

Area	Distance (m) Near Surface Plots: Overflow Dredging		
Limit	50 mgL^{-1}	10 mgL^{-1}	*5 mgL^{-1}
Eastern Limit of the Approaches			
Minimum	10	90	150
Maximum	110	200	250
Turning Circle			
Minimum	30	110	150
Maximum	160	220	270
*Representative of the Mean Background Concentration			



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Grid: MGA Zone 56

Note:
** Background Limits (<5mg/l) ** Protection of Aquaculture Species (<10mg/l).*
**** Dredging limits for previous dredging works in Botany Bay (<50mg/l).*

Source: Aerial Imagery from Nearmaps 2012

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EXTENT OF DISPERSION NEAR-SURFACE

URS

BOTANY BAY, NSW.

Figure: **10-2**

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Figure 10-2 confirms that despite using overflow techniques the amount of generated suspended sediment falls to levels below 5 mgL^{-1} within a very short distance of the boundary of the project site. Beyond this distance there is unlikely to be any significant impact.

- The limits set for the protection of aquaculture would not be exceeded at the inactive pearl oyster farm (therefore permitting its activation during the works).
- The limits set for the protection of recreational water (see **Table 10-1**) would ensure the safe use of Botany Bay whilst the works are taking place.
- There would be no impact to of the sensitive receptors listed in **Section 10.5.4**.

Overflow operations are also unlikely to cause an impact on recreational visibility other than in the area immediately around the project site, which is unlikely to affect any of the amenity resources identified in **Chapter 17, Amenity, Land Use, Recreation and Navigation**.

The time series plots (see **Technical Appendix C**) support these conclusions by confirming that the predicted concentrations of suspended sediment at the aquaculture site west of the Kurnell Wharf and Silver Beach (see **Figure 10-1**) ranges from undetectable to approximately 3 mgL^{-1}.

Deployment of the Dredging Spuds

The installation of the anchoring spuds associated with the backhoe dredger would be the only structures associated with executing the proposed works that would have the potential to generate scour. Their deployment would cause some disturbance of the seabed and suspension of fine sediments.

However, this process would only occur approximately once each day and would only occur over a short period of time (less than 5 minutes per spud). The suspended sediment plumes described above show that the plume would disperse quickly following cessation of the proposed work and the same would apply in this case. There would be a small cloud of suspended sediment, noting that the backhoe would not be operating while the spuds were being placed and so this would not be an additional mass of coincident suspended sediments being swept away by the prevailing tidal currents.

10.6.2 Sediment Deposition

Figure 10-3 illustrates the sediment deposition that is predicted to occur across Botany Bay by the end of the 23-week dredging program. The predicted depths of sediment deposition are approximately:

- 10- 35 mm over an area covering much of the dredging footprint extending outside the project site to cover the northern limit of the seagrass beds (covering approximately 0.2% of the total extent of the non-endangered species paddleweed *Halophila ovalis* that occurs within Botany Bay[14]);
- 5-10 mm over an area that includes approximately 50 % of the pearl oyster farm and an additional 0.5% of the paddleweed beds that occur within the Bay;
- 1-5 mm over an area that extends half way along the length of the Wharf and covers the southern headland of Kamay Botany Bay National Park and further area of seagrass (which includes both *Halophila ovalis* (approximately 0.7% of the total coverage in Botany Bay), strapweed *Posidonia australis* (~0.03%) and mixed beds of *Halophila ovalis* /*Posidonia australis* (~2.7%); with

[14] These levels are estimates, based on best available data at the point of assessment.

- no predicted deposition occurring at either Towra Point Aquatic Reserve or Nature Reserve, Cape Banks Aquatic Reserve, Bare Island, Dolls Point or Taren Point.

These levels of deposition are indicative upper limits based on the conservatism and assumptions built in to the modelling simulations (see **Section 10.4.5**).

The potential impacts of sediment deposition upon the edge of the seagrass beds and the aquaculture lease area are discussed in **Chapter 11, Ecology**.

10.6.3 Dispersion and Availability of TBT

Overview

The potential impacts of TBT on the natural environment relate to its short term and long term toxicity. TBT can bioaccumulate (due to being soluble in fat) and biomagnify (increase in concentration) up the food chain. It can cause imposex (sex changes) to marine gastropods, immunosuppression and hearing loss in marine mammals, and obesity in humans due to the abnormal growth of fat cells. It is most toxic to bivalve larvae (oysters, mussels etc.), where studies have shown the lethal dose to be 1,000 times less than any other toxic compound introduced in the marine environment[15]. It is also shown to affect oyster reproduction in pearl farms[16]. For these reasons, stringent limits for TBT have been set for aquaculture and ecological protection in Australia (see **Table 10-1**).

TBT is moderately hydrophobic. It is rapidly adsorbed on to suspended particulate matter, sediments and seagrass. The toxicity persistence of TBT (how long TBT remains available in the marine environment before breaking down) is far greater when adsorbed to sediments (from months-to-years depending on localised conditions) compared to when TBT is dissolved in the water column (days-to-weeks)[17&18].

Assessment Outputs

In terms of the proposed works, a considerable quantity of the highly contaminated sediment would be removed for disposal offshore via sea dumping. During the process of dredging however there would be disturbance and agitation of these sediments at the seabed, whilst the process of overflow dredging would result in a quantity of sediment (some of which would contain adsorbed TBT) being returned to Botany Bay, where it would disperse thereafter.

However when TBT is mobilised as suspended sediment through dredging very little is released in a soluble form[19] .limiting its bioavailability. Equally, the generation of sediment plumes that contain TBT do not generally result in TBT accumulating in benthic sediments '*due to the high mobility of the suspended sediments and the instability of TBT in these conditions*'[20].

For these reasons this assessment has focused on:

- the predicted deposition concentration of sediment-bound TBT to consider any long-term effects; and
- the simulation tests undertaken by Worley Parsons that consider the bioaccumulation potential of TBT (see **Technical Appendix D1** and **D2**).

[15] His, E, Belras, R, Seaman MNL (1999)
[16] Inoue *et al*. (2004)
[17] Stembeck *et al. (*2006).
[18] Natural Heritage Trust (Coasts and Clean Seas) Project (2004).
[19] Cheung, Wing, Yung, (2002)
[20] Seligam, (1996)

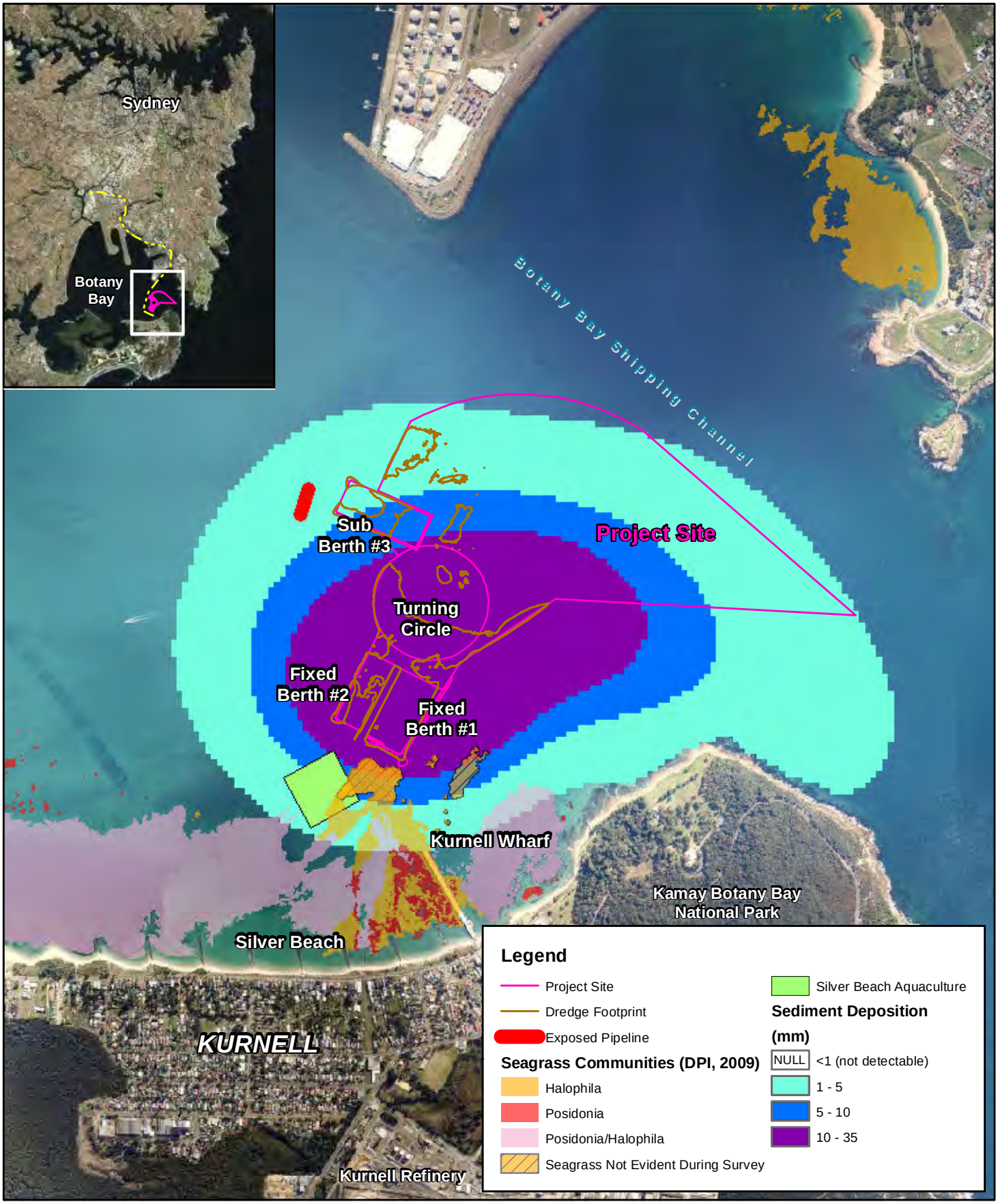
Deposition of Sediment-Bound TBT

Calculations have been used to predict the likely sediment-bound TBT within the deposited sediments. These calculations have been based on the deposition modelling undertaken by Cardno (see **Section 10.6.2**) and the sediment-bound TBT testing performed by Worley Parsons. The results have been compared against the sediment bound ISQG limits in **Table 10-1**. An explanation of the calculations is provided in **Technical Appendix D3**.

Table 10-3 Predicted TBT Concentration Post Dredging

Sediment Thickness	Approach/ Turning Circle ($\mu gSn.kg^{-1}$)	Sub-Berths ($\mu gSn.kg^{-1}$)	Fixed Berths ($\mu gSn.kg^{-1}$)	All Areas ($\mu gSn.kg^{-1}$)
35 mm	14.3	10.9	0.9	7.4
20 mm	8.2	6.2	0.5	4.3
15 mm	6.1	4.7	0.4	3.2
10 mm	4.1	3.1	0.3	2.1
5 mm	2.4	1.6	0.1	1.1
1 mm	0.4	0.3	0.03	0.2
Grey shaded cells demonstrate where the deposition is likely to exceed the ISQG-low threshold limit (see **Table 10-1**).				

Table 10-3 shows the predicted sediment-bound concentrations of TBT within the sediments that have been deposited as a result of the proposed dredging. It is predicted that only above 15 mm of deposition (largely within the dredge footprint, see **Figure 10-3**) would there be an exceedance of the ISQG-low threshold limit (accounting for the dredging that would take place within the turning circle and approaches). However, if the average is taken for all areas then it would require approximately 20 mm of deposition for there to be an exceedance of the ISQG-low threshold limit. Equally, the 95% upper confidence limit (UCL) data were used to ensure conservative modelling outputs. As such, it is considered unlikely that there would be a significant impact on the viability of the aquaculture site or the seagrass beds as a result of the deposition of significant sediment-bound concentrations of TBT in these locations.



N
W E
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0 75 150 300 450 600
Meters

Datum: GDA94
Grid: MGA Zone 56

Source: Aerial Imagery from Nearmap HyerTiles 2012.

CALTEX
Caltex Australia

KURNELL PORT AND BERTHING PROJECT

SEDIMENT DEPOSITION

URS

BOTANY BAY, NSW

Figure: 10-3

File No: 43177771.057.mxd Drawn: STB/SB Approved: CF Date: 20/12/2012

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Toxicity

Key to the assessment of toxicity is the bioavailability of TBT in the dispersed and deposited sediments. As discussed above, the dredged and overflow-generated sediments are unlikely to remain in suspension for sufficient time to generate levels of bioavailable TBT that would present a risk to the marine fauna by exceeding the water quality limits shown in **Table 10-1**.

With regard to deposited sediments there is a high degree of variability in the bioavailable portion of TBT in any given sample (i.e. there is no linear relationship between the sediment-bound concentration and the bioavailable concentration). This can be seen from the test results in **Technical Appendix D1** and **D2**).

What is clear however is that the predicted deposition would result in a sediment-bound TBT concentration of less than 5 $\mu gSn.kg^{-1}$ outside the project site (potentially around 2 $\mu gSn.kg^{-1}$ or less). At this concentration, it is anticipated that the bioavailable concentrations would be considerably lower; sufficient to be significantly below the water quality limits included in **Table 10-1** (i.e. <0.006 μgL^{-1} (for ecological protection) and <0.01 μgL^{-1} (for aquaculture protection)). Therefore, there is predicted to be no significant risk to the viability of the aquaculture lease area (and its availably to be used during the works) and/or impact from bioavailable TBT on the biota within seagrass beds.

There would be potentially higher concentrations of sediment-bound TBT deposited within the project site. Some of this sediment may be removed as the dredging works progress (something not considered in the deposition modelling) therefore reducing concentrations further. Anything remaining would be of a significantly lower concentration than found at present and would be unlikely to become bioavailable at concentrations high enough to cause a significant impact to the identified sensitive receptors. This conclusion is further supported by the distance between the area where sediments would be deposited and the location of the sensitive receptors backed by the toxicity testing discussed in **Chapter 9, Spoil and Contamination** and **Chapter 11, Ecology**.

TBT Concentrations in the Water Column

The final consideration has been the generation and dispersion (at source) of dissolved TBT within the water column resulting from the agitation and disturbance of sediments during their removal. The elutriate tests conducted on these sediments (see **Table 9-4**) confirm their potential to generate TBT at concentrations exceeding the threshold limits for water quality in **Table 10-1**. For each of the modelling simulation scenarios above, Cardno has assumed the sediments would generate the full 'elutriate' concentration listed in **Table 9-4** with the modelling showing how this would disperse across Botany Bay. This has confirmed in every instance, that concentrations would fall to zero within a short distance within the confines of the project site (see figures 7.1-7.8 in **Technical Appendix C**).

10.6.4 Groundwater

The limited connectivity between the marine and ground waters at the point where they interface (i.e. at the shoreline, which is away from the project site), and the absence of any confined groundwater under the project site, confirms that there would be no likely impact to groundwater levels, flows or quality as a result of the proposed works.

10.6.5 Pollution to Marine Waters during Construction

The potential to pollute marine waters through an unplanned, atypical or emergency situation when undertaking the proposed works would remain a risk. The preliminary hazard analysis (PHA) undertaken to support this EIS has included a number of appropriate measures to mitigate any such impacts. These are discussed in **Section 15.7**.

10.6.6 Structural Stability

The concept design for the proposed works has assessed if the existing structures would continue to provide adequate strength and stability for the proposal to increase the effective depth of the seabed to 12.8 m below Chart Datum (CD).

This has led to the proposed inclusion of a rock revetment and sheet pile wall to prevent the existing wharf piles being undermined at the south of fixed berth #1 (see **Section 4.5.1**).

At this stage there is no predicted impact on any other structures within or along, the shoreline as indicated through the results of the hydrodynamic and wind-wave modelling discussed in **Chapter 8, Hydrodynamics and Coastal Processes**. This is due to the predicted localised and minor changes that would occur to the hydrodynamics as a result of the proposed works. These changes are discussed further in **Chapter 8, Hydrodynamics and Coastal Processes**.

10.6.7 Operational Impacts

The ongoing operation of the port and berthing facility would not change as a result of the proposed works. There would be no requirement to manage additional discharges with the potential to impact water quality. In fact the likely decrease in shipping would reduce the potential likelihood of an impact to water quality, backed by the implementation of safer berthing equipment and hydraulic loading arms. Any such change to the operational hazard profile of the port and berthing facility as a result of the proposed works has been considered in the PHA (see **Chapter 15, Hazards and Risk Assessment**).

With regard to the specific management of ballast and bilge water, this would be consistent with existing practices. These are as follows.

- In accordance with the International Maritime Organisation (IMO) all ships are required to have in place a Ballast Water and Sediment Management Plan. Ships are required to carry a Ballast Water Record Book and carry out ballast water management procedures that accord with International Convention for the Control and Management of Ships' Ballast Water and Sediments (of which Australia is a signatory), the IMO Guidelines for the Control and Management of Ships' Ballast Water (2004) and the Australian Ballast Water Management Requirements (Version 5) (DAFF, 2011).
- The Department of Agriculture, Fisheries and Forestry (DAFF) who oversees ballast water management in Australia, discourages the discharge of high-risk (polluted) ballast waters in areas like Botany Bay favouring methods to manage the water in territorial seas (12 nautical miles from the coast) where there the environment allows for sufficient dilution and mixing. This process also ensures there would be no introduction of pest species into the marine environment (see **Chapter 11, Ecology**).
- The discharge of bilge water is not permitted within coastal NSW waters. Any bilge waters generated during the proposed works would be pumped and collected for disposal onshore.

Provided these measures are implemented, no adverse impacts on sediments or water quality are expected during operation of the port and berthing facility.

10.7 Mitigation

10.7.1 Overview

The modelling and calculations have predicted that the proposed dredging works would result in a localised impact in terms of the suspended sediments generated principally through overflow operations. A conservative assessment has been undertaken to predict the whole-project sediment deposition that would occur. This demonstrates that approximately 5-10 mm of sediment would deposit over half the aquaculture site and northern limit of the seagrass beds and 1 mm over a larger area including the headland of Kamay Botany Bay National Park. In terms of TBT deposition and its solution, a large amount of the TBT would be removed through dredging. Of the remaining sediment-bound TBT, the majority would settle outside the project site at a concentration less than the ISQG-low threshold limit. In addition, there would be no significant impact should TBT dissolve in to the marine waters as a result of disturbing the contaminated sediments.

10.7.2 General Works Management

The proposed dredging includes a number of inherent measures to limit turbidity and sedimentation impacts. The restrictions on overflow dredging within the fixed berths provides the best form of management as this process has the greater influence on sediment dispersion and turbidity as confirmed through the modelling outputs (see **Section 10.6.1**). Beyond the fixed berths the assessment has confirmed the remaining dredged material would predominantly comprise sand, which causes limited sediment plumes due to it falling out of suspension within a short distance of the dredging operations.

As noted in **Chapter 4, Proposed Description Works** whilst there is a preference to dredge 24-7, the continuous dredging of the berths would not be possible if they are to remain functionally operational during the works. Any breaks in the dredging schedule or the dredger moving from one area to another would aid in reducing the risk and duration and intensity of sediment plumes and turbidity.

It is anticipated that during the works there would be two days per fortnight lost to berthing and unloading in fixed berth #1 and 3-4 days per fortnight lost in fixed berth #2 and the sub berth. The modelling undertaken to support the EIS is conservative as it does not account for the shipping schedule. These periodic breaks would allow the turbidity to settle out of suspension. Beyond these measures additional mitigation and monitoring measures are set out below.

Key amongst the mitigation measures would be the implementation of the *Dredge and Spoil Disposal Management Plan* (DSDMP), which would include dredging management measures to minimise any water quality impacts. These measures would be consistent with the requirements set out under **Section 9.7.2**.

10.7.3 Monitoring

Modelling Verification Monitoring

Monitoring would also be undertaken to verify the results of the modelling. The monitoring program would be used to confirm the concentration of suspended sediments during dredging.

The monitoring would form part of the proposed *Dredge and Spoil Disposal Management Plan* (DSDMP) discussed in **Chapter 9, Spoil and Contamination**.

Suspended Sediment Monitoring

During the dredging works, suspended sediment monitoring (measured as turbidity) would be undertaken at the limit of the project site, with additional monitoring taking place within the aquaculture lease area and at a number of locations within the limits and extent of the seagrass beds close to the project site.

The above assessment has been based on a validated background suspended sediment concentration for the area of Botany Bay covered by the proposed works[21]. This concentration has been adopted for several recent assessments[22]. Regardless, Caltex proposes validating current levels through collecting representative background (dry-weather) suspended sediment concentrations prior to starting the works. This would provide confidence in the modelling results by indicating whether the background concentrations adopted in this assessment were accurate and representative of normal dry-weather conditions experienced in this part of Botany Bay in 2013. In the exceptional instance that the mean background concentration would differ from that used in this assessment, then the results and mitigation measures would be reviewed and revised accordingly.

Under the assumption of using the current background limit, continuous 'live' turbidity monitoring would be undertaken during the dredging works based on the following criteria:

- a limit of 50 mgL^{-1} (under normal dry weather conditions) at the outer limit of the project site; and
- a limit of 10 mgL^{-1} (under normal dry weather) at the aquaculture lease site and seagrass bed locations.

The above 'live' monitoring would be used to validate and confirm the modelling under the expectation that the actual levels would be less due to the conservatism built in to the modelling simulations (see **Section 10.4.5**).

No monitoring would be proposed at any of the other sensitive receptors. The turbidity monitoring would form part of a *Sediment and Water Quality Monitoring Program* (SWQMP), itself a sub-plan to the DSDMP.

10.7.4 Physico-Chemical Stressor Monitoring

As a precautionary approach a number of potential physico-chemical[23] stressors indicators (pH and DO) would also be monitored during the dredging works.

These would be required to ensure there was no change to the acidity of the area due to the presence of acid sulfate soils (ASS) (see **Chapter 9, Spoil and Contamination**) or, given the presence of peat within the fixed berths (see **Section 9.5.4**), no reduction in DO (i.e. the development of anoxic conditions)[24]. The results would be compared against the physico-chemical limits set by the *Water Quality Guidelines for Fresh and Marine Waters* 2000 for ecological and aquaculture protection.

These tests would be undertaken in parallel with the turbidity monitoring at the limit of the project site and form part of the DSDMP.

[21] Cardno, Taylor, and Treloar (2007).
[22] EA Cable Crossing EA (2007) and the Desalination Pipeline EA (2008).
[23] Refers to the physical (e.g. temperature, electrical conductivity) and chemical (e.g. concentrations of nitrate, mercury) characteristics of water.
[24] Temperate and salinity has been excluded for the above parameters as it is not considered likely that the dredged sediments would remain within the hopper for sufficient time to lead to evaporation and/or cause the excess water to warm-up prior to dewatering.

10.7.5 Additional Mitigation

Should a persistent exceedance be detected in the above parameters whilst the proposed dredging works are taking place, the works would temporarily stop and either the spill generated from overflow dredging would be reduced (i.e. rate of discharge of overflow water), or in an extreme case, stopped, with the removal of all the excess water to the Sydney Offshore Spoil Ground.

10.7.6 Licence Requirement

The reuse of sediment within Botany Bay is defined as pollution under the POEO Act and therefore requires that an associated licence be obtained.

10.7.7 Structural Stability

Further structural investigations would be conducted during the detailed design phase of the project to confirm the design specifications of the Wharf, whilst highlighting the need for any additional strengthening and stability requirements. These investigations would support the mitigation measure to further assess the potential for scour and erosion to occur around the berths, jetty and Wharf (see **Table 8-1**).

10.7.8 Spill Management

The controls currently in place to manage spill risk at the port and berthing facility would be extended to the works' contractors (see **Section 15.7**). A works-specific *Spill Control Plan* (SCP) would form a sub-plan to the DSDMP to set out these provisions. Regular inspections carried out as part of executing the DSDMP would ensure conformance with the provisions of the SCP. The works' contractors would be required to schedule regular maintenance of their equipment (as allowed for in the program (see **Section 4.4.2**)), whilst ensuring that spill containment provisions would be available to support the proposed works.

10.7.9 Residual Effects

With the proposed live monitoring as well as the implementation of further mitigation and management measures if required, it is predicted that the proposed works would not compromise the environmental values and management goals of the Georges River – Botany Bay System: Statement of Intent, whilst satisfying the criteria set by the *Water Quality Guidelines for Fresh and Marine Waters* to ensure ecological and aquaculture protection.

10.7.10 Summary

Table 10-4 provides a summary of the proposed mitigation and management measures to be implemented during the proposed works to ensure no significant impacts on water and sediment quality in Botany Bay.

Table 10-4 Water and Sediment Quality Mitigation and Management Measures

Mitigation and Management Measures	Implementation of mitigation measures		
	Design	Implementation	Operation
A *Sediment and Water Quality Monitoring Program* (SWQMP) would be developed and implemented prior to, and during, the proposed dredging works. This would form part of the DSDMP.		✓	
The SWQMP would include that turbidity monitoring be undertaken for the duration of the dredging works. This would be undertaken at the limit of the project site, within the aquaculture site and at a number of locations within the limit of the seagrass beds. The sampling would include: • obtaining background concentrations during dry weather conditions prior to dredging to confirm the limit of 5 mgL^{-1} as being representative of the baseline; and • live monitoring during the dredging works to ensure limits of 50 mgL^{-1} were achieved at the outer limit of the project site and 10 mgL^{-1} at the aquaculture lease site and seagrass bed locations.		✓	
The SWQMP would include a monitoring program for pH and dissolved oxygen at the limit of the project site, to be undertaken for the duration of the dredging works. These parameters would be compared against the limits set by the *Water Quality Guidelines for Fresh and Marine Waters 2000*. The sampling would include: • obtaining background concentrations prior to dredging; and • live monitoring during the dredging works to ensure the above limits were achieved.		✓	
Should any of the monitored parameters persistently exceed the threshold limits within the *Water Quality Guidelines for Fresh and Marine Waters 2000,* works would temporarily stop and either the spill rate would be reduced, or in extreme cases (i.e. where more than three exceedances were detected in a 24-hour period), overflow dredging would be halted temporarily in favour of removing excess water to the Sydney Offshore Spoil Ground.		✓	
A licence would be obtained under Section 120 of the POEO Act prior to commencing the works.		✓	
Further structural investigations would be conducted during the detailed design phase of the project to confirm the design specifications of the Wharf, whilst highlighting the need for any additional strengthening and stability requirements.	✓		
A *Spill Control Plan* (SCP) would form part of the DSDMP and CEMP. It would include controls currently in place at the port and berthing facility to manage spill risks. The SCP would include: • the requirement for staff to understand the limitations, controls, and methods to manage and prevent spills; • the protocol for reporting spills and the consequential actions to cease works immediately; • the need for regular inspections by the works' contractor to ensure the adoption of the relevant spill-management controls; • the need to plan for regular equipment maintenance; and • the requirement for spill containment provisions to be available to support the proposed works.	✓		
A *Sediment and Water Quality Monitoring Program* (SWQMP) would be developed and implemented prior to, and during, the proposed dredging works. This would form part of the DSDMP.		✓	

11 Ecology

11.1 Introduction

The following chapter assesses the potential impacts to the ecology (flora and fauna) of Botany Bay and the surrounding area as a result of the proposed works as described in **Chapter 4, Proposed Works Description**. It does this by considering the potential effects of the proposed works on the protected areas, marine habitats, flora and fauna in the area, as well as the potential for bioaccumulation (the uptake of toxins by marine species) and effects on recreationally fished and aquaculture species.

A range of supporting technical ecological information has been prepared in **Technical Appendix E,** which is referenced throughout this chapter. This includes: threatened species searches performed under the Commonwealth Environment Protection and Biodiversity Conservation Act (EPBC) Act, NSW Threatened Species Conservation (TSC) Act and NSW Fisheries Management (FM) Act; and species habitat requirements that have been used to inform the preparation of a number of relevant NSW Assessments of Significance (AOS) and Commonwealth Significant Impact Criteria (SIC) (see **Technical Appendix E**). These have been used as an input to the assessment of potential impacts of the proposed works.

This assessment of potential ecology impacts has also used the outputs of the hydrodynamic and coastal process modelling discussed in **Chapter 8, Hydrodynamics and Coastal Process** along with the data, assessment and conclusions of the impact assessments relating to water and sediment quality (see **Chapter 10, Water and Sediment Quality**).

11.2 Scope

The Director General's Requirements (DGRs) (see **Technical Appendix A**) requested that consideration be given to:

- "potential impacts on flora and fauna (including aquatic mammals and reptiles), nature and aquatic reserves and habitat including habitat loss, fragmentation, movement barriers and changed hydrodynamic conditions;
- impacts on threatened/endangered species, populations, and ecological communities and/or critical habitat;
- consideration of estuarine and groundwater dependent ecosystems, wetlands (including Towra Point Nature Reserve and Towra Point Aquatic Reserve) and mangroves adjacent to and up-river from the development;
- potential mobilisation of sediments and increased turbidity levels (including contaminated sediments) on aquatic flora and fauna;
- consideration of impacts associated with hydrodynamic changes;
- details of how impacts would be managed during construction and operation, the suitability of measures and adaptive management and maintenance protocols and monitoring programs;
- details of available offset measures to compensate the biodiversity impacts of the proposal, if necessary. Where offset measures are proposed these should be consistent with the Principles for the use of biodiversity offsets in NSW; and

- taking into account the Threatened Species Assessment Guidelines (NSW DPI, 2008)) and the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (DEC, 2004), Guidelines for Developments Adjoining Land and Water Managed by the Department of Environment, Climate Change and Water (DECCW, 2010) and Policy and Guidelines for Aquatic Habitat Management and Fish Conservation (DPI, 1999)."

A number of associated issues have also been raised by statutory agencies. They include:

- consideration of the dispersion of tributyltin (TBT) and its potential impacts on the viability of molluscs, spat and other aquatic fauna[1];
- the potential impacts on aquaculture and recreational fishing in terms of bioaccumulation and subsequent impacts to human health or the ecological food chain affecting threatened and migratory shorebirds (that feed on the adjacent intertidal mudflats) and other marine fauna;
- impacts on marine vegetation from direct removal, turbidity, sediment deposition, and erosion;
- impacts on intertidal habitats (with a map to show any corresponding impacts);
- specific consideration of potential impacts on seagrass beds, with particular note of strapweed (*Posidonia australis*);
- the potential impacts of shipping on biodiversity, including collisions, entanglement, avoidance of migration patterns, and the effects of artificial light;
- consideration of other protected areas and associated ecological communities within the region; and
- identification of the requirement for supplementary monitoring programs.

An assessment of the potential impact on marine mammals and fish arising from underwater noise generated as a result the proposed works is discussed in **Chapter 13, Noise** and summarised in this chapter.

11.3 Legislation and Planning Policy

11.3.1 International Conventions

Convention on Wetlands of International Importance 1971

The above convention (commonly known as the Ramsar Convention) is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Under the convention, member countries are encouraged to nominate sites containing representative, rare or unique wetlands, or those that are important for conserving biological diversity. These are commonly referred to as Ramsar sites.

[1] Taken to mean reference to the early life-history and in particular gastropods

11.3.2 Commonwealth Legislation

Environment Protection and Biodiversity Conservation Act 1999

The purpose of the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) is to ensure that actions likely to cause a significant impact on a Matter of National Environmental Significance (MNES) undergo an assessment and approval process. Under the EPBC Act, an action includes a project, undertaking, development or activity. An action that '*has, would have or is likely to have a significant impact on a matter of national environmental significance*' may not be undertaken without prior approval from the Commonwealth Minister of the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC).

- The MNES of relevance for consideration in this chapter are:
- Towra Point Nature Reserve, a designated Ramsar wetland (603.7 hectares) located approximately 1.5 km from the project site (see Technical Appendix E10); and
- a number of migratory and threatened species and ecological communities.

The *Administrative Guidelines* for the EPBC Act set out criteria to assist in assessing whether an 'action' is controlled under this Act and therefore requires Commonwealth Ministerial approval. In particular, the guidelines contain criteria for assessing whether the action is likely to have a significant impact on a MNES. These criteria are known as *Significant Impact Criteria* (SICs).

In instances where the applicant believes there to be a significant impact, or there is any uncertainty, a referral is made to the Commonwealth Minister for SEWPAC to confirm whether the proposed works constitute a 'controlled action'.

SIC assessments were undertaken for those species listed under the EPBC Act that were considered to have a high likelihood of being impacted by the proposed works (see **Appendix E9**). The results of the SIC assessments indicate that it is considered unlikely that the proposed dredging works would have a significant impact on any MNES listed under the EPBC Act, and therefore an EPBC Referral was not pursued for this proposed works.

11.3.3 State Legislation and Policy

National Parks and Wildlife Act 1974

The NP&W Act sets out responsibilities for the care, control and management of all national parks, historic sites, nature reserves, reserves, Aboriginal areas and state game reserves.

Ecologically, this Act administers the protection of flora and fauna. It makes it an offense to harm any threatened biota protected under the NP&W Act without the necessary licence or development consent. It also enables the creation of State-protected sites of ecological value.

The relevant provisions of the NPW Act and key relevant state-protected sites of ecological value have been considered in this chapter to ensure the protection of any associated listed species.

Fisheries Management Act 1994

The objects of the FM Act are to conserve, develop and share the fisheries resources of NSW for the benefit of present and future generations.

Part 7A of the FM Act provides for the conservation of all biological diversity of aquatic and marine vegetation. It also ensures that the impact of any 'action' affecting threatened species, populations or ecological communities is appropriately assessed. Schedule 6C outlines the marine vegetation that is listed as noxious marine vegetation under the Act.

Schedules to the FM Act provide the listings of aquatic threatened species, populations, ecological communities and listed noxious marine vegetation that would be considered in this assessment.

Section 197D of the FM Act sets out requirements for the determination of development applications under Part 4 of the EP&A Act that have the potential to impact on aquatic reserves, and specifically that it must give consideration to the objectives of the FM Act.

Threatened Species Conservation Act 1995

The TSC Act gives legal status for threatened biota of conservation significance in NSW. The principal aim of this Act is to 'conserve biological diversity and promote ecologically sustainable development'.

The TSC Act ensures the protection of 'threatened species, populations and ecological communities'. A list of 'endangered' species, populations and communities is included under Schedule 1. 'Critically endangered' species and endangered communities are listed under Schedule 1A. 'Vulnerable' species and communities are listed under Schedule 2. The TSC Act identifies a number of Key Threatening Processes under Schedule 3, which are also considered within this assessment.

This assessment has utilised the TSC Act and its related threatened species assessment guidelines (NSW DECC, 2007) in preparing this EIS. Assessments of Significance (AOS) assessments were undertaken for those species listed under the TSC Act that were considered to have a high likelihood of being impacted by the proposed works (see **Appendix E8**).

State Environmental Planning Policies

State Environmental Planning Policies (SEPPs) that are potentially relevant to this assessment include the following.

- SEPP Kurnell Peninsula 1989.
  - SEPP Kurnell Peninsula provides local planning policy for the only part of the project site that falls within an LGA. It contains provisions relating to development control and environmental planning.
- SEPP N^{o}14 Coastal Wetlands 2000.
  - SEPP N^{o}14 does not directly apply to the proposed works as this SEPP was not found to extend into the study area, or coincide with the Towra Point Nature Reserve Ramsar site, Taren Point or Dolls Point.
- SEPP N^{o}71 Coastal Protection 2002.
  - SEPP N^{o}71 aims to '*protect and manage the natural, cultural, recreational and economic attributes of the NSW coast*' through the preservation of a range of coastal assets. The policy aims to ensure that development in the NSW coastal zone is appropriate and suitably located. The proposed works do not fall within the NSW coastal zone as defined under this SEPP (refer to **Figure 11-1**).

- SEPP N^{o}62 Sustainable Aquaculture 2000.
  - Under Part 3A of SEPP N^{o}62 consent authorities are required to consider whether a development may have an adverse effect on oyster aquaculture due to its nature and location. Dredging and commercial port facilities are identified as development that may have adverse impacts on oyster aquaculture. This chapter has considered the impacts of the proposed works on oyster aquaculture. The development application (DA) would be referred to the Department of Primary Industries (DPI) (Fisheries) for comment once lodged.

Further information on each of these SEPPs and their relevance to this assessment are included in **Section 5.5.1.**

11.4 Method of Assessment

11.4.1 Overview

The ecological assessment methodology comprised the following key components:

- review of relevant guidance and standards;
- desktop review of relevant ecological data;
- field surveys; and
- a Habitat Suitability Assessment (HSA).

Information gathered via the above listed methods was then used to assess the potential impacts on the ecological values of the study area (see **Section 11.4.3**). Where impacts were predicted to be significant, avoidance and mitigation measures have been suggested, and if relevant, residual impacts noted.

The methodologies used for each stage are discussed in the following sections.

11.4.2 Guidelines and Standards

The assessment has been undertaken in accordance with the following guidelines, principles and resources:

- the Threatened Species Assessment Guidelines, the AOS (DECC, 2008);
- the MNES, SIC Assessment Guidelines (DEWHA 2009);
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (DEC, 2004);
- Draft Guidelines for Threatened Species Assessment (DEC & DP&I 2005);
- the principles of offset as adopted in NSW;
- the principles of ecologically sustainable development (ESD); and
- the Manual for Mapping and Monitoring Seagrass Resources (McKenzie *et al*, 2003).

11.4.3 The Project Area and Study Area

For the purposes of this assessment the project site and the study area are considered separately. The project site includes the active area of dredging and its immediate environs, as shown on **Figure 11-1**.

The study area includes:

- the area of Botany Bay approximately 1 km south, west and east of the project site (as defined by the conclusions of the assessment in **Chapter 10, Water and Sediment Quality**), including the areas where the sediments would be reused (see **Section 4.4.9**);
- the intertidal and coastal areas that form part of the Kamay Botany Bay National Park, Bare Island, Silver Beach and the areas within Woolooware and Quibray Bays; and
- the protected areas of Towra Point, Dolls Point and Taren Point.

11.4.4 Desktop Review

A desktop review has been completed to identify all potential ecological values with respect to State and Commonwealth listed threatened flora, fauna, populations and ecological communities (biota), as well as all MNES up to 5 km from the proposed works. A 5 km search area was applied to searches to cover marine and intertidal habitat that could potentially be affected by the proposed works, whilst excluding extensive terrestrial areas that would not be relevant to the assessment. Ecological values have been obtained by reviewing the following documentation prior to the field survey.

- The SEWPAC Protected Matters Search Tool (PMST) online database for all species, communities and other EPBC Act MNES selected for a 5 km buffer around the study area on 8 March 2012 (see to **Technical Appendix E1**).
- A NSW Office of Environment and Heritage (OEH) Bionet search of the Atlas of NSW Wildlife *Records Download* and *Species List* for NSW and Commonwealth-listed threatened species potentially occurring within or surrounding the study area, on 16 March 2012 (see **Technical Appendix E2**) (see **Figure 11-2**).
- A NSW OEH Geographic Information System (GIS) spatial data request was sent to the Spatial Data Programs Unit of OEH for all records of threatened species within the Port-Hacking (9129) and Sydney (9130) 1:100 000 map sheets, on 16 March 2012 (see **Figure 11-2**).
- The NSW Department of Primary of Industries (DPI) Fishing and Aquaculture Species Protection 'Find a Species by Geographic Region' online records viewer for the Sydney Metro CMA on 21 March 2012 (see **Technical Appendix E3**).
- The NSW Department of DPI FM Act listings of threatened fish and marine vegetation search results for the Sydney Metro Catchment Management Authority (SMCMA) on the 27 March 2012 (see **Technical Appendix E4**).
- The NSW OEH CMA sub-region search online database for the Sydney CMA sub-region for threatened populations and TECs potentially occurring within the study area or surrounding environs, on 29 June 2012 (see **Technical Appendix E5**).
- A NSW DPI Mapping the Estuarine Habitats of NSW request for the spatial data layers associated with the map title Botany Bay and Cooks River, on 10 May 2012 (refer to **Figure 11-2**).
- A Wildlife Link Bird Life Australia Search 13 December 2012.
- A NSW Government Community Access to Natural Resources Information (CANRI) Spatial Data Download for shape file datasets for SEPP *N*^{o}14 – Coastal Wetlands protected areas, and SEPP No71 – Coastal Protection, on 21 March 2012.
- Aerial imagery over time for the study area (NearMap 2012; Google Maps 2012).

The desktop review also identified the potential for bioaccumulation-related impacts in relation to the proposed works, through review of the following.

- National Water Quality Management Strategy: Paper No 4 -Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 1 - The Guidelines (Chapters 3 – Aquatic Ecosystems). Australian and New Zealand Environment and Conservation Council/Agriculture and Resource Management Council of Australia and New Zealand, October 2000.
- Advancing Australia's Sediment Quality Guidelines. Australasian Journal of Ecotoxicology 14: 11-20 *Bately G* and *Simpson S* (2008).
- National Assessment Guidelines for Dredging (DEWHA) (2009).
- Caltex Dredging: Sediment Sampling and Analysis Plan (SAP) Implementation Report – Final Report. Worley Parsons Pty Ltd, Worley Parsons (2012) (see **Technical Appendix D2**).

Previous seagrass studies within Botany Bay have also been reviewed and used as baseline data in order to determine the current extent and distribution of seagrass communities in the study area (see **Technical Appendix E11**). Key data sources included:

- aerial photography (NearMaps, 2012; GoogleMaps, 2012) to identify the extent of the seagrass beds in the study area in 2012; and
- Creese RG, Glasby TM, West G, Gallen C (2009) Mapping the Habitats of NSW Estuaries. NSW I&I – Fisheries (now NSW DPI (Fisheries)) Final Report Series No. 113.

Information on recreationally fished species and their habitat, and information on local aquaculture activities was also gathered to understand any potential constraints related to these aspects.

Legend

- Towra Point Aquatic Reserve ^^
- Silver Beach Aquaculture
- Dredge Footprint
- Project Site
- Submarine Fuel Pipelines
- Ramsar Wetlands
- Estuarine Macrophytes *
- SEPP 71 - Coastal Protection ^

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Datum: GDA 1994
Grid: MGA Zone 56

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Kilometres

Source: Aerial Imagery from Bing Maps © 2010 Microsoft Corporation and its data supplies.
* NSW DPI 2008
^ Community Access to Natural Resources Information (CANRI)
^^ Office of Environment and Heritage (OEH)

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KURNELL PORT AND BERTHING PROJECT, BOTANY BAY

ECOLOGY PROJECT SITE AND STUDY AREA

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Figure: 11-1

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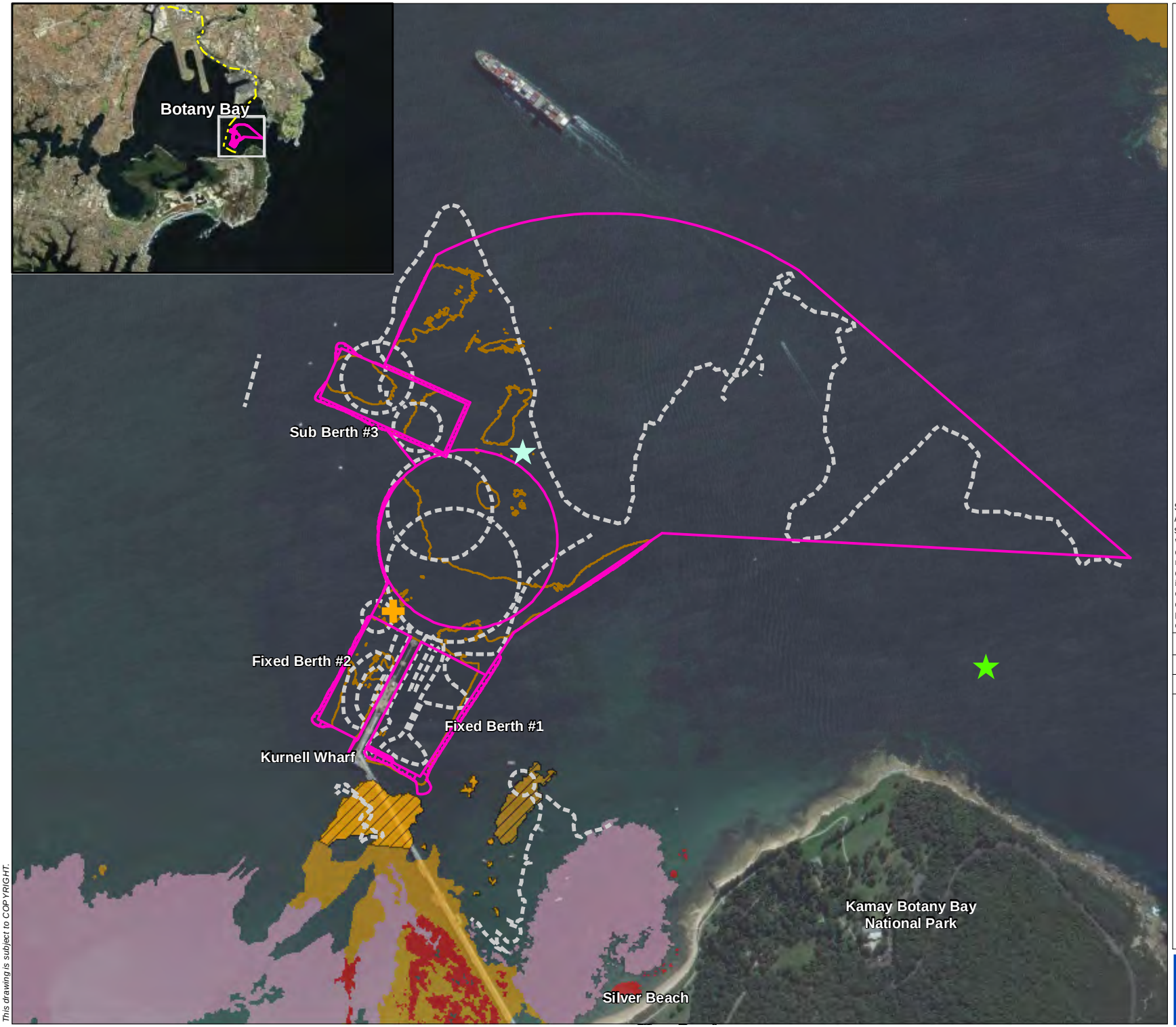

Legend

- Project Site
- Dredge Footprint
- Additional Ecology Survey (URS)

Seagrass Communities (DPI, 2009)

- Halophila
- Posidonia
- Posidonia/Halophila

Flora Sample

- Halophila ovalis < 1%

Threatened & Migratory Species

- Southern Giant Petrel (URS)
- White-bellied Sea Eagle (URS)

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Datum: GDA 1994
Grid: MGA Zone 56

Source:
Aerial Imagery from Bing Maps © 2010 Microsoft Corporation and its data suppliers.

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KURNELL PORT AND BERTHING PROJECT, BOTANY BAY.

FIELD SURVEY AREA

URS

Figure: 11-2

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11.4.5 Field Survey

Surveys

The primary focus of the ecological field surveys were the identification of flora, fauna and habitat resources within the project site and the area immediately to the south. The surveys helped confirm the results of the desktop review, and in certain circumstances, identified new biota.

The key ecological constraints considered during the field surveys were:

- NSW and Commonwealth-listed threatened species, populations and ecological communities;
- marine habitat resources; including extent of seagrass habitat, macroalgae deposits, artificial reef structures;
- potential threatened species habitat;
- presence of noxious weeds and noxious marine vegetation and introduced flora and fauna;
- presence of marine invertebrates; and
- the identification of sensitive ecological receptors to turbidity and sedimentation from dredging activities.

Four field surveys were carried out on 29 May, 22 June, 26 June and 29 August 2012 by a qualified ecologist and three certified divers. Survey lines shown on **Figure 11-2** provided extensive coverage of the berths, turning circle and a reasonable coverage of the approaches[2]. The surveys focused on where dredging would take place and the re-used sediments would be placed of the subsea fuel pipelines (see **Section 4.4.9**). The survey also included an area south of the project site to assess the distribution, extent and condition of the seagrass beds (see **Section 11.5.2**).

The flora and fauna identified during the field survey are a listed in **Technical Appendix E6**).

The surveys were undertaken broadly in line with the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft)* (DEC, 2004), *Draft Guidelines for Threatened Species Assessment* (DEC & DP&I 2005) and the *Manual for Mapping and Monitoring Seagrass Resources* (McKenzie *et al*., 2003). The condition of the project site, existing levels of disturbance, and overall lack of habitat resources, required that the survey guidelines be adapted to allow the appropriate assessment of a highly modified environment.

Given the disturbed nature of the project site, the surveys, adapted from the guidelines outlined above and modified accordingly, included the following techniques:

- recording of any threatened species identified within the study area;
- opportunistic observations of flora species found within the study area, including the identification of any aquatic plants, vegetation communities and populations present;
- recording of any noxious aquatic and marine weeds;
- opportunistic observations of any fauna species within the study area, including migratory species; and

[2] It should be noted that a sweep either side of the lines was undertaken to an approximate distance 20 metres either side.

- an assessment of the habitats and habitat resources present, and their suitability for threatened species or populations predicted to occur within the study area.

The stratification of habitats and vegetation types to determine survey effort as recommended in the guidelines outlined above was not undertaken. This process was considered inappropriate to the survey requirements given the marine nature of the proposed works, and taking into account the homogenous and modified nature of the project site.

Instead, biogenic habitat categories were recorded for the field study area, with categories adopted from (NSW DPI (Fisheries), 2009) (see **Table 11-1**). Marine benthic random meander surveys (Cropper, 1993) were undertaken to determine the presence (if any) of seagrass, or potential suitable habitat within the project site and the surrounding study area.

Seagrass Surveys

Seagrass surveys involved towed diver bottom searches and circular diver bottom searches (see **Figure 11-2**). The towed diver bottom searches covered a sweep of approximately 20 m either side of the survey lines shown on **Figure 11-2**. Seagrass samples were taken, where seagrass was present, to confirm species identification. All field surveys aimed to ensure adequate sampling of the project site and the seagrass beds directly to the south.

Table 11-1 Biogenic habitat categories for coastal sub tidal bay environments[3]

Biogenic Habitat	Description
Macroalgae	Primarily brown seaweeds such as *Ecklonia radiate, Sargassum spp.* or *Phyllospora comosa.* This habitat could also contain small patches of the green alga *Caulerpa filiformis.*
Turfing algae	Small filamentous and foliose red and brown algae of the genera *Zonaria, Corallina, Amphiroa* or *Laurencia* (often with some *Sargassum spp).*
Sessile invertebrates	Sponges, ascidians, tube worms, bryozoans and corals, typically found on vertical or sloping walls on the deep edges of reefs.
Peat barrens	Peat beds with no obvious plant or animal growth. This habitat could also contain a few scattered macroalgae.

Survey Limitations

The field surveys were limited to four site visits undertaken between May and August 2012 during the winter months. At this time of year certain species are less active and the primary production function of the marine environment tends to be lower, potentially reducing the extent of the seagrass beds at depth.

The annual migration route of cetaceans along the NSW coast vary between species. For example, Humpback Whales migrate northwards from the Antarctic between May and July (NSW OEH NPWS, 2012)[4] Although the timing of the field surveys would have accounted for this species for example, it should be noted that it did not necessarily account for all marine migratory species that would have the potential to pass through the study area during their migration. For this reason, presence was assumed for a number of marine migratory species.

[3] Adopted from (Creese et al, 2009).
[4] NSW OEH NPWS (2012) Kamay Botany Bay National Park. NSW Office of Environment and Heritage, National Parks and Wildlife Services. Accessed online 7/1/2012 - http://www.environment.nsw.gov.au/NationalParks/parkWhaleWatching.aspx?id=N0066

The method of survey was also limited to towed dive surveys, rather than obtaining and reviewing data using other more advanced techniques such as side-scan sonar. While this has the potential to result in some survey gaps in the coverage across the field survey area, this has been managed by undertaking as representative a sweep of the area as possible and exercising the precautionary principle in instances of uncertainty.

11.4.6 Habitat Suitability Assessment

An assessment of the likelihood of habitats present for TSC, FM and EPBC Acts listed species, populations and ecological communities within the project site and study area has been undertaken based on the results of the desktop review and the field surveys. This HSA assisted in identifying the potential for listed species, populations or communities to occur within the study area, rather than relying solely on one-off surveys that are subject to seasonal and weather limitations and which provide only a snapshot of the ecological assemblages present at the particular point at which they are undertaken.

11.4.7 Impact Assessment

Threatened Biota

Following the results of the HSA, any threatened biota that were considered to have potential to occur within the project site/study area were the subject to AOS and/or SIC assessments depending on whether they are listed under the TSC, FM and/or the EPBC Acts.

Key Threatening Processes

Where the proposed works would threaten the survival, abundance or evolutionary development of a native species or ecological community5 this is defined as a Key Threatening Process (KTP). KTPs have been considered during the impact assessment process.

Non-Threatened Species

Whilst the ecological assessment has focused on the threatened biota and relevant KTPs, it has also identified a number of other non-threatened species in the project site and study area due to their proximity or susceptibility to potential impact arising from the proposed works. Consultation with a number of relevant stakeholders has also resulted in a number of non-threatened species being considered as part of this assessment (see **Section 11.2**). The potential effects of both direct (e.g. habitat loss) and indirect impacts (e.g. noise, pollution etc.) have been considered for these receptors.

A key consideration has been the potential impact of the dredging works on sensitive receptors. Of particular concern is the potential for sedimentation and turbidity impacts as well as the potential release of bioavailable contamination into Botany Bay resulting in bioaccumulation.

11.4.8 Evaluation of Magnitude of Impact

For the purposes of this assessment impacts have been defined as follows.

- **Negligible:** unlikely to be any effect or consequence on the species.

[5] SEWPaC (2012).

- **Minor:** a small area of potential habitat or a small number of individuals will be directly or indirectly affected in no more than a few discrete locations but an important population will not be affected.
- **Moderate:** a large area of potential habitat or a small number of individuals will be directly or indirectly affected and the impact will occur over numerous sites. An important population may experience some short to medium term effects.
- **Major:** impact would occur over a relatively large area of potential habitat and lead to the loss of a large proportion of the local habitat or important population. There are likely to be long-term impacts to an important population.
- **Beneficial:** impact would have a positive effect or consequence on the species or habitat over any geographic area.

11.4.9 Assessment of Significance

Impacts have been considered significant where the results of the AOS or the SIC assessments suggest that a significant impact is either likely or has the potential to occur.

The significance of any direct or indirect impacts on other sensitive ecological receptors has also been considered. The sensitivity of the receptor and the characteristics of the impact (i.e. extent, magnitude, reversibility, frequency, permanence etc.) have been used to inform conclusions of impact significance.

Mitigation and management measures to avoid or minimise any potential impacts on the environment from the project have been described in **Section 11.7**.

11.5 Existing Environment

The information presented in this section is based on the results of the desktop review of relevant existing literature and previous studies as referenced throughout the section, along with the results of field studies conducted in 2012.

The project site is located within the Botany Bay sub-catchment of the Sydney Metropolitan CMA (SMCMA 2012). **Figure 11-1** shows the location of the project site and the study area.

Key environmental features considered in this assessment include protected areas, marine sub-tidal and intertidal habitats, and species of conservation significance. The current assessment has been limited to those areas and species identified as being potentially present in the area where impacts may occur. These include species that may be present within the study area and nearby protected areas.

11.5.1 Protected Areas

There are five designated protected areas within Botany Bay that are within close proximity to the project site (see **Figure 11-1**):

- Towra Point Nature Reserve;
- Towra Point Aquatic Reserve;
- Kamay Botany Bay National Park, including Bare Island;
- Cape Banks Aquatic Reserve; and
- Taren Point and Dolls Point.

Towra Point Nature Reserve is the site of a Ramsar-listed wetland managed by NSW Office of Environment and Heritage (OEH). The reserve is located approximately 1.5 km to the south-south-west of the project site and extends for approximately 6 km to the west, covering a total area of 603 hectares. It is the largest wetland of its type in the Sydney Basin. The reserve represents vegetation types that are now rare in the area. The reserve comprises a variety of habitats such as seagrass beds, mangroves, saltmarshes, dune woodlands, casuarina forest, littoral rainforest, sand dune grasslands and migratory wading bird habitats (DECCW, 2010). Further information on the condition and status of this site is provided in **Technical Appendix E10**.

Towra Point Aquatic Reserve surrounds Towra Point and covers an area of approximately 1,400 hectares. The reserve is managed by the Fisheries Section of the NSW DPI and is divided into two zones. The aquatic wildlife refuge zone, in which some recreational fishing is permitted, extends around Towra Point Nature Reserve into the Bay area. The "no-take" sanctuary zone is located within Quibray Bay (see **Figure 17-1**). The reserve is considered to support high levels of aquatic biodiversity, with more than 230 species of fish recorded within the reserve (NSW OEH National Parks and Wildlife Services (NPWS) 2012).

Kamay Botany Bay National Park covers a total area of 456 hectares and includes land on both the northern and southern entrances of Botany Bay. The southern part of the park is located on the north-eastern portion of Kurnell Peninsula, while the northern part of the park is located on the La Perouse peninsula. Both park sections lie approximately 800 m outside the boundary of the project site. The park contains rich diverse terrestrial ecosystems including cliffs and rock platforms, dunes, freshwater streams and swamps and wet forest (NSW OEH NPWS, 2012).

Cape Banks Aquatic Reserve covers an area of 22 hectares, extending 100 m seaward from the mean low water mark along the northern part of the Kamay Botany Bay National Park. The Cape Banks Aquatic Reserve is located approximately 1 km to the north east of the project site. The reserve was established as a marine research site in the 1940s and includes rock platforms, crevices, rock pools and boulder and cobble shorelines. Some recreational fishing is permitted in the reserve.

Taren Point and Dolls Point mark the western end of Botany Bay, and are located between 6 km and 7.5 km west of the project site respectively. Both areas have extensive residential development, although the shorelines provide habitat for shorebird communities. Taren Point is the more significant site and is protected under the TSC Act as an endangered ecological community. The protection covers the relict tidal delta sands. Taren Point provides habitat for a shorebird community including waders that uniquely occur within this location. The community is part of a highly diverse shorebird assemblage of some 20 bird species, with the noted presence of the vulnerable Terek Sandpiper (*Xenus cinereus*).

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Projection: Transverse Mercator
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Source: Aerial Photography - Bing Maps © 2010 Microsoft Corporation and its data suppliers.
Street Data - © Mapinfo Australia Pty Ltd and PSMA Australia Ltd
Ramsar Wetlands - Department of Sustainability, Environment, Water, Population and Communities - 20 March 2012
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KURNELL PORT AND BERTHING PROJECT, BOTANY BAY.

RECORDED THREATENED BIOTA

URS

Figure: **11-3**

Rev. **A** A4

Legend

- Project Site
- Dredge Footprint
- 3km Buffer

Seagrass - SEPP71

Macrophyte

- Halophila
- Mangrove
- Mangrove/Saltmarsh
- Posidonia
- Posidonia/Halophila
- Saltmarsh
- Zostera
- Zostera/Halophila

Flora

- *Acacia terminalis subsp. terminalis*
- *Callistemon linearifolius*
- *Pterostylis sp. Botany Bay*
- *Senecio spathulatus*
- *Syzygium paniculatum*
- *Thelymitra atronitida*

Reptilia

- Green Turtle

Mammalia

- Australian Fur-seal
- Dugong
- Eastern Bentwing-bat
- Grey-headed Flying-fox
- Humpback Whale
- New Zealand Fur-seal
- Southern Myotis
- Southern Right Whale
- Yellow-bellied Sheathtail-bat

Amphibia

- Green and Golden Bell Frog
- Wallum Froglet

Aves

- Australasian Bittern
- Black-browed Albatross
- Black-tailed Godwit
- Blue-billed Duck
- Broad-billed Sandpiper
- Curlew Sandpiper
- Diamond Firetail
- Eastern Bristlebird
- Glossy Black-Cockatoo
- Great Knot
- Grey Ternlet
- Kermadec Petrel
- Lesser Sand-plover
- Little Tern
- Pied Oystercatcher
- Powerful Owl
- Regent Honeyeater
- Sanderling
- Scarlet Robin
- Sooty Oystercatcher
- Southern Giant Petrel
- Star Finch
- Superb Parrot
- Terek Sandpiper
- Varied Sittella
- Wandering Albatross
- White Tern
- White-fronted Chat
- White Bellied Sea Eagle (migratory)

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KURNELL PORT AND BERTHING PROJECT, BOTANY BAY.

RECORDED THREATENED BIOTA (LEGEND)

URS Figure: 11-3
Rev. A A4

11.5.2 Marine Sub-tidal and Intertidal Habitats

Key marine habitats in Botany Bay include seagrass beds, mangrove forests and saltmarsh, un-vegetated soft sediments, reefs and intertidal beaches.

Seagrass Beds

Seagrass beds provide foraging habitat for a range of conservation significant species, including Dugong, turtles, and various species of fish in the family Syngnathidae (seahorses and their relatives). Seagrass habitats also provide nursery habitat for fish and invertebrate species.

The seagrass beds in and around Botany Bay are well developed, and the range and extent of communities has been well documented over the last few decades (NSW DPI (Fisheries), 2009). Key seagrass taxa include *Halophila* spp*.* (Paddleweed), *Posidonia australis* (Strapweed) and *Zostera/ Heterozostera* spp*.* (Eelgrass).

In 1995 it was estimated that seagrass beds in Botany Bay extended over 624 hectares and accounted for up to 25% of the primary productivity in the Bay (Marine Pollution Research, 2007). Being light dependent, dense beds of seagrass in the Bay are largely confined to waters shallower than approximately 3 m in depth (The Ecology Lab, 2005), although *Halophila ovalis* is tolerant of low light levels and is known to occur at water depths up to 15 m (QLD DPI, 1998). The density of seagrass meadows generally decreases with increased depths.

The distribution of seagrass beds in Botany Bay is not uniform, with all *Posidonia* species and 90% of *Zostera* spp. found on the southern side of the Bay, including in the Towra Point Aquatic Reserve and off Silver Beach (Marine Pollution Research, 2007).

Recent estuarine habitat mapping of the Botany Bay, Cooks River and the Georges River catchments undertaken by NSW DPI (2009) investigated the extent of estuarine habitats in the area, including seagrass. The results show that around the project site seagrass beds of *Halophila ovalis*, *Posidonia australis* and mixed *Halophila/Posidonia* are present. Recent surveys have suggested that *Zostera capricorni* may also be present.

P. australis is listed as an endangered population under the FM Act due to its slow reproduction and poor propagation by seed (refer to **Plate 11-1** and **Figure 11-3**). Dense seagrass beds have been identified as being located immediately off Silver Beach. The beds are found in the sub-tidal zone and extend from the Kurnell Peninsula headland in to Woolooware Bay in depths ranging between approximately 0.5 – 3 m below chart datum (CD) (DPI, 2009) (**Figure 11-3**).

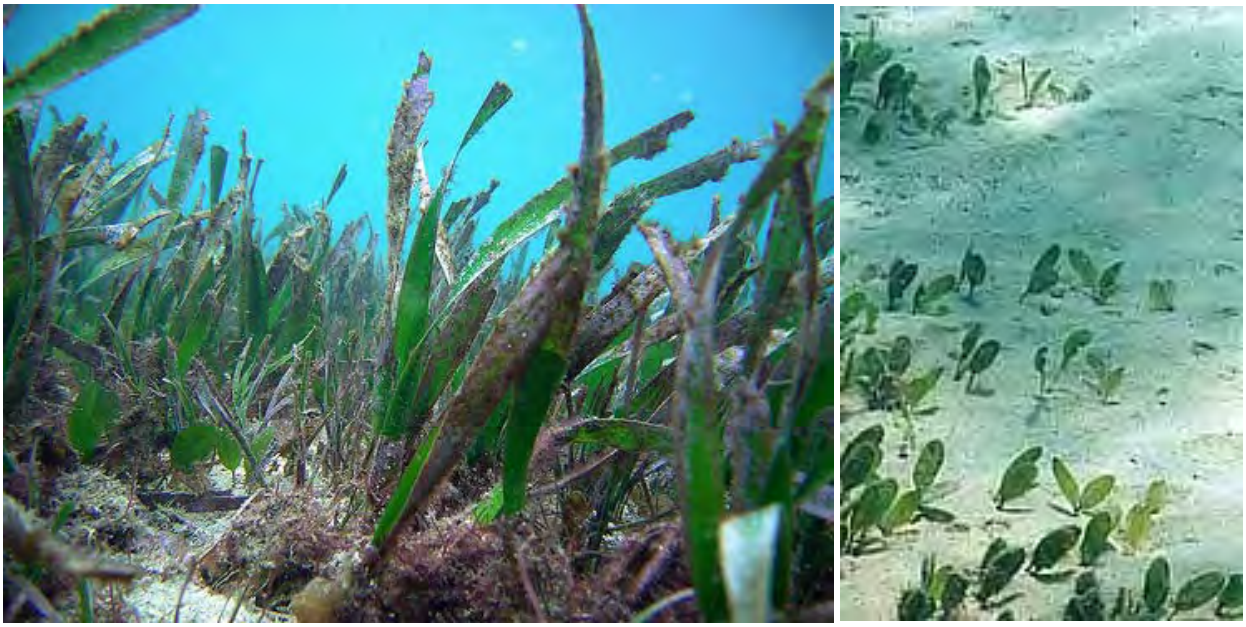
During dive surveys conducted for the present project, the *Halophila ovalis* patch to the south of fixed berth #1 was noted to have receded significantly when compared to DPI 2009 data, and the *Halophila* community previously mapped to the south-east of the fixed berth #2 was not found. It was pointed out by (Creese *et al*, 2009) that the mapping technique undertaken for the study was unable to take account of discontinuities within mapped seagrass beds.

In addition, there are many instances in NSW where quite substantial bare patches occur within beds, often because of human activities such as the installation of boat moorings. These ‘holes’ can mean that the real extent of a bed is much less than that mapped (Creese *et al,* 2009). The extent of the *Posidonia/Halophila* patch to the south-east of the fixed berths was observed to align with the DPI (Fisheries) 2009 mapping, although it appeared to be largely composed of *Posidonia*. The observed reduction in the extent of *Halophila* communities in these patches may be explained by the species’

seasonal pattern of low biomass in winter when salinity, temperature and light are limiting, followed by high biomass in summer seasons. A study on *H. ovalis* by (Hillman *et al,* 1995), showed there to be seasonal differences in biomass and marked differences in seasonal trends of the species.

As the dredging footprint is between 10 and 14 metres below CD, it is expected that *H. ovalis* would be the only species likely to occur, and that this would be only at very low densities due to light limitation. This was supported by the dive surveys, in which the only seagrass found was a single observation of *H. ovalis*, within the project dredged footprint.

Plate 11-1 Seagrass habitat surrounding the Project Site (Left) *Posidonial Halophila* community (Right) *Halophila ovalis*[6]



Un-vegetated Soft Sediments

The majority of the project site and the exposed sections of the subsea fuel (see **Section 4.4.9**) consist of/are located in areas of largely un-vegetated soft sediment habitats including peat barrens and sand/silt substrates. The proposed dredge footprint is almost exclusively composed of un-vegetated soft sediments, with only one plant of *H. ovalis* nearby to the project site identified during dive surveys of the site.

Soft sediments have lower habitat value than that of seagrass or reef habitats, but are likely to support a range of infaunal and epifaunal invertebrates including including crustaceans, sea pens, sponges, ascidians, gorgonians, barnacles, anemone, sea urchins, soft corals and hydroids. Soft sediment invertebrate species in these areas may, in turn, provide foraging habitat for fish and turtles. Soft sediments also provide a substrate that may support future seagrass growth.

Reefs

Rocky reefs support a range of attached macroalgae and marine invertebrates, as well as providing

[6] http://www.divingthegoldcoast.com.au/images/a3780_lg.jpg and http://www.botanybay.info/wp-content/uploads/2011/06/Sea-Grass.jpg

refuge and foraging habitat for a range of fish species and turtles. There are no areas of rocky reef within the proposed dredge footprint, with the nearest known reef area being an area of shallow sub-tidal to intertidal reef habitat located along the shore between Silver Beach and Sutherland Point and four artificial reefs located in and around Port Botany. These are located in Yarra Bay, around Bare Island and in Congwong Bay (NSW DPI, 2012) (see **Figure 17-1**). These reefs were established to provide new fish habitats and support the recreational fishing sector, and are located between approximately 0.5 and 1.2 km outside the project site.

The artificial structures, comprising the existing wharf facilities within the project site, provide some reef-like habitat for invertebrate and fish species, along with attached macroalgae.

Estuarine Mangrove Forest

Mangroves support a range of fish and invertebrate assemblages, provide important foraging and shelter habitat for shorebirds and wading birds and act as a shoreline buffer for wave and wind energy.

Mangrove forests occur within Towra Point Nature Reserve and are present along southern shorelines including Quibray Bay, Weeney Bay and Woolooware Bay. The mangroves of Botany Bay are estimated to cover approximately 420 hectares (DNR, 2012) and consist of two species, River Mangrove (*Aegiceras corniculatum*) and Grey Mangrove (*Avicennia marina*).

Saltmarsh

Botany Bay supports saltmarsh habitats, with approximately 90% of Sydney's remaining saltmarsh communities located in Towra Point Nature Reserve. The total area of saltmarsh in Botany Bay was estimated to cover approximately 157 hectares.

Intertidal Beach Habitats

Within the study area, Silver Beach is located at Kurnell and is a sandy beach interspersed with 14 rockwall groynes constructed from the late 1960s to combat beach erosion. While beach habitats can provide roosts for seabird and shorebird species, studies show that Silver Beach has not been used as a roost site for at least the last 10 years (Marine Pollution Research, 2007). Parts of Silver Beach are adjacent to residential areas and the beach is used for recreational activities. It is therefore subject to continuing disturbance. The beach provides some foraging and resting habitat for shorebirds, with occasional sightings of Pied and Sooty Oyster Catchers and Little Terns on the beach (Marine Pollution Research. 2007; Bionet, 2012).

Threatened Ecological Communities

No listed marine threatened ecological communities (TECs) under the TSC Act exist within the study area. Eight TECs were predicted to occur based on desktop reviews however all are terrestrial communities and would not be affected by the proposed works.

11.5.3 Species of Conservation Significance

Marine Plants

Of the 14 threatened flora species identified through the desktop review, all except *P. australis* were terrestrial and have no marine lifecycle component (see **Technical Appendix E7**). These species are therefore not considered further in this assessment.

A total of 8 marine plant species were recorded during the field survey (see **Technical Appendix E6**), including 5 species of macroalgae and 3 species of seagrass. No species recorded during the field survey are listed under the TSC or EPBC Acts. However, the seagrass *P. australis* is listed under the FM Act as an '*endangered population in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW)*'. *P. australis* was found 300 m south of the project site.

Greater densities of marine plant assemblages are present to the south of the project site, including extensive seagrass communities adjacent to Silver Beach as discussed in **Section 11.5.2** (see **Figure 11-3**).

Intertidal Flora

Intertidal flora, including saltmarsh and mangrove species are discussed in general terms in **Section 11.5.2**. However, these species are outside the potential direct disturbance area of the project and have been assessed as not being at risk of indirect impacts from the project events (see **Chapter 10, Water and Sediment Quality**). A discussion of individual saltmarsh and mangrove species has therefore not been included.

Marine and Intertidal Fauna

A total of 116 threatened fauna species (listed under the FM Act, the TSC Act or the EPBC Act) were identified as being present, or potentially present, within 10 km of the project site. A HSA and a review of the Birdata records for each of these species identified 41 fauna species as being potentially or likely to occur in or adjacent to the project area (see **Technical Appendix E7**). These species include:

- 29 bird species;
- 6 marine mammals;
- 3 marine turtles,
- 2 sharks; and
- 1 ray-finned fish.

Table 11-2 lists the threatened species carried forward for more detailed assessment based on the results of the HSA (see **Technical Appendix E7**). Species that predominantly utilise terrestrial habitat and are not expected to utilise intertidal or marine areas were excluded from detailed assessment.

An additional 24 bird species and one family of ray-finned fishes (see **Table 11-3**) were identified as being migratory and/or marine species under the EPBC Act and, based on the habitat suitability assessments, were also carried forward for more detailed assessment of potential impacts.

Table 11-2 Potentially Impacted Threatened Fauna and Flora

Scientific Name	Common Name	FM Act Status	TSC Act Status	EPBC Act Status
Birds				
Ardena carneipes	Flesh-footed Shearwater	N/A	Vulnerable	Migratory
Caldris alba	Sanderling	N/A	Vulnerable	Migratory
Calidris tenuirostris	Great Knot	N/A	Vulnerable	Migratory
Charadrius leschenaultii	Greater Sand Plover	N/A	Vulnerable	Migratory
Charadrius mongolus	Lesser Sand Plover	N/A	Vulnerable	Migratory
Diomedea exulans	Wandering Albatross	N/A	Endangered	Vulnerable/Migratory
Eudyptula minor	Little Penguin	N/A	Threatened community	Marine
Gygis alba	White Tern	N/A	Vulnerable	N/A
Haematopus fulignosus	Sooty Oystercatcher	N/A	Vulnerable	N/A
Haematopus longirostris	Australian Pied Oystercatcher	N/A	Endangered	N/A
Limicola falcinellus	Broad-billed Sandpiper	N/A	Vulnerable	Migratory
Limosa limosa	Black-tailed Godwit	N/A	Vulnerable	Migratory
Macronectes giganteus	Southern Giant-Petrel	N/A	Endangered	Endangered/Migratory
Macronectes halli	Northern Giant-Petrel	N/A	Vulnerable	Vulnerable/Migratory
Onychaprion fuscata	Sooty Tern	N/A	Vulnerable	N/A
Pandion cristatus	Eastern Osprey	N/A	Vulnerable	N/A
Petroica boodang	Scarlet Robin	N/A	Vulnerable	N/A
Procelsterma cerulean	Grey Ternlet	N/A	Vulnerable	N/A
Pterodroma leucoptera leucoptera	Gould's Petrel	N/A	Vulnerable	Endangered/Migratory
Pterodroma nigripennis	Black-winged Petrel	N/A	Vulnerable	N/A
Pterodroma neglecta neglecta	Kermadec Petrel	N/A	Vulnerable	Vulnerable
Pterodroma soladri	Providence Petrel	N/A	Vulnerable	N/A
Puffinus assimilis	Little Shearwater	N/A	Vulnerable	N/A
Sterna albifrons	Little Tern	N/A	Endangered	Migratory
Thalassarche bulleri	Buller's Albatross	N/A	N/A	Vulnerable/Migratory
Thalassarche cauta cauta	Shy Albatross	N/A	Vulnerable	Vulnerable Migratory
Thalassarche cauta steadi	White-capped Albatross	N/A	N/A	Vulnerable/Migratory
Thalassarche melanophris	Black-browed Albatross	N/A	Vulnerable	Vulnerable/Migratory
Xenus cinereus	Terek Sandpiper	N/A	Vulnerable	Migratory
Mammals				
Arctocephalus forsteri	New Zealand Fur-seal	N/A	Vulnerable	N/A
Arctocephalus pusillus doriferu	Australian Fur-seal	N/A	Vulnerable	N/A
Dugong dugon	Dugong	N/A	Endangered	Migratory
Eubalaena australis	Southern Right Whale	N/A	Vulnerable	Migratory
Lagenorhynchus obscurus	Dusky Dolphin	N/A	Endangered	Endangered
Megaptera novaeangliae	Humpback Whale	N/A	Vulnerable	Vulnerable/Migratory

Scientific Name	Common Name	FM Act Status	TSC Act Status	EPBC Act Status
Reptiles				
Caretta caretta	Loggerhead Turtle	N/A	Endangered	Endangered/Migratory
Chelonia mydas	Green Turtle	N/A	Endangered	Endangered/Migratory
Dermochelys coriacea	Leatherback Turtle	N/A	Vulnerable	Endangered/Migratory
Sharks and Fish				
Carcharias taurus	Grey Nurse Shark	Critically Endangered	N/A	Critically Endangered
Carcharodon carcharis	Great White shark	Vulnerable	N/A	Vulnerable/Migratory
Epinephelus aemelii	Black Cod	Vulnerable	N/A	Vulnerable
Populations				
Posidonia australis.	*Strapweed	Endangered	Not listed	Not listed
**Observed during the field surveys*				

Table 11-3 Potentially Impacted Migratory and Marine Fauna of Conservation Significance

Scientific Name	Common Name	FM Act Status	TSC Act Status	EPBC Act Status
Birds				
Actitis hypoleucos	Common Sandpiper	N/A	N/A	Migratory
Ardea alba	Great (White) Egret	N/A	N/A	Migratory
Ardea ibis	Cattle Egret	N/A	N/A	Marine/Migratory
Arenaria interpres	Ruddy Turnstone	N/A	N/A	Migratory
Calconectris leucomelas	Streaked Shearwater	N/A	N/A	Marine/Migratory
Calidris acuminate	Sharp-tailed Sandpiper	N/A	N/A	Migratory
Calidris ferruginea	Curlew Sandpiper	N/A	N/A	Migratory
Calidris ruficollis	Red-necked Stint	N/A	N/A	Migratory
Calidris canatus	Red Knot	N/A	N/A	Migratory
Charadrius bicinctus	Double-banded Plover	N/A	N/A	Migratory
Charadrius veredus	Oriental Plover	N/A	N/A	Migratory
Gallinaga hardwickii	Latham's Japanese Snipe	N/A	N/A	Migratory
Haliaeetus leucogaster	White-bellied Sea-Eagle	N/A	N/A	Marine/Migratory
Hirundapus cudacutus	White-throated Needletail	N/A	N/A	Migratory
Limosa lapponica	Bar-tailed Godwit	N/A	N/A	Migratory
Merops ornatus	Rainbow Bee-eater	N/A	N/A	Migratory
Numenius phaeopus	Whimbrell	N/A	N/A	Migratory
Numenius madagascariensis	Eastern Curlew	N/A	N/A	Migratory
Numenius minutus	Little Curlew	N/A	N/A	Migratory
Pluvialis fulva	Pacific Golden Plover	N/A	N/A	Migratory
Pluvialis squatarala	Grey Plover	N/A	N/A	Migratory
Puffinus leucomelas	Streaked Shearwater	N/A	N/A	Migratory
Sternula nereis nereis	Fairy Tern	N/A	N/A	Migratory
Tringa brevipes	Grey-tailed Tattler	N/A	N/A	Migratory
Fish				
Family Syngnathidae	Seahorses, Pipefish, Seadragons, Pipehorses, Ghost Pipefish, Seamoths.	Protected	N/A	Marine

Bird Species

Seventeen threatened and 3 non-threatened seabirds were identified as being potentially present during the literature searches and HSA, many of which have been confirmed as being present in the Botany Bay area (see **Tables 11-2** and **11-3**). Seabird species of interest include albatrosses and giant petrels, petrels, terns, shearwaters and penguins.

The pelagic seabirds, including Albatrosses and Giant Petrels, are among the most dispersive and oceanic of all birds, spending more than 95% of their time foraging at sea in search of prey and usually only returning to land to breed (Environment Australia (EA), 2001). The identified albatross and petrel species may potentially overfly the project site, although where they forage is generally further offshore. Breeding habitat for these species is usually on small, remote islands throughout the Southern Ocean (EA, 2001). Critical habitat in Australia includes six islands, which constitute the only suitable breeding habitat under Australian jurisdiction and are located in Tasmania and the Sub-Antarctics (EA, 2001).

Terns and shearwaters feed at sea, generally diving into the water but may also skim the surface. Prey is principally fish but may also include crustaceans (e.g. krill), insects and other marine invertebrates. Shearwaters also feed by pursuing prey underwater (Commonwealth of Australia, 2011). Shearwaters will commonly rest in large flocks on the water surface, while terns are more likely to rest on shore.

The Little Tern migrates from eastern Asia and is found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. In NSW, Little Terns arrive from September to November, occurring mainly north of Sydney and with smaller numbers found south to Victoria. The species breeds in spring and summer along the entire east coast from Tasmania to northern Queensland and is seen until May, with only occasional birds remaining over winter months (SEWPAC, 2012b). There is a breeding colony of Little Terns on Towra Spit, with 50 chicks recorded to hatch at the colony in 2010.

Little Penguins are generally found from Perth, Western Australia across the southern coast of Australia up to Sydney, NSW (Land Conservation Council, 1993). Mating occurs between August and October, with egg laying commencing in September and chicks fledging 8 to 10 weeks after hatching. Little Penguins in Botany Bay may be from any of the three regional populations, including the threatened colony at Little Manly, and populations from Lion Island and Five Island. Botany Bay provides suitable foraging habitat for Little Penguins, which feed primarily on small fish and forage in shallow waters within 15 to 20 km of the coast (CSIRO, 2000 & Gormley and Dann 2009).

The White-bellied Sea Eagle and the Osprey are found predominantly in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. Habitat is characterised by the presence of large areas of open water. (SEWPAC, 2012a). Both species are known to occur in Botany Bay, and an individual White-Bellied Sea Eagle was observed during field studies for the project.

Twelve threatened and 21 non-threatened migratory shorebirds and wading birds were identified as being potentially present during the literature searches and HSA; many of which have been confirmed as being present in the Botany Bay area (see **Tables 11-2** and **11-3**). These species generally utilise intertidal and supra-tidal shorelines and wetland areas, where they rest, forage and nest. The Towra Point Nature Reserve and Towra Point Aquatic Reserve, along with other coastal reserves throughout the area, provide important habitat for shorebirds and wading birds, including migratory species. One of the key species nesting in the area is the Little Tern, with a closely monitored breeding colony located at Towra Point. Some shorebird species (e.g. the Sooty Oystercatcher and Pied Oystercatcher) have been observed on Silver Beach and are also likely to occasionally utilise waterfront areas throughout Botany Bay.

Mammals

Australian Fur Seals breed on islands of the Bass Strait but range throughout waters off the coasts of South Australia, Tasmania, Victoria and NSW. Numbers of this species are believed to be increasing as the population recovers from historic hunting (Hofmeyr *et al.*, 2008 and Shaughnessy, P.D.(1999)). Australian Fur Seals have been previously observed in Botany Bay (DECCW, 2011).

New Zealand Fur Seals may forage throughout waters around the southern part of Australia, with population studies for New Zealand fur seals in Australia carried out in 1990 estimating an increasing population of about 35,000. The species breeds in southern Australia at the Pages Islands, and on Kangaroo Island, which produces about 75% of the total pups in Australia (Marine Bio, 2012 & Goldsworthy, S.D.,*et al.,* (2009)). New Zealand Fur Seals have been previously observed in Botany Bay (DECCW, 2011).

Dugongs are found in Australian waters from Shark Bay in Western Australia to Moreton Bay, Queensland. In NSW, the species inhabits coastal and estuarine waters around Wallis Lake, Port Stephens, Lake Macquarie and Brisbane Waters, which contain some of the largest seagrass beds in NSW including the *Halophila* species that is preferred by Dugongs. Individuals found as far south as Sydney, are generally considered to be vagrants (SEWPAC, 2012). However, the presence of seagrass beds in Botany Bay does provide suitable foraging habitat for Dugong.

Humpback Whales are present around the Australian coast in winter and spring. Humpbacks undertake an annual migration between the summer feeding grounds in Antarctica to their winter breeding and calving grounds in northern tropical waters. The northern migration on the south-east coast of Australia starts in April and May while the southern migration peaks around November and December (DEH, 2005a). The exact timing of the migration period varies between years in accordance with variations in water-temperature, sea-ice extent, prey abundance, and location of feeding grounds (DEH, 2005a & SEWPAC, 2010a). Feeding occurs where there is a high krill density, and during the migration this primarily occurs in Southern Ocean waters south of 55°S (DEH, 2005a). Although Humpback Whales would generally not enter Botany Bay, the whales migrate along the coastline of Sydney each year and the headlands of the Kamay Botany Bay National Park are promoted as whale watching sites.

Southern Right Whales are distributed in the southern hemisphere, typically between 20°S and 60°S. They are present around the Australian coast from May to October (DEH, 2005b). This species generally migrates to the warmer waters of southern Australia during winter and inhabits sub-Antarctic waters in summer, where their main feeding grounds are generally between 40°S and 55°S (DEH 2005b). In NSW, the Southern Right Whale has been frequently observed close to shore, with the majority of sightings occurring from July to September around the southern and central NSW coastline (south of Newcastle). During winter and spring these whales breed in shallow coastal waters less than 5 m in depth, with breeding known in Victoria and South Australia (DEH, 2005b & Payne, 1986). There are no sites in NSW that are considered to be regular calving grounds for Southern Right Wales (OEH, 2012).

Dusky Dolphins are a small to medium sized dolphin that often occurs in large schools, with the numbers of individuals in a school varying seasonally. These dolphins are considered to primarily inhabit inshore waters (Gill *et al*., 2000 & MarineBio, 2012). Dusky Dolphins have been recorded from the waters around Sydney.

Reptiles

Loggerhead Turtles have a global distribution throughout tropical, sub-tropical and temperate waters. In the Pacific Ocean there are breeding aggregations centred on Japan, south Queensland and New Caledonia (Limpus & Limpus, 2003). The eastern Australian population nests on the southern Great Barrier Reef and adjacent mainland coastal areas. In 2000, it was estimated that there were 500 nesting females per year of the eastern Australian population (SEWPAC, 2012f). The species prefers a range of habitats including sub-tidal and intertidal reefs, seagrass meadows and soft-bottomed habitats. The juvenile diet includes algae, pelagic crustaceans, and molluscs, but adult and large immature Loggerhead Turtles are carnivorous, specialised for feeding on hard-bodied, slow-moving invertebrate prey. In eastern Australian coastal waters they principally feed on gastropod and bivalve molluscs, portunid crabs and hermit crabs (Chaloupka & Limpus, 2001 & Moodie, 1979). Although Botany Bay is towards the southern extent of the distribution for Loggerhead Turtles, the area does include potential suitable habitat for this species.

Green Turtles are found in tropical and subtropical waters throughout the world. In Australia, there are seven regional populations of Green Turtles that nest in different areas: the southern Great Barrier Reef; the northern Great Barrier Reef; the Coral Sea; the Gulf of Carpentaria; Western Australia's north-west shelf; the Ashmore and Cartier Reefs; and Scott Reef. The largest Green Turtle nesting aggregation in the world occurs on Raine Island in the Great Barrier Reef where thousands of females nest nightly in an average nesting season (Limpus, 2008c & Witherington *et al.,* 2006). Green Turtles forage in shallow coastal areas, in particular seagrass beds, feeding principally on seagrass and seaweeds although juveniles are also carnivorous (Bjorndal, 1996). Green Turtles have been recorded in Botany Bay, although they are not common in the area, which is at the southern extent of their range.

Leatherback Turtles occur in inshore and offshore marine waters throughout the world's tropical and temperate seas, with most sightings in temperate waters. Large numbers of Leatherback Turtles feed in coastal waters from southern Queensland to the central coast of NSW. The Leatherback Turtle is principally a pelagic species, and feeds primarily on jellyfish. The species takes 13-14 years to reach maturity, and is known to make long migrations from feeding areas to breeding sites. There are only rare records of Leatherback Turtles nesting in Australia, with the nearest regular nesting sites being the Solomon Islands and Malayan Archipelago (SEWPAC, 2010d).

Sharks and Fish

Grey Nurse Sharks are native to subtropical to cool temperate waters in the Mediterranean Sea and the Atlantic, Indian and western Pacific Oceans. In Australia there is an east coast and a west coast population of Grey Nurse Sharks. The east coast population is found predominantly in inshore coastal waters along the coast of NSW and southern Queensland. The species diet consists of a range of fish, other sharks, squid, crab and lobsters. Although the species is generally found in deeper waters between 15 and 40 m (NSW DPI, 2007), historical records indicate the species was fished by hook and line at ‘regular nurse grounds’ off Dolls Point in Botany Bay (NSW Fisheries, 2002), and suitable foraging habitat exists for the species within the project site.

The Great White Shark is found throughout the world in temperate and subtropical oceans, with a preference for cooler waters. This distribution includes the coastal waters of NSW. Great White Sharks can be found from close inshore, around rocky reefs, surf beaches and shallow coastal bays to outer continental shelf and slope and make long ocean crossings. The species are often found in higher abundances around seal colonies (SEWPAC, 2012).

The Black Cod is found in warm temperate and subtropical parts of the south-western Pacific. Adults are usually found in caves, while small juveniles are found in coastal rock pools, and larger juveniles around rocky shores and estuaries (NSW DPI, 2007). In NSW, the species occurs along the entire coast, with a higher population density documented in northern NSW. The species were once widespread along the NSW coast, with historical evidence suggesting that declines in Black Cod numbers were already noticed adjacent to Sydney as far back as the early 20th century. Potential suitable habitat may exist for this species in and around Botany Bay, by way of near-shore rocky and offshore coral reefs at depths down to 50 m (MPA, 2010). The species has been historically recorded from Botany Bay (MPA, 2005).

There are currently up to 31 syngnathids (seahorse, pipefish, pipehorse and seadragon), four solenostomids (ghostpipefish) and two species of pegasids (seamoths) that are known to occur in NSW waters. Although not listed as threatened species in Australia, all species of the families Syngnathidae, Solenostomidae and Pegasidae are protected under both the FM Act 1994 and EPBC Act, making it illegal to possess, collect or harvest these species without a permit. Prey species of syngnathids consists of small crustaceans, and habitats range from deep reefs to seagrass and macroalgae, as well as man-made structures.

The majority of syngnathids inhabit shallower inshore areas (NSW DPI, 2012). Syngnathids often exhibit site and mate fidelity, maintaining small home ranges. Seagrass beds, reefs and artificial structures in Botany Bay provide suitable habitat for a range of syngnathid species and the Protected Matters Search returned 22 species of syngnathid from within 5 km of the project site.

Threatened Populations

Two threatened populations were identified during the desktop review, of which only the endangered population of *P. australis* is a marine species and at risk of impacts from the proposed works. *P. australis* is discussed in **Section 11.5.2** and above in the section on marine plants.

11.5.4 Recreation and Aquiculture

Recreational Species Habitat

Botany Bay is a popular recreational fishing area due to its proximity to Sydney and its reputation for large catches (State Pollution Control Commission, 1981). On 1 May 2002, the Bay became one of thirty designated Recreational Fishing Havens (RFHs) in NSW and subsequently commercial fishing was excluded.

Recreational fishing occurs throughout the Bay from the shore and boats. Areas of specific significance for recreational fisheries comprise the habitats discussed above including seagrass beds, mangroves and rocky shores around the Bay. As discussed in **Chapter 17, Amenity, Land Use, Recreation and Navigation**, four artificial reefs (located north outside the ecology study area) have been constructed and are key recreational fishing areas with a high species diversity and abundance (NSW DPI, 2012) (see **Figure 17-1**).

Aquaculture Habitat

There have historically been three forms of aquaculture within the study area. The most significant of these has been oyster farming. The NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS) identifies those areas within NSW's estuaries that are prioritised for oyster aquaculture, including Quibray Bay, Woolooware Bay and the inlet to the west of Towra Point.

A former commercial finfish farm (Fin Fish Sea Cage Farm) is located adjacent the Kurnell Wharf, approximately 100 m to the west of Kurnell Wharf (see **Figure 11-1**) (Aquaculture lease number ALDI/098)). The farm has historically raised mulloway (*Argyrosomas japonicus*), yellowfin bream (*Acanthopagrus australis*) and snapper (*Pagrus auratus*) in floating metal-framed cages.

In 2008, the operators of Fin Fish Sea Cage Farm received approval from Sutherland Shire Council to develop the site for (pearl) oyster farming (DA Consent 2763833). Currently the site remains leased yet unfarmed[7].

11.6 Impact Assessment

11.6.1 Overview

This section assesses the potential impacts of the proposed works on the environmental values discussed in **Section 11.5** including protected areas, marine sub-tidal and intertidal habitats and species of conservation significance. The assessment takes into account all aspects of the proposed works and associated potential direct and indirect impacts including:

- direct removal of habitat;
- creation of sediment plumes and associated impacts on water quality, including mobilisation of contaminated sediments;
- deposition of sediments disturbed during dredging;
- ship strike and entrainment in dredging equipment;
- altered light regimes;
- acoustic impacts;
- introduction of pest species;
- marine oil spills; and
- changes to hydrodynamic processes.

The impact assessment takes into account KTPs as described under the EPBC, the TSC and the FM Acts. For threatened species, the evaluation has also been made against the factors of assessment contained in the *Threatened Species Assessment Guidelines* (NSW DPI, 2008), with the results of these assessments where undertaken presented in **Technical Appendix E8**.

11.6.2 Protected Areas

Potential impacts of the project on protected areas that have been assessed include:

- creation of turbidity plumes and associated impacts on water quality;
- altered light regimes;
- acoustic impacts;
- changes to hydrodynamic processes; and

[7] NSW OEH (2012).

- marine oil spills.
  - Potential impacts on species that may utilise protected areas are discussed separately in **Section 11.6.6**.

Creation of a Turbidity Plume and Water Quality Impacts

The proposed dredging method, namely that of using a backhoe dredge with a closed bucket and loading dredge spoil onto a spilt hopper barge, reduces the potential for sediment loss into the water column relative to other dredging methods such as trailing sucker hopper dredging (see **Section 2.5.4**). In sediment dispersion modelling undertaken for the proposed works (see **Technical Appendix C** and **Chapter 10, Water and Sediment Quality**) it was determined that suspended sediments were unlikely to exceed 10 mgL^{-1} beyond approximately 200 m of the proposed dredging activities (see **Section 10.6.1**). Background turbidity concentrations in Botany Bay vary significantly with rainfall, with suspended sediment concentrations ranging from 5 mgL^{-1} up to 25 mgL^{-1} following outwash from the Georges River post a storm event. Given that the nearest protected area (Kamay Botany Bay National Park) is approximately 800 m from the boundary of the project site there would be no impact from suspended sediments on any of these identified protected sites discussed in **Section 11.5.1**.

Altered Light Regimes

The proposed development takes place in an area already heavily affected by anthropogenic light sources, including industrial and residential developments, existing shipping and port activities at Kurnell, the Port of Sydney, and Sydney (Kingsford Smith) Airport. The majority of the works would take place during daylight hours limiting the need for lighting other than in the winter months and the start and end of the day. The exception would be the dredging activities, which would continue throughout the night.

Additional lighting from the proposed works would include that used on the dredger and the barges used to transport sediments, as well as in areas of any static works being undertaken away from the existing Wharf. Works on the Wharf or immediately off the Wharf would not be lit given the adequate lighting provisions in place already.

Given the nearest protected area to the project site is 800 m and the current levels of artificial light in the area, it is not considered that there would be any impacts on any protected areas as a result of the use of lighting associated with the proposed works.

Acoustic impacts

Noise sources associated with the proposed works would include the operation of dredging equipment (as a continuous operation for approximately 23 weeks) and demolition and construction activities at the berth facilities (including piling and rock revetment construction (limited to daytime hours only)). Although the proposed works would facilitate a reconfiguration of berthing arrangements at the port and berthing facility, impacts from these ships would be mitigated by a reduction in overall shipping numbers as the upgraded facility becomes operational.

Noise modelling has been undertaken for the proposed works, comprising a 2,500 m catchment extending in any direction from the project site for airborne noise, and an area of 250 m in any direction from the project site for underwater noise (see **Technical Appendix G** and **Chapter 13, Noise** for full details).

Airborne ambient noise in the immediate area is dominated by industrial activities at the Refinery, including frequent transport movements. Other noise sources include aircraft, local vehicle movements and natural noise sources. Principal underwater ambient noise sources currently include shipping movements to the Kurnell port and berthing facility and the Port of Sydney and the movement of gas and liquid through the array of subsea pipelines that cross Botany Bay.

Modelling results show that the noise levels generated by the works at the Botany Bay Environmental Education Centre in the Kamay Botany Bay National Park (the closest protected area to the project site) would not exceed the limits for such institutions set by the ICNG. No impacts on the conservation values of any protected area are therefore anticipated. Although noise from the proposed works would be audible to recreational users of these areas at times it is considered that the impacts from this noise would be no more than minor.

Modelling results from the dredging activities predict that detectable underwater noise levels (taking account of the existing ambient peak noise levels in the area) are likely to extend up to 150 m from the point of the dredging activities. The nearest marine protected areas to the project site are the Towra Point Aquatic Reserve and the Cape Banks Aquatic Reserve, both approximately 1 km from the project site. It is therefore considered that underwater noise from the project would not impact on the habitat or recreational values of these protected areas.

Changes to Hydrodynamic Processes

Shorelines and facilities at Silver Beach, Towra Beach, Lady Robinsons Beach, Brotherson and Hayes Docks, the Airport runways and recreational boat user facilities were investigated in terms of potential changes in nearshore wave conditions in the dredging area (**Technical Appendix C** and **Chapter 8, Hydrodynamics and Coastal Processes**). The only predicted changes to wave heights are found to occur on Silver Beach (+/-0.05% compared against existing conditions) and only within the groyne field.

Minor changes in wave direction may also occur at this site, with changes of wave direction on Towra Beach being less than 0.1° and not predicted to have any identifiable effect (Cardno, 2012). No impacts are predicted to occur at any of the protected areas assessed as a result of changes in hydrodynamic processes resulting from the proposed works.

Marine Oil Spills

Any ship-based activity presents some risk of marine oil spills, and the potential for consequential impacts on the marine environment. The overall national oil risk for spills for ships between 10 tonnes and 100 tonnes was assessed in 2011 as being primarily from shore-based spills, trading ships in port or at sea, and from offshore oil production. Small commercial ships and shore-based operations were assessed as presenting the greatest risk of spills for ships between 1 tonne and 10 tonnes (DNV, 2011).

There would be minimal additional shipping movements in the area on undertaking the proposed works (possibly up to 10 ships at any one time). The principal ships involved in the works would be the use of the backhoe dredge and three split hopper barges (operating in rotation) as well as smaller supply ships and tugboats supporting this operation and the upgrade to the fixed berths and sub berth (see **Section 17.5.2**). The ships associated with the proposed works would all be slow-moving and would largely operate within a Marine Security Zone (an area where there is no access by non-authorised ships). This would pose minimal risks of a shipping incident that may result in an oil spill. In addition, the spill management protocol at the existing port and berthing facility are rigorous given the nature of operations in this location. These controls would extend to the additional ships required to undertake the proposed works to ensure there was no risk of shipping impacts as discussed further in **Chapter 17, Amenity, Land Use, Recreation and Navigation.**

Hydraulic oils would be used on dredging and construction equipment, although in smaller quantities than fuel oils. Hydraulic oils are generally miscible with water, and while they pose some minor risk of toxicity if spilled, there is minimal risk of a significant surface slick or oil stranding on shorelines. Again, the above controls backed by the intention for the proposed works to operate under a spill management plan and dredging and spoil disposal management plan (DSDMP) (see **Chapter 19, Mitigation and Management Controls**) limits the potential for such impacts to occur through safe operating procedures and ongoing maintenance and observation.

On completion of the proposed works, the ability to reconfigure the berthing arrangements is expected to result in a reduction in the overall traffic and consequently would reduce the likelihood of a marine oil spill, simply through a reduction in probability.

In the unlikely event of a marine oil spill occurring, it would be expected that the oil would strand on shorelines, potentially including protected areas, with the areas affected depending on the size of the spill and prevailing wind and tide direction at the time of the incident. Some hydrocarbon toxicity in shallow sub-tidal environments would also be likely to occur. The impact of such a spill would also depend on the seasonal presence of marine fauna and bird species. A marine oil spill has the potential to temporarily impact the habitat and recreational values of protected areas in Botany Bay. However, the likelihood of such an event occurring is considered low and would not significantly increase as a result of the proposed works.

11.6.3 Marine Sub-tidal and Intertidal Habitats

Potential impacts of the project on sub-tidal and intertidal habitats areas that are assessed include:

- direct removal of habitat;
- creation of a turbidity plume and associated impacts on water quality;
- deposition of sediments disturbed during dredging;
- acoustic impacts;
- changes to hydrodynamic processes; and
- marine oil spills.

Direct Removal of Habitat

No significant areas of seagrass, macroalgae, reef or intertidal habitat would be directly removed as a result of the proposed works. Benthic habitats directly impacted by the proposed works would be predominantly un-vegetated soft sediments, including peat barrens. Un-vegetated soft sediments are the dominant benthic habitat types throughout Botany Bay, and the proposed works would directly impact on only approximately 0.17 km^2 of soft sediments and peat barrens, representing a negligible proportion of available habitat of this type in the area.

Following the completion of the 23-week dredging program it is expected that the disturbed areas would be rapidly recolonised by invertebrate fauna and fish.

Previous studies have identified that the overall abundance of marine fauna in dredged areas of Botany Bay is equal to or greater than undisturbed areas, although the species diversity is reduced in disturbed areas (Marine Pollution Research, 2007). No significant impacts on, or fragmentation of, critical or important benthic habitat values in Botany Bay are anticipated as a result of direct removal during the proposed works.

Creation of Sediment Plumes and Water Quality Impacts

Suspended sediments in Botany Bay are typically in the order of ~5 mgL^{-1} and range up to 25 mg L^{-1} following heavy rainfall events in the catchment (Cardno, 2012). As such, habitats in the area are regularly subject to high suspended sediment loads and associated increased suspended sediments.

The proposed dredging would take place across approximately 23 weeks, and so disturbance from suspended sediments would be temporary in nature and limited to a small area surrounding the works, as discussed previously. Modelling of suspended sediment plumes (see **Section 10.6.1**) predicts that the extent of sediment concentrations of up to 50 mgL^{-1} would be limited to an area of between 10 and 160 m from the extent of the dredging works. Concentrations of up to 10 mg L^{-1} would be limited to an area of between 90 m and would be unlikely to exceed 10 mg L^{-1} beyond 220 m from the dredging works (Cardno, 2012).

No seagrass beds were observed within this zone during the 2012 field surveys, and given the natural variability in suspended sediments in the Bay, this increase is unlikely to impact on any seagrass that may occur in the area. Modelling identified that additional suspended sediments resulting from the dredging activities at the nearest significant seagrass beds offshore from Silver Beach would be less than 0.5 mgL^{-1} (Cardno, 2012). Negligible to minor temporary impacts are predicted on limited areas of seagrass habitat as a result of the suspended sediments generated from the proposed works, with no impacts on, or fragmentation of, critical or important seagrass habitat.

The works would not require any ships or equipment to track over, or operate immediately adjacent to, the seagrass beds. All operations would be constrained to the dredge footprint, a minimum distance of 300 m to the north. The propeller wash created from these ships would be considerably less than that created by the existing berthing ships (tankers) and support ships that use and work around the fixed berths. For this reason the ships required to undertake the works are unlikely to cause any indirect impact on the seagrass beds in terms of sediment dispersion and deposition (see **Section 10.6**) or due to scour and erosion (see **Section 8.6.7**).

Un-vegetated soft sediment habitats in the area of the proposed dredging works would be exposed to increased suspended sediments and turbidity during the works in accordance with the modelling results presented in **Section 10.6.1**. However, the faunal communities typically associated with these habitats are adapted to high levels of sedimentation, and are unlikely to be impacted by the temporary increases in suspended sediment as a result of the proposed works.

Large alternate areas of this habitat type are present in the immediate area of the project site and Botany Bay. For this reason no impacts on any important or critical areas of habitat or the ecology of the area are anticipated.

Reef habitats in the area support a range of macroalgae and faunal species, and those within 200 m of the dredging areas would be exposed to increased suspended sediments for the duration of the dredging program; with the sediments settling out within a few hours of ceasing works. Given the low proportion of reef habitat in the potential impact zone however, no impacts on the ecology of the area are anticipated as a result of increased suspended sediments resulting from project activities.

Artificial reefs in Botany Bay, created to enhance recreational fishing habitats, are well beyond the area that is predicted to be impacted by increased suspended sediments resulting from the dredging activities.

Once upgraded, the facility would continue to operate as previously with the same level of propeller wash and disturbance to the same areas of Botany Bay. The engineering assessment has confirmed that only in fixed berth #1would such a change be notable (see **Section 8.6.7**). This has led to the inclusion of the rock revetment and sheet piled wall in the design to mitigate the effects of scour and turbidity from the

wash of the propellers. With these provisions in place there would be no impact to the seagrass beds to the south. The overall reduction in shipping following the upgrade would also reduce the number of plumes that are generated in the berths each month. No additional impacts on any critical or important seagrass beds or other benthic habitats are therefore expected as a result of operations from the facility arising from the proposed works.

Deposition of Sediments

Sediment deposition at the end of the 23-week dredging program was calculated and was shown to be approximately 10-35 mm over much of the dredging footprint. Deposition of 5-10 mm was calculated over an area that includes the northern limit of the seagrass beds offshore from Silver Beach. It was estimated that this deposition would affect only 0.2% of the total known extent of *H. ovalis* that occurs in Botany Bay. Beyond this, 1-5 mm of deposition is predicted over an area that includes further areas of seagrass including *H. ovalis* (and additional 0.5% of the total cover in Botany Bay), *P. australis* (~0.03% of total cover in Botany Bay) and mixed beds of *H. ovalis/P. australis* (~2.7% of total cover in Botany Bay) (see **Section 10.6.2**).

The critical sediment deposition threshold for *H. ovalis* is 2 cm per year (Vermaat *et al.,* 1997 & Erftemeijer & Lewis, 2006). Given the relatively short duration of the proposed dredging program, it is possible that 10 mm could be deposited across the absolutely extremity of the *H. ovalis* beds over this time. This deposition would be in an area that experiences seasonal variation in the extent and condition the *H. ovalis* due to its ephemeral nature. In the 2012 winter survey, the beds did not extend into the area where deposition would likely reach 10 mm (see **Figure 10-3**).

It is likely that the small parts of the *P. australis* beds would be capable of tolerating the minimal deposition of sediment (1-5 mm) likely to occur as a result of the proposed works. Should any small areas of *P. australis* be impacted due to sediment deposition at the periphery of their extent, then it is likely that these small areas would recolonise as the underlying seagrass rhizomes would not be affected, allowing prorogation following the 23-week dredging program.

An assessment of the potential for contamination resulting from the mobilisation and deposition of sediments was undertaken (see **Chapter 10, Water and Sediment Quality** and **Technical Appendix D1**). While the deposited sediments would contain a residual concentration of tributyltin (TBT), exceedances of the Interim Sediment Quality Guidelines (ISQG) threshold limits set for ecological protection would only occur where deposition was greater than approximately 15-20 mm. This would be unlikely to impact the seagrass beds or aquaculture site as this level of deposition would be limited to areas within a few hundred metres of any locations where overflow dredging operations would take place.

No other sediment contaminants exceeded the NAGD levels for safe disposal at sea (Worley Parsons, 2012).

The reuse of sediments to cover the exposed subsea fuel pipelines and former anchoring point (see **Section 4.4.9**) would occur in areas comprising of soft sediment which contain no significant areas of seagrass, macroalgae, reef or intertidal habitat as confirmed through the surveys of these areas during the field surveys (see **Figure 11-1**).

No impacts are predicted on soft sediment habitats, reefs, mangroves and saltmarsh as a result of additional sediment deposition from the dredging activities or the placement of sediments to cover the subsea fuel pipeline or infill the former anchoring point.

Changes to Hydrodynamic Processes

As discussed in **Section 11.6.2** only negligible changes to wave heights and direction are predicted to occur at any location as a result of the proposed works. None of these changes are anticipated to have any impact on either sub-tidal or intertidal habitat areas (Cardno, 2012).

Marine Oil Spills

Marine oil spills may result in contamination of benthic habitats, particularly in shallow or confined waters where hydrocarbon concentrations in the water column would be less subject to 3-dimensional dilution effects. However, except where chemical dispersants are used oil would largely remain as a surface slick. Studies of oil concentrations below slicks of heavy oils in open water have found that hydrocarbon concentrations are at very low concentrations (<5 parts per million and often below detection within approximately 3 m of the surface) as the majority of the oil will remain on the surface unless kept in suspension by high energy wave action (Ballou *et al.,* 1987). The decision as to whether to use chemical dispersants would be taken by the relevant NSW or Commonwealth Combat Authority; taking account of advice from relevant environmental specialists.

Seagrass may be impacted by marine oil spills where intertidal seagrass are directly exposed to, and coated by, the oil, or suffer the effect of chemical toxicity, which could result in a reduction in the photosynthetic response of these plants. Laboratory and field trials commissioned by the Australian Maritime Safety Authority demonstrated that seagrass including *Z. capricorni* and *H. ovalis* were not significantly impacted by crude oil at the highest concentrations tested, and any minor reduction in photosynthetic capacity was followed by full recovery of the plant in all field experiments (Wilson *et al.*, 2010).

Mangroves and saltmarshes are also vulnerable to the effects of marine oil spills, including coating of the plant and chemical toxicity associated with the oil (Proffitt. C.E., 1996). The extent and duration of these impacts would depend on the volume and type of oil spilled and the degree of exposure of the plants to the oil, as well as the spill response methods and efficacy as discussed in **Section 11.7.9**.

As mentioned above, the probability of a marine oil spill resulting from the project is exceptionally low, and managed through the most stringent controls possible at the port and berthing facility. The proposed works would not increase the risk of a marine oil spill in the area, with the probability of occurrence reducing further following the upgrade due to the fewer number of ships using the facility.

11.6.4 Marine Plants

Potential impacts on marine plants that have been assessed include:

- direct removal of habitat;
- creation of a turbidity plume and associated impacts on water quality;
- deposition of sediments disturbed during dredging;
- introduction of pest species; and
- marine oil spills.

Direct Removal of Habitat

The proposed works would require the direct removal of some aquatic marine flora from within the project site.

During the field surveys, no seagrass was identified within the proposed dredge footprint, and due to the water depth at the site it is expected that any seagrass occurring in the area would only include low densities of *H. ovalis* and would not constitute significant foraging or other habitat for marine fauna. No impacts on *P. australis* are anticipated as a result of direct habitat removal during the proposed works.

Marine plants that were observed during the surveys, and which may be directly impacted through dredging works, include macroalgae species *Polysiphonia* sp., *Padina fraseri, Sargassum* spp., and *Ecklonia radiata.* Macroalgae species may provide shelter and foraging habitat for fish, including syngnathids, however significant macroalgae habitat, including potentially impacted species, is present outside the immediacy of the project site.

Any removal of algal species resulting from the proposed works is not considered likely to result in a significant loss or overall reduction in the biodiversity of the local region.

Creation of a Turbidity Plume and Water Quality Impacts

The potential for impacts of suspended sediments on seagrass, mangroves and saltmarsh are discussed above in **Section 11.6.3**.

No significant areas of macroalgae have been identified in the project site and the minor and temporary additional turbidity generated by the proposed works is within the naturally occurring levels in Botany Bay. No impacts on macroalgae species are therefore expected from turbidity generated by the proposed works.

Deposition of Sediments

The potential for impacts resulting from sediment deposition on seagrass, mangroves and saltmarsh are discussed above in **Section 11.6.3**.

Marine Oil Spills

The potential for impacts from marine oil spills on seagrass, mangroves and saltmarsh are discussed above in **Section 11.6.3**.

11.6.5 Introduction of Pest Species

Ships and dredging activities have the potential to introduce or translocate pest species through ballast water, hull fouling, and the relocation of sediments. The introduced species of particular relevance to the project include the algae *C. taxifolia*, which has the potential to out-compete seagrass and reduce associated habitat values, and the toxic dinoflagellate *Alexandrium* sp., whose cysts in benthic sediments may be disturbed during the dredging activities.

Blooms of toxic dinoflagellates in the water column produce neurotoxins, which can cause fish kill and may also accumulate in shellfish and affect aquaculture industries. However, toxic dinoflagellate cysts have not found to be abundant in Botany Bay, and no toxic dinoflagellate blooms have been recorded there (Pollard & Pethebridge, 2002). It is considered that the risk of a marine pest introduction or blooms of existing pest species as a result of the project would be negligible, backed by the provisions to manage marine pests through having in place a ballast water management plan consistent with International Maritime Organisation (IMO) requirements (see **Section 4.7.2**).

11.6.6 Marine and Intertidal Fauna

In assessing the potential impacts of the proposed works on marine and intertidal fauna, the species of interest were considered as functional groups based on their potential use of the habitats in the area as shown in **Table 11-4**. For key threatened species, a more detailed assessment of the significance of impacts has been undertaken in accordance with the *Threatened Species Assessment Guidelines* (NSW DPI, 2008) and is presented in **Technical Appendix E8.**

Table 11-4 Impacts Considered for Faunal Species

	Direct removal of habitat	Turbidity plumes / reduced water quality	Ship strike / entrainment in dredge	Altered light regimes	Acoustic impacts	Marine oil spills
Albatross / Giant Petrels		X		X		X
Terns / Shearwaters /Pelagic Seabirds	X	X		X	X	X
Little Penguins		X	X	X	X	X
Sea Eagles/Osprey		X				X
Shorebirds/Waders				X	X	X
Seals			X		X	X
Cetaceans		X	X		X	X
Dugong	X	X	X		X	X
Turtles	X	X	X			X
Sharks		X			X	X
Fish (including syngnathids)	X	X			X	X

Direct Removal of Habitat

Direct habitat removal has the potential to temporarily displace seabirds, including terns, shearwaters and petrels, which may occasionally alight on existing wharf structures scheduled for decommissioning. However, these structures do not represent critical or important habitat for these species, and replacement structures, as well as a large number of shoreline and marine structures in the area, would provide alternative habitat for these birds.

Removal of seagrass and algae during dredging works and the demolition of existing structures have the potential to impact on species that use these habitats for foraging or refuge (e.g. Dugong, turtles, and fish including syngnathids). As discussed above, no seagrass beds have been identified in the area where direct habitat removal would occur, and any seagrass that may occur in the area would be very low density (due to the depth of the site) and would not provide high quality foraging habitat for Dugong, green or loggerhead turtles.

The low density of marine plants at the project site also reduces the habitat value of the area for fish species, with large alternate areas of high value seagrass and macroalgae habitat available throughout the areas adjacent to the proposed dredge footprint.

Underwater structures support macroalgae and provide shelter habitat for fish species including syngnathids. The installation of new structures may result in some increase in habitat in the area.

Dredging of un-vegetated sediments would result in direct disturbance and removal of this habitat type within the dredge footprint, which may provide foraging habitat for loggerhead turtles. However, this species is uncommon in the area and large alternate areas of suitable foraging habitat are present in Botany Bay.

The removal of habitat during the proposed works would not impact on any critical or important habitat. It would have no adverse impact on the lifecycle for any threatened species, is not inconsistent with any recovery or threat abatement plan, and would not increase risks associated with KTPs.

Creation of a Turbidity Plume and Water Quality Impacts

Sediment plumes may affect species that forage in the water column, including seabirds, Sea-Eagles and Ospreys, and penguins, as well as marine mammals, turtles, sharks and fish. In the case of diving birds, sediment plumes in the water may obscure prey species beneath the surface.

Birds that forage beneath the surface may be temporarily displaced to areas where there is improved water clarity. However, the low foraging value of habitat for most species in the immediate project site, the predicted limited dispersion of suspended sediments as discussed previously (also see **Chapter 10, Water and Sediment Quality**), and the availability of large areas of alternate foraging habitat means that no significant impacts on any threatened species as a result of sediment plumes associated with the dredging are expected.

The mobilisation of seabed sediments during dredging has the potential to also mobilise contaminants in the sediments and increase their bioavailability, resulting in the potential for toxicity in marine fauna. The sediment chemistry and associated implications for water quality are assessed in **Chapter 10, Water and Sediment Quality**,

Water and Sediment Quality

This assessment identified that the only contaminant present in the sediments that exceeded the ISQG threshold limits for ecological protection, or NAGD levels for safe disposal at sea, was TBT.

Although TBT may be mobilised as suspended sediments through dredging, very little is released in soluble form and its bioavailability is therefore low. The assessment demonstrated that dredged and overflow sediments are unlikely to generate levels of bioavailable TBT that would present a risk to marine fauna by exceeding water quality limits included in **Table 10-1**. Further, any potential dissolved TBT generated would be sufficiently dispersed not to impact on any of the ecological values of the project site or surrounding areas, including seagrass beds or the aquaculture lease area.

Toxicity testing was also undertaken as part of the impact assessment for the proposed works, with exposures of the Sydney Rock Oyster and the amphipod *Melita plumulosa* to TBT concentrations representing the most contaminated sediments within the project site (as reported in **Technical Appendix D1**). These studies concluded that there would be no likely impact on potential ecological receptors.

Ship Strike/Entrainment in Dredge

Any marine operations pose a risk of the ship striking marine fauna, with the greatest risk occurring where fast moving ships are operating in shallow and/or confined waters (Laist *et al.*, 2001). Slower moving species that surface to breathe, such as Dugong, marine turtles and whales, are at the greatest risk of being struck.

Dredging and construction activities for the proposed works would include the use of a range of ships including the dredge, barges and a number of support ships. Ongoing operational shipping movements would include tankers, tugs, pilot ships and workboats. Due to the slow-moving nature of the majority of these ships, which would generally also be operating in water depths exceeding 10 metres, the risk of ship strike to marine fauna is considered to be low. Threatened or protected marine mega-fauna are not common in Botany Bay, and suitable foraging habitat in the project site is limited, further reducing the likelihood of ship strike on any of these species. Although any ship strike may result in serious harm to the animal, it is not considered that strikes pose a significant risk to any of these species at a population or community level.

Unlike hydraulic dredging methods, the risk of entrainment of marine vertebrate fauna by backhoe dredges is very low. Species of conservation significance in the area, such as cetaceans, marine turtles and Dugong, are not considered to be at risk of entrainment in dredging equipment during the project.

Altered Light Regime

Artificial lighting has the potential to disorientate seabirds and shorebirds. However the area surrounding the project site is already highly illuminated at night by adjacent industrial and residential development, shipping, port and aircraft operations. The additional lighting resulting from the proposed works would be associated with the dredging operations and would include only the lighting aboard the project ships (which would be in place for approximately 23 weeks). The nearest area of shoreline likely to be utilised by shorebirds and waders is located a minimum of 600 m outside the project site at Silver Beach. This area is already influenced by onshore lighting and is unlikely to experience any additional discernible light spill from the marine operations.

Acoustic Impacts

Potential sources and levels of noise from project activities are discussed in **Section 11.6.2**, and results of noise modelling are presented in **Technical Appendix G** and **Chapter 13, Noise**. Noise above ambient levels would arise from the proposed works and be most critically influenced by piling and rock dumping operations. Operationally, shipping numbers are likely to fall reducing the ongoing noise sources in the area.

Modelling results show that the noise levels at Silver Beach (the closest area likely to be utilised by shorebirds or wading birds to the project site) would be between 54 and 57 dB(A), and excluding piling and impulsive noise, would be between 35 and 47 dB(A). These levels are less than criteria levels for passive recreational use. Silver Beach is already exposed to continuous noise from the Refinery, in addition to traffic in the area.

For underwater noise levels, assessment results predict that detectable underwater noise (taking account of the existing ambient peak noise levels in the area) associated with the dredging works are likely to extend up to 150 m from the point of the dredging activities. Underwater noise generated by piling:

- would occur over a period of a few weeks during daylight hours;
- has the potential to result in behavioural disturbance of marine fauna including marine mammals, turtles, and birds; and
- may result in physical impacts on fauna, particularly fish species that have a swim bladders if they are in very close proximity to the noise source (see **Chapter 18, Noise**).

Marine Oil Spills

Marine oil spills have the potential to impact on marine and intertidal fauna where they are coated in oil; particularly in the case of birds. Associated with this is the risk of impacts through hydrocarbon toxicity. Seabirds and shorebirds exposed to oil are at risk as oil reduces the waterproofing and insulating capacity of their feathers, and the birds ingest oil in an attempt to clean themselves. Shorebirds would be at risk in the event that oil strands on shorelines where the birds are feeding or roosting. Seabirds are less at risk of exposure, but may encounter oil when feeding or resting on the water surface. The degree of sensitivity of birds to oiling varies depending on the type of bird, but is generally considered to be high (Australian Maritime Safety Authority (AMSA), 2012a & Hyland and Schneider, 1979).

Marine mammals and turtles are generally considered to be less sensitive to oil impacts. However, these animals may be directly exposed to oil and to hydrocarbon vapours when they surface to breathe (Hyland and Schneider, 1979).

Fish species are potentially at risk from a marine oil spill where the water is shallow enough that hydrocarbon concentrations in the water exceed threshold toxicity levels. The likelihood of toxic impacts on fish species would depend on the nature of the oil spilled, with greater levels of dissolution into the water column likely for light grades of oil such as marine diesel (Engelhardt 1983, Etkin, 1997 & Hyland and Schneider, 1979).

A marine oil spill in the area has the potential to impact on commercially farmed or recreationally harvested fish species, including shellfish. It is also has the potential to temporarily reduce the saleability of fish products from areas where it is perceived there has been contamination.

Although the consequences of a marine oil spill are potentially serious, as discussed in previous sections, the likelihood of a marine oil spill resulting from the project is low, with the risk managed under rigorous controls already put in place at the port and berthing facility.

Only minor additional shipping traffic would be required to undertake the proposed works, operating in an area where non-authorised ships are not permitted to access. This means that all shipping in the immediate vicinity of the dredging operations (bar a small area in the approaches) is heavily regulated and under the control of Caltex and Sydney Ports Corporation. Consistent with the current facility's 50-year operation to date, the risk of a major oil or hydrocarbon spill is therefore considered to be low.

11.7 Avoidance and Mitigation Measures and Residual Impacts

This section describes the proposed measures to avoid or minimise the risk of impacts discussed in **Section 11.6**, and it provides an assessment of the residual risk of impacts on marine ecological values.

Mitigation and management measures would be detailed in the Construction Environmental Management Plan (CEMP), Dredging and Spoil Disposal Management Plan (DSDMP), and Fauna Management Plan developed for the proposed works. Mitigation and management measures for the proposed works as a whole are summarised in **Chapter 19, Mitigation and Management Measures**, with **Section 19.4** setting out the provisions would be included in the CEMP, DSDMP and associated sub-plans to ensure that impacts are effectively managed and minimised.

11.7.1 Avoidance

The design of the proposed works reflects consideration of the existing environment so as to avoid ecological impacts. As discussed in **Chapter 2, Needs and Alternatives**, the proposal to upgrade the existing facility at Kurnell avoids impacts on other areas of Botany Bay that would have arisen through a decision to construct a new facility or lay additional pipework under Botany Bay.

The decision by Caltex to select a backhoe dredging method, with the use of a closed bucket, has the advantage that it would limit sediment dispersion and therefore avoid impacts on the wider environment beyond the immediate area of the project site (as discussed below). The benefits of this approach are enhanced through not using overflow dredging techniques in the fixed berths and contaminated areas of the project site. This would further limit the possibility of indirect impacts from the dredging works on areas beyond the immediate project site.

The works program has been designed so as to minimise the time required for dredging to be completed, thereby facilitating the recolonisation by benthic organisms of the disturbed dredged area within a shorter timeframe than would have occurred through proposing that works be restricted to the standard hours laid out by the Interim Construction Noise Guidelines (ICNG).

Additional detail on the need for the proposed works, and the consideration and selection of alternatives to avoid impacts is considered in **Chapter 2, Needs and Alternatives**. In addition, **Chapter 4, Proposed Works Description,** provides information on design measures included as part of the proposed works that would avoid impacts on the ecological environment of Botany Bay.

11.7.2 Direct Removal of Habitat

Proposed measures to minimise the direct removal of habitat during dredging operations would include:

- the selection of the backhoe dredging method which is inherently accurate compared to other alternatives (see **Chapter 2, Needs and Alternatives**) and would minimise the removal of habitat to those areas where dredging is planned;
- all project operations personnel would be fully trained in the use of the equipment and would undergo training in accordance with the CEMP, DSDMP and environmental measures agreed as part of the proposed works' approval;
- dredging activities would be restricted to locations shown on the dredging plan(s); and
- an accurate positioning system (GPS) would be used on the dredger to ensure direct impacts would be restricted to the approved dredging area and to minimise over-dredging.

Given the small area of direct disturbance associated with the proposed works and lack of high value habitat within the project area, backed by the implementation of the above measures, it is considered that the residual impacts of direct habitat removal would be negligible.

11.7.3 Creation of a Sediment Plume and Impacts on Water Quality

Proposed measures to minimise the creation of a sediment plume, and to minimise the risk of contamination resulting from the disturbance and redistribution of contaminated sediments, would include:

- a Sediment and Water Quality Monitoring Program (SWQMP) being developed as part of the DSDMP and implemented prior to, and during, the proposed dredging works;
- as part of the SWQMP, turbidity monitoring would be undertaken for the duration of the dredging works, with monitoring of background concentrations and live monitoring to ensure suspended sediment limits are not exceeded during the works;
- the SWQMP would be used to guide any requirement for adaptive management of measures during the project, including the cessation of overflow dredging if required;
- the DSDMP would contain controls and measure to ensure that no overflow dredging operations take place at the contaminated areas in the approach to the sub berth and in the fixed berths;

- further controls on the spill rate would be introduced if required, or in extreme cases overflow dredging would be halted temporarily in favour of removing excess water to the Sydney Offshore Spoil Ground;
- a remediation action plan (RAP) would be prepared and approved ahead of undertaking the proposed dredging works; and
- the CEMP and DSDMP would contain measures for the management of acid sulphate soils (ASS).

Based on the results of modelling, which predict turbidity from the proposed works to only affect a very limited area, a lack of high-value habitat within the predicted zone of elevated turbidity, and with the implementation of the above measures, it is considered that the residual impacts of turbidity and associated changes in water quality would be negligible.

11.7.4 Deposition of Sediments

Measures described above to reduce the incidence of a sediment plume and the disturbance of contaminated sediments would also have the effect of reducing sediment deposition as a result of the proposed works.

Based on the results of modelling, which show minimal increases in sediment deposition from the proposed works, lack of high value habitat within the predicted zone of elevated deposition of sediments, and with the implementation of the above measures, it is considered that the residual impacts of sediment deposition would be negligible.

11.7.5 Ship Strike/Entrainment in Dredging Equipment

Proposed measures to minimise the risk of ship strikes during the proposed works would include:

- all project operations personnel would be fully trained in the use of the equipment and would undergo training in accordance with the CEMP, DSDMP and environmental measures agreed as part of the proposed works' approval;
- observations for marine turtles, Dugong and cetaceans would be undertaken during the dredging, piling and rock revetment works and, where marine fauna approach within the precautionary exclusion zones designated in the DSDMP (see **Chapter 13, Noise**), dredging operations would temporarily cease until the animal has left the exclusion zone; and
- ship speeds would be restricted to not more than 4 knots within the project site.

It is also worth noting that the selection of the backhoe dredging method poses a far lower risk of marine fauna entrainment than alternate dredging methods in terms of the risk of entrainment of marine fauna.

Given the low abundance of marine megafauna in Botany Bay and the lack of high quality foraging habitat for these species in the project site, along with the proposed mitigation measures above (managed through a Fauna Management Plan), the residual risk of ship strike or entrainment is considered to be negligible.

11.7.6 Altered Light Regimes

Proposed measures to minimise the risk of light impact resulting from the proposed works would include:

- lighting on ships and dredging equipment would be minimised to that required for safe operations and to meet regulatory navigational safety requirements;
- the only operations continuing through the hours of darkness would be dredging activities, with no additional shore-side lighting associated with the proposed works; and
- the proposed works would be designed to prevent excess light spill outside areas not required to be lit.

With the proposed mitigation measures in place, additional lighting from the proposed works would contribute minimally to the high levels of shore and ship-sourced artificial lighting that already exist in the area. It is considered that any impacts on fauna (including birds) relating to the requirement to light elements of the proposed works would be negligible, with no significant impacts on critical or important habitat or interference with life cycle processes for these species.

11.7.7 Acoustic Impacts

Proposed measures to minimise the impacts of airborne noise during the proposed works are set out in **Section 13.7**.

Given the distance of the nearest sensitive receptors (including protected areas) to the project site, the modelled low-levels of noise at these sites, and the mitigation measures proposed in **Chapter 13, Noise**, it is considered that the residual impacts of noise from the project would be minor on both the habitat and recreational values of any area in the vicinity of the works.

Given the low abundance of marine mammals in Botany Bay, the lack of high value foraging habitat for these species in the project site and with the mitigation measures proposed above (included as part of a Fauna Management Plan), it is considered that the impacts of underwater noise on marine fauna would be negligible.

No significant impacts on, or fragmentation of, critical or important habitat or interference with the life cycles of any threatened species are expected to occur as a result of airborne or underwater noise associated with the proposed works.

11.7.8 Introduced Marine Pests

Proposed measures to minimise the risk of marine pest introductions during the project would include:

- regular inspections of the active working areas and of equipment during maintenance for the presence of *C. taxifolia* and treatment of any *C. taxifolia* in accordance with the NSW *Control Plan for the Noxious Marine Alga Caulerpa taxifolia 2009*;
- regular inspections by the Department of Agriculture, Fisheries and Forestry (DAFF) at the port and berthing facility;
- any dredge equipment sources from outside the region would be subject to hull cleaning and/or inspection for marine pests prior to the commencement of works; and
- adherence to DAFF requirements for the transfer of ballast water, with no ‘high risk’ ballast water or sediments from ballast tanks being discharged into Botany Bay.

With the above proposed control measures, it is considered that the residual risk of the introduction or translocation of marine pests as a result of project activities would be very low and no impacts on critical or important habitat for any threatened species would likely occur.

11.7.9 Marine Oil Spills

Proposed measures to minimise the risk and impacts related to a marine oil spill during the project would include:

- biodegradable oil would be used within the pile rig;
- all fuel and hydraulic oils would be stored in secure, bunded areas and precautions would be taken during any refuelling or oil transfer operations to avoid oil entering the marine environment;
- prestart checks would be undertaken prior to commencing piling works;
- all ships used for the proposed works would hold current certifications in accordance with their class and function;
- all ships and hydraulic equipment would be maintained in good condition with regular servicing and maintenance scheduled as part of the works;
- all ship crew would be fully qualified and trained for their respective roles;
- all ships would be operated in full accordance with international, Commonwealth and State navigational safety and environmental protection standards and regulations;
- all ships would have an on-board Ship-Oil Pollution Emergency Plan (SOPEP) or equivalent applicable to their class;
- oil spill response equipment would be located at the Wharf, and trained oil spill response personnel would be available at all times throughout the works;
- spill kits would be held on board barges, dredges and workboats; and
- all ships would not exceed a speed of 4 knots within the project site.

Although a marine oil spill has the potential to impact on threatened species habitat as discussed previously, the proposed works would not significantly increase the risk of a marine oil spill. With the additional mitigation measures described above it is considered that the residual risk of impacts of a marine oil spill associated with the proposed works are negligible.

11.7.10 Changes to Hydrodynamic Processes

Proposed measures to minimise the impacts of changes to hydraulic processes as a result of the proposed works would include:

- the inclusion of erosion and scour provisions in the design as discussed in **Section 8.6.7**.

Based on the results of the hydrodynamic modelling, which predicts no impacts on the shoreline as a result of changes to wave heights or direction as a result of proposed works, and with the mitigation measures proposed above, it is considered that no residual impacts from changes to hydrodynamic processes would occur. No impacts from changed hydrodynamic processes are anticipated on any critical or important habitat for threatened species.

11.8 Residual Impacts

Providing the mitigation and management measures discussed above are implemented, the likelihood of the proposed works presenting any residual impacts to any important or critical habitat affected by is low. Any residual impacts would be restricted to areas of inter-tidal soft sediment that are commonplace in the Bay. The proposed works would not affect any threatened biota in these areas, and recolonisation of disturbed areas by benthic organisms is likely to take place relatively quickly, limiting the duration of the residual impact. The measures taken control through avoidance and mitigation measures to address any potential indirect impacts discussed above, are sufficient ensure that there is a low probability of related residual impacts.

11.9 Summary

Table 11-5 below outlines the mitigation and management measures that would be put in place to avoid or minimise the likely impacts on the ecological resource of Botany Bay and its immediate environs.

Table 11-5 Ecology Mitigation and Management Measures

Mitigation and Management Measures	Implementation		
	Design	Implementation	Operation
To minimise the direct removal of habitat: • all project operations personnel would be fully trained in the use of the equipment and would undergo training in accordance with the CEMP, DSDMP and environmental measures agreed as part of the proposed works' approval; • dredging activities would be restricted to locations shown on the dredging plan(s); and • an accurate positioning system (GPS) would be used on the dredger to ensure direct impacts would be restricted to the approved dredging area and to minimise over-dredging.		✓	
To minimise the creation of sediment plumes and the risk of contamination: • a Sediment and Water Quality Monitoring Program (SWQMP) being developed as part of the DSDMP and implemented prior to, and during, the proposed dredging works; • as part of the SWQMP, turbidity monitoring would be undertaken for the duration of the dredging works, with monitoring of background concentrations and live monitoring to ensure suspended sediment limits are not exceeded during the works; • the SWQMP would be used to guide any requirement for adaptive management of measures during the project, including the cessation of overflow dredging if required; • the DSDMP would contain controls and measure to ensure that no overflow dredging operations take place at the contaminated areas in the approach to the sub berth and in the fixed berths; • further controls on the spill rate would be introduced if required, or in extreme cases overflow dredging would be halted temporarily in favour of removing excess water to the Sydney Offshore Spoil Ground;		✓	

Mitigation and Management Measures	Implementation		
	Design	Implementation	Operation
• a remediation action plan (RAP) would be prepared and submitted with the DA; and • the CEMP and DSDMP would contain measures for the management of acid sulphate soils (ASS).			
To minimise the risk of ship strike: • all project operations personnel would be fully trained in the use of the equipment and would undergo training in accordance with the CEMP, DSDMP and environmental measures agreed as part of the proposed works' approval; • observations for marine turtles, Dugong and cetaceans would be undertaken during the dredging, piling and rock revetment works and, where marine fauna approach within the precautionary exclusion zones designated in the DSDMP (see **Chapter 13, Noise**), dredging operations would temporarily cease until the animal has left the exclusion zone; and • ship speeds would be restricted to not more than 4 knots within the project site.		✓	
To minimise the risk of light impact: • lighting on ships and dredging equipment would be minimised to that required for safe operations and to meet regulatory navigational safety requirements; • the only operations continuing through the hours of darkness would be dredging activities, with no additional shore-side lighting associated with the proposed works; and • the proposed works would be designed to prevent excess light spill outside areas not required to be lit.	✓	✓	
To minimise the risk of marine pest species being introduced: • regular inspections of the active working areas and of equipment during maintenance for the presence of *C. taxifolia* and treatment of any *C. taxifolia* in accordance with the NSW *Control Plan for the Noxious Marine Alga Caulerpa taxifolia 2009*; • regular inspections by the Department of Agriculture, Fisheries and Forestry (DAFF) at the port and berthing facility; • any dredge equipment sources from outside the region would be subject to hull cleaning and/or inspection for marine pests prior to the commencement of works; and • adherence to DAFF requirements for the transfer of ballast water, with no 'high risk' ballast water or sediments from ballast tanks being discharged into Botany Bay		✓	

Mitigation and Management Measures	Implementation		
	Design	Implementation	Operation
To minimise the risk and impact of marine oil spills: • biodegradable oil would be used within the pile rig; • all fuel and hydraulic oils would be stored in secure, bunded areas and precautions would be taken during any refuelling or oil transfer operations to avoid oil entering the marine environment; • prestart checks would be undertaken prior to commencing piling works; • all ships used for the proposed works would hold current certifications in accordance with their class and function; • all ships and hydraulic equipment would be maintained in good condition with regular servicing and maintenance scheduled as part of the works; • all ship crew would be fully qualified and trained for their respective roles; • all ships would be operated in full accordance with international, Commonwealth and State navigational safety and environmental protection standards and regulations; • all ships would have an on-board Ship-Oil Pollution Emergency Plan (SOPEP) or equivalent applicable to their class; • oil spill response equipment would be located at the Wharf, and trained oil spill response personnel would be available at all times throughout the works; • spill kits would be held on board barges, dredges and workboats; and • all ships would not exceed a speed of 4 knots within the project site.		✓	

12 Heritage

12.1 Introduction

The following chapter considers the potential impacts of the proposed works on indigenous (Aboriginal) and historic heritage values. The assessment has focussed on existing and potential values in the form of Aboriginal places and objects, heritage items, maritime archaeology and shipwrecks. This chapter is supported by a heritage impact assessment (HIA) (see **Technical Appendix F**).

12.2 Scope of the Assessment

The Director General's Requirements (DGRs) (see **Technical Appendix A**) requested that consideration be given to *"Aboriginal and historic heritage items and values of the site and surrounding area (including known or probable maritime heritage sites and appropriate surveys) taking into account the NSW Heritage Manual (NSW Heritage Office, 1996), Assessing Heritage Significance Guidelines (NSW Heritage Office, 2001) and Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, 2005)."*

12.3 Legislation and Planning Policy

12.3.1 Legislation

Commonwealth Environment Protection and Biodiversity Conservation Act 1999

This Act provides a legal framework for the protection and management of places (matters) of national environmental significance (MNES). Several heritage lists are addressed by the EPBC Act, including the National Heritage List (NHL). The NHL protects places that have outstanding value to the nation. Approval from the Commonwealth Minister for the Department of Sustainability, Environment, Water, Population (SEWPAC) is required for 'controlled actions' that are likely to have a significant impact on items and places listed on the NHL.

NSW Heritage Act 1977

This Act ensures the protection of significant heritage places, buildings, works, relics, moveable objects and/or precincts. These include Aboriginal places or objects, items and places of historic heritage significance, and shipwrecks. Where these items have particular importance to the State they are listed on the State Heritage Register (SHR). Shipwrecks older than 75 years are listed on the NSW Maritime Heritage Shipwreck Database (MHSD) as 'historic shipwrecks'.

NSW National Parks and Wildlife Act 1974 (as amended)

This Act provides for the care, control and management of historic sites within the Office and Environment and Heritage (NSW OEH) Estate. This Act also provides for the protection of all Aboriginal places and objects throughout NSW. Aboriginal objects reported to NSW OEH are registered on the Aboriginal Heritage Information Management System (AHIMS).

12.3.2 Planning Policy

NSW Environmental Planning Policy: Kurnell Peninsula 1989

Sections 23A-23D of this Policy include provisions for the protection of local heritage items, relics and archaeological sites. Schedules 2 and 3 of the SEPP list archaeological sites and heritage items that are covered by this Policy.

12.4 Method of Assessment

This assessment of Aboriginal and historic heritage has involved the following tasks.

- Establishment of the study area.
- Establishment of the existing known and potential heritage environment relative to Aboriginal places and objects, historic sites and items, and maritime archaeology.
- Evaluation of the importance and/or sensitivity of the identified known and potential heritage values within the existing environment. This evaluation of importance is based on the historic, aesthetic, scientific, and social/spiritual significance of an item or place, as well as a consideration of its integrity.
- Assessment of the impact that the proposed works would potentially have on the heritage significance of an item or place (i.e. the impact the proposed works would have on its historic, aesthetic, scientific, and social/spiritual significance).
- Identification of mitigation in the form of further surveys, investigations, recovery and archival recordings to be undertaken in light of the identified impacts.
- A description of the residual impacts and their effects (if required).

12.4.1 Guidance and Standards

The Aboriginal heritage assessment has been conducted in accordance with:

- the *Burra Charter*; and
- the *Draft Guidelines For Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005[1]).

The historic and maritime heritage assessment has been conducted in accordance with:

- the *Burra Charter*;
- the NSW Heritage Manual (NSW OEH); associated supplementary publications including, *Archaeological Assessments 1996*, *Assessing Heritage Significance 2001* and *Assessing Significance for Historical Archaeological Sites and 'Relics' 2009;*
- the *Significant Impact Guidelines 1.1 Relating to Matters of National Environmental Significance* (DEWHA, 2009); and
- the *Underwater Heritage Principles and Guidelines* (NSW Heritage Office,1994).

[1] These guidelines were specified within the DGRs.

12.4.2 Study Area and Timescales

Initial Search Area

An initial records' search included:

- a 6 km by 7 km area centred on the project site with regards to Aboriginal heritage;
- an area approximately 100 m back from the Kurnell Peninsula shoreline for historic heritage; and
- records of maritime heritage within and in the vicinity of Botany Bay.

The searches were undertaken to provide an understanding of the heritage values in and around the study area.

Study Area

The study area for this assessment has included:

- the project site;
- the area of Botany Bay approximately 1 km south, west and east of the project site (as defined by the conclusions of the assessment in **Chapter 10, Water and Sediment Quality**);
- the village of Kurnell; and
- the shoreline and southern headland that form part of Kamay Botany Bay National Park.

Areas beyond 1 km to the west of the project site and the La Perouse shoreline have been excluded from the assessment based on the sediment dispersion and wave modelling outputs discussed in **Chapter 10, Water and Sediment Quality**, which have identified a neutral impact at these locations.

This assessment has considered impacts resulting from undertaking the proposed works, along with any long-term change to the heritage values of the area through the proposed upgrade of the port and berthing facility.

Timescales

The assessment has considered impacts resulting from the approximate 23-week dredging program. This includes short-to-medium term impacts caused due to the proposed works (sediment deposition) and any long-term and permanent impacts caused as a result of the removal or materials. The survey has also considered the permanent changes resulting from the upgrade to the Wharf infrastructure.

12.4.3 Baseline Environment

The assessment has involved a detailed desktop review of numerous historical texts and reports, along with various heritage registers that exist at a Commonwealth, State, local and non-statutory level in order to understand the history of Botany Bay and the Kurnell Peninsula. The following resources have been reviewed to compile a list of heritage values within the study area.

- Commonwealth.
  - National Heritage List (NHL).
  - Commonwealth Heritage List (CHL).
  - Australian National Shipwreck Database (ANSD).

- State, Local and Non-Statutory
  - National Trust of Australia (NSW) Register.
  - National Trust of Australia (NSW) Industrial Archaeological Sites List.
  - Register of the National Estate (RNE).
  - The NSW State Heritage Inventory.
  - The NSW State Heritage Register.
  - NSW OEH Maritime Heritage Shipwreck Database (MHSD).
  - NSW OEH Aboriginal Heritage Information Management System (AHIMS).
  - State Environmental Planning Policy (Kurnell Peninsula) 1989.

The findings of the desktop review were confirmed and supplemented through a land based site visit undertaken on 11 September 2012.

12.4.4 Consultation

Consultation has been undertaken to:

- provide La Perouse Local Aboriginal Land Council (LALC), as statutory representatives of the local Aboriginal community, with the opportunity to comment on the Aboriginal cultural heritage values of the study area and to be involved in the heritage assessment process;
- identify potential Aboriginal cultural heritage values of the study area;
- integrate potential Aboriginal heritage values and recommendations for management into the assessment report; and
- provide an opportunity for the local Aboriginal community to comment on the outcomes and recommendations of the HIA reporting.

Consultation was undertaken with La Perouse LALC on 5 September 2012. The LALC was advised of the proposed works and invited to identify any spiritual, traditional, historical or contemporary associations and attachments that the study area has for the present-day Aboriginal community in accordance with Step 1 of the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005). Consultation was undertaken with La Perouse LALC on 5 September 2012 with the HIA (see **Technical Appendix F**) being issued on 24 October 2012, with a request for feedback by 8 November 2012. La Perouse LALC was contacted again on 26 November 2012 by phone and asked if it would like to comment on the report. No response had been received at the time of preparing this EIS (16 January 2012).

This level of consultation should be regarded as an initial consultation only (see **Section 12.2**). Any feedback obtained during the period of exhibition would provide sufficient and reasonable time to allow the La Perouse LALC to make any response. Caltex, under the advice of a qualified heritage consultant, would pursue active consultation with La Perouse LALC during this period. Any received comments and requirements that would materially affect the conclusions of this chapter and its supporting HIA would be included in a preferred scheme report as relevant.

12.4.5 Evaluation of the Magnitude of Impact

The magnitude of potential impacts on known cultural heritage values of heritage significance has been based on:

- the removal, destruction, damage or substantial alteration of the fabric of a heritage item, place, or archaeological site;
- the extent to which the proposed activities would have a substantial and/or long-term impact on one or more heritage values of the place, including the complete or partial loss of one or more heritage values;
- the extent to which partial loss would affect the integrity and understanding of a heritage value;
- the extent to which the proposed works would enhance or detract from the setting of a heritage item or place, including its enjoyment, views and context (where that setting contributes to the heritage values of the item or place); and
- the extent to which the proposed works would diminish one or more heritage values of an item or place by restricting or inhibiting significant uses and associations of the place, or the ability of the place to demonstrate creative or technical achievement.

Table 12-1 Magnitude of Impact/Potential

Rating	Impact Definition
Beneficial	Respects or enhances heritage value and/or understanding of the item or place.
Neutral	No change or impact likely to occur as a result of the proposed works.
Minor	Minor temporary and/or reversible changes to fabric, setting, context, uses or associations, and/or no substantial or long-term effect on heritage value, integrity or understanding of the item or place.
Major	Permanent changes to fabric, setting, context, uses or associations, and/or substantial or long-term effect on the heritage value, integrity or understanding of the place.

12.4.6 Assessment of Significance

The assessment of whether an impact is likely to be significant is based on professional judgement and an understanding of how the proposed works would be likely to impact on the historic, aesthetic, scientific, social or spiritual significance of a heritage item, place, or archaeological site, having regard to the context or intensity of the impacts. Heritage significance or cultural heritage value is embodied in the place itself; its fabric, setting, use, associations, meanings, records, related places and related objects.

An impact is considered significant where there is a real chance or possibility that the action would have a major impact on the heritage values of a National heritage place or, in the case of a local heritage item, results in a permanent loss of heritage value. Such impacts are subject to mitigation and consideration of their residual effects. Partial loss of heritage fabric can be significant where the fabric embodies particularly sensitive or important values. Where the potential impacts are serious or irreversible the precautionary principle and the principle of inter-generational equity apply.

12.4.7 Evaluation of Maritime Heritage Potential

An evaluation of the potential for unknown maritime heritage to occur has been based on the hydrodynamics of the area, information from previous excavations and working of the seabed and the nature of activities that have taken place within Botany Bay that are likely to have contributed to the heritage environment. When referring to heritage potential in this chapter, the definitions in **Table 12-2** have been used for each of the ratings.

Table 12-2 Definition of Potential Heritage Ratings

Rating	Archaeological Potential
Low	No archaeological or heritage features are present.
Medium	There is the potential for features, sites and/or relics based on an archaeological assessment of the history and condition of the area.
High	There are known/recorded features, sites and/or relics.

The potential for an area to contain an archaeological feature, site and/or relic does not necessarily advocate there being a significant impact as per the definition set out above in **Section 12.4.6**.

Where there is a medium potential for maritime heritage to occur then there is a requirement to include measures to confirm presence/absence ahead of undertaking the proposed works. If presence is confirmed, then a corresponding impact assessment would be required under the terms set out in the previous section. In the absence of certainty (i.e. presence/absence cannot be clearly confirmed), the precautionary principle would be applied (see **Section 20.4.1**).

12.5 Existing Environment

12.5.1 Aboriginal Heritage

The Kurnell Peninsula was inhabited by the Gweagal people at the time of European contact. Early European accounts of the area indicate that small groups of Aboriginal people camped near the water, sometimes in bark huts. There is extensive recorded evidence of fishing and shell fishing activity in the area. Radiocarbon dating has been obtained for a number of Aboriginal occupation sites on the Kurnell Peninsula, the majority of which date to within the last 3,000 years.

A search of the AHIMS has confirmed that there are no registered places or objects located within the project site. The listed sites within the study area include the Aboriginal burial and midden sites in Kamay Botany Bay National Park (AHIMS Site 52-3-0219). These sites contribute to the significance of the Kurnell Peninsula Headland NHL listing as well as Potential Archaeological Deposits (PADs) on the Silver Beach foreshore.

12.5.2 Historic Heritage

The Kurnell Peninsula Headland is well known as the place where British explorer Lieutenant Commander (later Captain) James Cook first set foot on the shore of eastern Australia in April 1770. The landing place was declared a historic site in 1899. In 2004, the Kurnell Peninsula Headland was listed on the NHL, recognising its outstanding heritage value to the nation as the site of first recorded contact between British and Indigenous people in eastern Australia.

In the 1950s the Australian Oil Refinery Company built the Kurnell Refinery and 56 storage tanks. A submarine pipeline between the Refinery and a terminal at Banksmeadow was also constructed to enable the transportation of jet fuel to Sydney (Kingsford Smith) Airport, petrol and diesel. Kurnell Wharf and its associated breasting island were also constructed at this time.

The history of the area has resulted in there being a number of important heritage items across the Peninsula. Associated with the Peninsula is the Isaac Smith Memorial, the Cook Monument and the Meeting Place Precinct, which includes significant evidence of Holt's wharf, Brine's Dock, Trust wharf and a sandstone block seawall that has been constructed in various stages along the foreshore (see **Technical Appendix F**).

A consolidated list of heritage items and places located within the assessment study area is provided in **Table 12-3**.

Table 12-3 Historic Heritage Located within the Study Area

Name	Primary Address	Heritage Register	Significance
Kurnell Peninsula Headland	Cape Solander Drive, Kurnell, NSW, Australia	NHL OEH Section 170 Register Kurnell SEPP National Trust Register RNE	National
Australian Oil Refinery	Cape Solander Drive, Kurnell	Kurnell SEPP	Local
Bonna Point Reserve	Sir Josephs Banks Drive, Kurnell		
Crown Land Boatshed	Prince Charles Parade, Kurnell		
Silver Beach and roadway	Prince Charles Parade, Kurnell		

12.5.3 Maritime Heritage

Shipwrecks

No shipwrecks or other elements of maritime heritage have been positively identified or notified within the assessment study area.

A search of the Commonwealth ANSD and the NSW MHSD confirmed that there are 5 possible shipwreck sites that lie within the waters of Botany Bay (the initial search area (see **Section 12.4.2**). Archival research by the Australian National Maritime Museum (ANMM) has identified an additional four potential shipwrecks. These relate to those records listed in **Table 12-4**.

Table 12-4 Shipwrecks Listed on the Commonwealth and State Registers

Ship Name	Year Wrecked	Vessel Type	Where Wrecked
Archival research by Australian National Maritime Museum			
George	1877	Cutter	Botany Bay, Lady Robinsons Beach
Reclama	1930	Dredging vessel	Botany Bay, off Bunnerong Point.
Unknown Shipwreck- possible the ketch Arab	1907	Unidentified	Botany Bay, off the northern headland.
Unidentified Barge	1953	Barge	Botany Bay, off Bunnerong Point
NSW Shipwrecks Database			
Eileen	1934	Trawler	Kurnell
Magnet	1874	Sailing vessel	Sydney, Botany Bay
Minnie Wamsley	1903	Single screw steamer	Botany Bay
Prompt	1881	Sailing vessel	Botany Bay, ashore near government wharf
Swan	1836	Sailing vessel	Botany Bay, Lady Robinsons Beach

Unexpected Maritime Relics

The mobile nature of the maritime environment and the range of activities that have taken place in and around Botany Bay in the past two hundred years also create a potential for unexpected maritime relics to occur within the less intensively worked areas of the project site, mainly relating to the turning circle and approaches.

Other Marine Archaeology

Historical information indicates the possibility for other items of underwater marine archaeology to lie within Botany Bay. These potential relics include items associated with early fishing, extractive industries (such as shell gritting), kelp harvesting, anchoring and mooring.

12.6 Impact Assessment

12.6.1 Aboriginal Heritage

Previous archaeological investigations carried out near the foreshore demonstrate that despite disturbance across the Kurnell Peninsula, *in situ* archaeological deposits may still be present. However, all the Aboriginal heritage sites that have been identified on the Silver Beach foreshore and within Kamay Botany Bay National Park on the Kurnell Peninsula Headland are located above the high water mark.

The results of hydrodynamic and sediment modelling (see **Chapters 8, Hydrodynamics and Coastal Process**) suggest there will be some very small changes in wave energy along the length of Silver Beach and minor sediment build up along the Kurnell Headland foreshore.

These negligible affects would not affect any known Aboriginal archaeological deposits.

As such, the proposed works are expected to have a **neutral** impact on any known Aboriginal heritage sites or values and would be unlikely to affect their heritage significance.

12.6.2 Historic Heritage

Context and Setting (Visual) Impacts

The proposed works, including the use of dredging equipment, would have a **minor** and temporary (short term) impact on the important views of Botany Bay that contribute to the national heritage values of the Kurnell Peninsula Headland (see below).

Upgrades to the infrastructure on the breasting island, including installation of replacement hydraulic loading arms to service ships at fixed berth #1 would involve the permanent removal of the remaining 1960s manual loading arms from the Wharf. This change in technology would have a **minor** adverse impact on the historic and scientific significance of the overall site. These changes would not alter views of the Wharf from the headland, insofar as there would be little change to the mass or scale of the existing berthing structure. Extensions to the wharf structure by the addition of a third mooring dolphin, similar to the existing dolphin, would not interrupt views to the Meeting Place Precinct from the headlands to the north, and would have a **neutral** impact on the existing approach experience to the site from the Bay. Overall, the proposed works would not have any long-term or significant impact on the current view corridors, the orientation of the site to the Bay, or the national heritage values of the Place.

Sediment Dispersion Impacts

Sediment deposition could potentially obscure significant archaeological evidence of early wharves and rock cuttings along the foreshore, including Holt's wharf and Brine's dock associated with the National Park Precinct. This build-up would not impact on the physical fabric of the rock cuttings that form the base of these wharf structures, but it has the potential to interfere with the visual appreciation or interpretation of these elements by the general public. There would be a **minor** temporary impact to the important views of Botany Bay from the Meeting Place Precinct, the visual and physical relationship between the site and the Bay and the natural beauty of the Place, which all contribute to the Kurnell Peninsula Headland.

Predictions of sediment deposition (see **Figure 10-2**) show an overall conservative temporary sediment deposition following the 23-week dredging program of 1-2 mm at the shoreline off Kamay Botany Bay National Park (Southern Headland). As such, any potential impact on the intertidal environment is considered **neutral**; not affecting the national heritage values of the National Park or the known or potential other heritage values. Although the Isaac Smith Memorial is sited offshore, the predicted sediment build up is unlikely to have an adverse impact on the stability or setting of this monument.

Changes to water turbidity would have a **minor** and temporary impact on important views of Botany Bay and the Kurnell Peninsula Headland. Once the proposed works were complete they would not have a long term impact on the amenity or aesthetic significance of the beach and roadway.

Hydrodynamic Impacts

Hydrodynamic modelling of the proposed dredging works has indicated there would little change to the wave energy and direction in the vicinity of the Kamay Botany Bay National Park and Silver Beach (see **Section 8.6.2**). As such, there would be a **neutral** impact on the remains of the Isaac Smith Memorial, the Trust wharf, the original elements of the sandstone seawall and the structural integrity of the sandstone groynes.

Heritage Value Impacts

The proposed upgrade to the Kurnell Wharf fixed berth infrastructure aims to keep the Wharf in operation and as such would support the primary industrial heritage significance of the overall Refinery site as a rare, active, oil refinery in NSW. Removal of the existing equipment from fixed berth #1, and installation of a new hydraulic loading arm and manifold, could impact upon significant fabric of the wharf structure. This is considered a **major** impact in the short term to the asset, as the loss would be permanent, however the replacement structures would ensure the future use of the port and berthing facility.

Installation of three dolphins to allow the berthing of larger ships would be unlikely to have an adverse impact on the wharf structure. It would also reinforce and maintain the primary value of the Wharf as a port and berthing facility. This is considered a **neutral** impact to the heritage value of the Wharf.

12.6.3 Maritime Heritage

Despite the disturbance of the project site, backed by the reasonable amount of survey data that have been collected during the past years, it remains unknown whether there are any relics associated with the known or unidentified shipwrecks or other maritime heritage. As such, an evaluation of magnitude of impact or an assessment of significance is not possible.

Shipwrecks and Maritime Relics

Given the materials used in the construction of the potential shipwrecks, their relatively small size, the exposed nature of the seabed in this area of the Bay, and the dredging and extensive surveying and diving that has taken place in the sub berth and fixed berths, it is predicted that the potential for any shipwrecks or other items of underwater cultural heritage to be present in the vicinity would be **low**.

Given the less extensive limited dredging and disturbance that has taken place in the western part of the turning circle and approaches, there is a **medium** potential to disturb potential shipwrecks, articles associated with shipwrecks, or other items of underwater cultural heritage value in this area.

12.7 Mitigation

12.7.1 Discussion

Notwithstanding the conclusions discussed above, care would be taken to minimise the dispersion of sediment along the Kurnell Headland foreshore (in accordance with the mitigation committed to in **Chapter 10, Water and Sediment Quality**). Should any archaeology or heritage items be discovered during the proposed dredging works, activities would cease and notification made to the NSW Heritage Office.

12.7.2 Residual Impacts

The main residual impact would be the potential discovery of any marine relic (principally in the western part of the turning circle and approaches). This would be managed in accordance with the mitigation and management measures listed below requiring reporting, recording and subsequent management. Providing these measures are followed there would be no anticipated significant residual impact or effect from the proposed works.

12.7.3 Summary

Table 12-5 outlines the mitigation and management measures that would be put in place to minimise any adverse impacts on existing and potential heritage items affected by the proposed works.

Table 12-5 Heritage Mitigation and Management Measures

Mitigation and Management Measures	Implementation		
	Design	Implementation	Operation
A photographic record of the existing fabric and operation of Kurnell Wharf would be prepared prior to the proposed works. This would focus in particular on the existing infrastructure at fixed berth #1. This record would become part of the history of the place and would be maintained for the appreciation of present and future generations.	✓		
A management control would be included in the *Dredge and Spoil Disposal Management Plan* (DSDMP) and the *Construction Environmental Management Plan* (CEMP) for the works' contractor to monitor for heritage items or relics during dredging. If relics were to be discovered in the dredging areas, the works would immediately cease at that location and the relics would be reported to NSW Heritage Council (in accordance with Section 146 of the *Heritage Act 1977*). Further assessment by a maritime archaeologist and development of an appropriate management strategy may also be required at this point.		✓	

13 Noise

13.1 Introduction

The following chapter assesses the likely noise and vibration impacts resulting from the proposed works. A separate noise and vibration technical report (see **Technical Appendix G**) has been prepared to support this EIS chapter.

13.2 Scope of the Assessment

The Director General's Requirements (DGRs) (see **Technical Appendix A**) requested that consideration be given to "*noise and vibration from all activities and sources on and offsite, and impacts to adjoining receivers…*" during the construction stage, "…*taking into account the Interim Construction Noise Guidelines (DECC, 2009)…*". The DGRs also requested that consideration be given to '*changes to operational impacts including noise…*'.

A number of associated issues have been raised by other statutory agencies that are relevant to this chapter. They include:

- presenting a clear outline of the mitigation, monitoring and management measures the applicant intends to apply to the proposed works with regard to noise and vibration;
- the need to consider all noise and vibration sources associated with the proposed works (and the proposed hours of operation);
- the need to identify all noise-sensitive receptors; and
- consideration of cumulative noise and vibration effects resulting from the proposed works.

The noise assessment has considered the coincidence of various activities that would be undertaken to upgrade the port and berthing facility (see **Table 4-4**) thereby addressing the cumulative impacts of the proposed works.

Further consideration of the proposed work's cumulative impact on selected (noise-sensitive) receptors in combination with other projects is considered in **Chapter 18, Cumulative Effects**.

Noise impacts resulting from construction road traffic have been discounted given the small number of trucks required to undertake the proposed works relative to the two-year construction program (see **Section 4.6**).

An assessment has been undertaken to consider the likely underwater noise impacts on marine fauna resulting from the proposed dredging, piling and rock placement works (see **Section 13.6.3**).

The piling method adopted in the noise model is hammer piling (drop hammer). Whilst this activity would only take place for short periods during the final placement of each sunk pile (see **Section 4.5.1**), it represents the worst case of the vibratory and hammer methods and has been adopted in the modelling.

A detailed assessment of surface vibration has not been performed due to the large separation distance between the potential vibration sources and nearest receptors. At 100 m, vibration from piling is predicted to be less than 0.14 mms^{-1}, which is considered to be 'just perceptible' by British Standard 5228-2 (BS-5228-2), which is commonly adopted in Australia to assess vibration in the absence of any local standard. The nearest residential receptors are approximately 800 m from any works-generated vibration sources.

Any impacts relating to vibration would be considered negligible and have therefore not been considered further[1].

The following assessments have been undertaken to support the above scope:

- a quantitative assessment of potential noise impacts on terrestrial (land-based) receptors;
- a qualitative assessment of potential noise impacts on marine receptors; and
- a qualification in relation to the proposed operational changes and any noise impact on sensitive receptors.

13.3 Legislation and Planning Policy

NSW Protection of the Environment Operations Act 1997

The POEO Act includes a single licencing arrangement for a range of pollutants including noise. Under this Act certain scheduled activities are licenced, as is the case of the Kurnell Refinery operation. These activities require the operator to obtain an Environmental Protection Licence (EPL). This licence defines operating noise limits that must be observed when working on the site. This Act therefore serves to regulate noise pollution.

NSW Protection of the Environment Operations (Noise Control) Regulation 2008

This Regulation controls noise generated from road transport and ships. It makes it an offense for all ships to emit 'offensive' noise[2], whilst requiring the maintenance of noise-control equipment on ships.

No specific legislation applies to underwater noise.

13.4 Method of Assessment

13.4.1 Overview

This assessment has been undertaken in accordance with the guidance noted below and with reference to the POEO Act. It has involved:

- establishment of the study areas for considering the impacts of noise;
- consideration of the existing environmental baseline in relation to acoustic amenity and existing noise control limits;
- identification of relevant sensitive receptors within the defined study areas;
- calculation (through modelling) of the predicted 'airborne' noise emissions resulting from the proposed works;

[1] British Standard (BS) 5228-2:(2009) *Codes of Practice for Noise and Vibration Controls on Construction and Open Sites.*

[2] Offensive noise is given its definition under the POEO Act as being noise that is harmful, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances is harmful (or likely to be harmful to) a person who is outside the premises from which it is emitted; interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from where it is emitted and that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulation. Unreasonable interference with comfort and repose will depend on the circumstances, for instance the time and location of noise.

- consideration of the potential for underwater noise emissions resulting from the proposed works;
- evaluation of the results of the modelling and quantification exercises compared against the impact assessment criteria set out in the *Interim Construction Noise Guideline 2009* (ICNG) to determine if the potential for noise emissions is significant; and
- assessment of the residual effects with mitigation and management controls in place.

13.4.2 Noise Measurements

Noise is measured in decibels (dB). Two measurements of noise have been presented in this chapter: dB(A) relating to the human responsiveness to noise travelling through the air, and dB (re: 1 µPa), which is a measure of noise travelling through water as a pressure wave. Certain elements of the noise assessment have considered the maximum level of noise that would be generated during any 15-minute period (L_{Aeq} 15-mins). Other key noise terms have been defined within the technical appendix.

13.4.1 Guidance and Standards

This assessment has been undertaken in accordance with the following guideline and policy.

NSW Interim Construction Noise Guideline 2009

This guideline deals with the assessment of noise from construction activities and advises on approaches to minimise noise impacts through *feasible and reasonable* measures. It is specifically aimed at regulating construction works and is used to assist the NSW Environment Protection Authority (EPA) in setting statutory conditions in the planning approval process.

The guideline considers impacts on residents and other sensitive land users. It does so by presenting assessment approaches that are tailored to the scale of construction works and indicating how working practices can be modified to minimise noise. For the purpose this assessment, construction can include installation, alteration, maintenance and repair work.

A main feature of the guideline is the differentiation between works lasting less or more than three weeks. Above this timeframe the guideline requires a more robust assessment method and implementation of stricter management controls.

This reflects the principle that a higher level of noise would more likely be accepted by the community for shorter amounts of time; particularly where activities must be performed at night for safety or operational reasons.

The guideline defines ‘standard hours’ for construction works (excluding blasting) as being Monday-Friday (0700h-1800h) and Saturday (0800h-1300h).

The guideline states the conditions when undertaking construction outside the recommended standard hours might be acceptable. Five categories of works are included that might be undertaken outside recommended standard hours. The two categories of relevance to the proposed works are the following:

- delivery of oversized plant or structures; and
- works where the applicant demonstrates and justifies a need to operate outside the recommended standard hours.

NSW Industrial Noise Policy 2000

The objective of this policy is to allow the need for industrial activity to be balanced with the desire for a quiet community. This policy establishes noise criteria that:

- aim to protect the community from excessive intrusive noise and preserve the amenity for specific land uses (thereby identifying sensitive receptors);
- can be used as a basis for deriving project-specific noise levels;
- provide a consistent method of assessment;
- assist in outlining a range of appropriate mitigation to control industrial noise; and
- provide a formal process to guide the determination of *feasible and reasonable* noise limits for consents.

This Policy introduces the concept of the Rating Background Level (RBL), which has been used to assess the impact of noise-generating activities on surrounding sensitive receptors.

13.4.2 Study Area and Timescales

The study area adopted for the assessment of 'airborne' noise comprises a 2,500 m catchment extending in any direction from the limit of the project site. This 2,500 m catchment includes all the peripheral communities surrounding Botany Bay.

The underwater study area focuses on an area up to 250 m from the limit of the project site to account for potential disturbance caused through piling and dredging works.

The adopted assessment timescales account for the planned two-year works' program (see **Table 4-4**) along with any operational changes anticipated over the 50-year design period for the Kurnell port and berthing facility following its upgrade.

13.4.3 Airborne Noise

Ambient and Background Noise Data

Data relating to existing and ambient and background noise has been obtained through long-term monitoring and at key locations around the Kurnell Peninsula between 2006 and 2012:

- Botany Bay Cable Crossing (Wilkinson Murray (2006));
- 2011 Community Noise Evaluation (HFP (2011));
- Kurnell B-Line Jet Fuel Pipeline Upgrade Project (Construction and Vibration Noise Assessment) (Renzo Tonin (2011));
- Kurnell B-Line Jet Fuel Pipeline Upgrade Project (Construction Management) (URS (2012)); and
- Kurnell Port and Berthing Facility (Background Noise Monitoring) (2012).

Noise Sensitive Receptors

The location of residents and other sensitive receptors have been identified through a review of the above assessments, the use of GIS and mapping data and verified through a site walkover.

Prediction of Noise Levels

The predicted noise emissions have been calculated using the SoundPLAN 7.1 acoustics model. This model is approved by the NSW EPA and has been used to predict noise levels at the identified sensitive receptors.

The modelling has considered eight working scenarios (see **Table 13-1**) to account for when the various components that make up the proposed works would coincide. The assessment has considered activities that would be undertaken during standard hours set by the ICNG and works that would need to be completed outside of these standard hours, specifically the upgrade of the sub berth, which would take place during the daytime 7-days a week, and dredging, which would take place on a continual 24-hour basis. The need to undertake these works outside of the standard hours is due to the considerable economic impacts that would result from the proposed works being completed within the standard hours. This issue is discussed in detail in **Section 2.5.4.**

Each of the modelling scenarios has considered a worst-case scenario of the maximum noise generated over any 15-minute period.

The program of works is presented in **Table 4-5**. Published sound power levels (SWL) have been used as input to the modelling scenarios based on the equipment lists set out in **Table 4-4**. The SWLs are included in table 7-2 of **Technical Appendix G**.

For each scenario, it has been assumed that all equipment would operate simultaneously, at normal loads and constantly for a 15-minute period. The modelling has focused on representing the construction works, the potential overlapping of activities and location of those activities. In reality there would be often periods when not all the equipment was being operated simultaneously. As such the modelling output can be considered conservative.

The assessment has assumed the minimum separation distance between the limit of the project site to the sensitive receptor locations. Since the proposed scenarios include working on different areas of the project site there are potentially more than one minimum distance for consideration. In these instances the modelling has included a number of variants and results.

Noise contours for all the modelling scenarios are contained in appendix B of **Technical Appendix G**. Split hopper barges have been excluded from the scenarios as they themselves are not a noise-generating source. They would be manoeuvred by the various tugboats, which have been included in the relevant scenario.

Table 13-1 Construction Noise Scenarios

No	Description	Activity	Noise Source	Qty
1	2013 Q3: Dredging works. All potential critical locations within the dredging footprint have been considered. Six-month work duration, however, this scenario represen0074s the first quarter. Reuse works (one week) would not have a material influence on the noise emissions. Installation of sheet piled wall within fixed berth #1.	Dredging (including loading)	Backhoe Dredger (BHD)	1
			Tug Boat	2
		Sheet Piling	Pile Rig	1
			Rig Power Pack	1
			Water Jet Pump	2

No	Description	Activity	Noise Source	Qty
2	2013 Q4: Dredging works coinciding with the installation of quick release hooks (QRH) loading arms and a new manifold and Rock Revetment.	Dredging (including loading)	BHD	1
			Tug Boat	2
		Preventer line replacement and QRH installation	Grinding and Cutting	2
			Auxiliary Boats	3
		Installation of loading arms and manifold	Mobile Crane	2
			Tug Boats	4
			Miscellaneous Manual Tools	1
		Rock revetment construction	BHD	1
			Tug Boat	2
			Impact Rock Transfer	1
3	2014 Q1: Dredging works coinciding with the loading arms and a new manifold installation, bollard replacement, sub-berth upgrade works and rock revetment installation.	Dredging (including loading)	BHD	1
			Tug Boat	2
		Replacement of existing bollards	Grinding and Cutting	2
			Power Generator	2
		Installation of loading arms and manifold	Mobile Crane	2
			Tug Boats	4
			Miscellaneous Manual Tools	1
		Rock revetment construction	BHD	1
			Tug Boat	2
			Impact Rock Transfer	1
		Sub berth upgrade	Tug Boat	1
			Barge Power Generators (Compressors/Generators)	2
			Miscellaneous Manual Tools	1
			Grinding and Cutting	2
4	2014 Q2: Sub-berth upgrade works.	Sub berth upgrade	Tug Boat	1
			Barge Power Generators (Compressors/Generators)	2
			Miscellaneous Manual Tools	1
			Grinding and Cutting	2
5	2014 Q3: Installation of new mooring dolphins/platform foundations, installation of a new fire system.	New platform foundation installation	Piling	1
			Rock Pile	1
			Mobile Crane	1
			Grinding and Cutting	2
			Rig Power Pack	1
			Water Jet Pump	1
			Tug Boats (to Support Jack Up Barge)	2
		Fire system installation	Mobile Crane	1
			Tug Boats	2
			Grinding and Cutting	2

No	Description	Activity	Noise Source	Qty
6	2014 Q4: Installation of new bowing dolphins, installation of a new fire system and decommissioning of hydraulic loading arms.	New platform foundation installation	Piling	1
			Mobile Crane	1
			Grinding and Cutting	2
			Rig Power Pack	1
			Water Jet Pump	1
			Tug Boats (to Support Jack Up Barge)	2
		Fire system installation	Mobile Crane	1
			Tug Boats	2
			Miscellaneous Manual Tools	1
		Decommissioning of the hydraulic loading arms	Mobile Crane	1
			Tug Boats	2
7	2015 Q1: Installation of new bowing dolphins, and decommissioning of hydraulic loading arms.	New platform foundation installation	Piling	1
			Rock Pile	1
			Mobile Crane	1
			Grinding and cutting	2
			Rig Power Pack	1
			Water Jet Pump	1
			Tug Boats (to Support Jack Up Barge)	2
		Decommissioning of the hydraulic loading arms	Mobile Crane	1
			Tug Boats	2
8	2015 Q2: Installation of new bowing dolphins.	New platform foundation installation	Piling	1
			Mobile Crane	1
			Tug Boat	2
			Grinding and Cutting	2
			Rig Power Pack	1
			Water Jet Pump	1
			Tug Boats (to Support Jack Up Barge)	2

*Works occurring both within and outside of the standard working hours are **shaded grey**.*

For each of the above scenarios the noise model has taken into account:

- the sound (power levels) (see table 7-2, **Technical Appendix G**) for the equipment relevant to each modelled scenario;
- the locations of sensitive receptors;
- meteorological effects and attenuation due to distance; and
- ground and atmospheric absorption.

Meteorological, Atmospheric and Terrain Conditions

The dispersion of noise can be significantly influenced and affected by meteorological, topographical and terrain (surface reflectivity) conditions. Relative heights of the sensitive receptors and the Kamay Botany Bay National Park have been taken into account. However, the impact of topography and terrain would be minimal given that the proposed works would occur on open water.

Standard meteorological conditions have been included as input to the noise modelling. A conservative source-to-receptor downwind propagation factor of 1 ms^{-1} and 5 ms^{-1} (assuming a height of 3 to 11 m above the ground) has been included in the modelling parameters[3].

Evaluation of the Magnitude of Impact

Tables 13.1 and **13.2** present the recommended noise management levels set by the ICNG.

The limits are set relative to the rating background level (RBL). This is the overall background noise level measured in each relevant assessment period (during or outside the recommended standard hours) as defined by the NSW *Industrial Noise Policy* (INP) *2000*. To determine the RBL requires a measurement of the background noise level in the absence of the noise under investigation (in this case the proposed works).

Management levels include both absolute values and values relative to the ambient environment (i.e. a 'background plus' limit). Management noise levels apply to the most affected property boundary, or the most affected location within 30 m of a residence where the building is more than 30 m from the property boundary.

Table 13-2 Construction Noise Criteria (Residential Receptors)

Standard and Non-Standard Working Hours	Management Level $L_{Aeq, 15min}$	How to apply
Standard Working Hours: • Monday to Friday: 0700-1800 • Saturday: 0800-1300 • No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours.

Further management levels are provided in relation to *other sensitive land uses.*

[3] These parameters are included under the SoundPlan 7.1 model.

Table 13-3 Construction Noise Criteria (Other Sensitive Land Uses)

Land Use	Management Level, LAeq, 15min (applies when properties are being used)
Classrooms at schools and other educational institutions.	Internal noise level: 45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion).	External noise level: 65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation).	External noise level: 60 dB(A)
Commercial premises (offices, retail outlets, etc.).	External noise level: 70 dB(A)
Industrial premises.	External noise level: 75 dB(A)

Assessment of Significance

The assessment of significance has considered the following.

In terms of residential receptors, the assessment has compared two thresholds:

- the point where an exceedance of the *noise affected management limit* indicates the potential for some community reaction to noise; and
- the point where an exceedance of the *highly noise affected management limit* indicates the potential for a strong community reaction to noise.

Different mitigation and management controls would be put in place depending on which of the criteria were exceeded.

In terms of other land uses, the assessment has focussed on the potential for undue disturbance caused by an exceedance of the above threshold limits for the defined land use.

In each instance an exceedance defines the need to provide *feasible and reasonable* mitigation and management measures and to make a consideration of any residual effects.

13.4.4 Underwater Noise

Noise Sensitive Receptors

Marine fauna that could be potentially sensitive to the proposed works have been identified through the ecological assessment, recorded sighting of marina fauna and previous studies in the area[4]. In lieu of there being no underwater noise regulations or guidelines in NSW, the potential disturbance from the proposed works has been assessed based on the reported auditory sensitivity for each of the relevant identified species.

[4] Maunsell/AECOM (2006)

Evaluation of the Magnitude of Impact

The adopted criteria used in this assessment are based on a number of studies[5] that indicate that acute damage occurs to the marine fauna considered in this assessment where underwater noise levels are generated at levels above:

- 180 dB (re: 1 µPa)[6] for the proposed method of dredging; and
- 225 dB (re: 1 µPa) for the proposed method of piling (hammer piling).

The result of investigations undertaken by Richardson *et al.* 1995[7] (as an internationally recognised authority on underwater noise) conclude that there would be no tangible adverse noise effects experienced from the planned rock placement activities (see **Technical Appendix G**). As such, there are no assessment criteria for the effects of the rock revetment works (see **Section 13.6.3**).

Assessment of Significance

An impact is considered significant where underwater noise from the proposed activities could result in acute damage to sensitive marine fauna if not mitigated.

13.5 Existing Environment

13.5.1 Airborne Noise

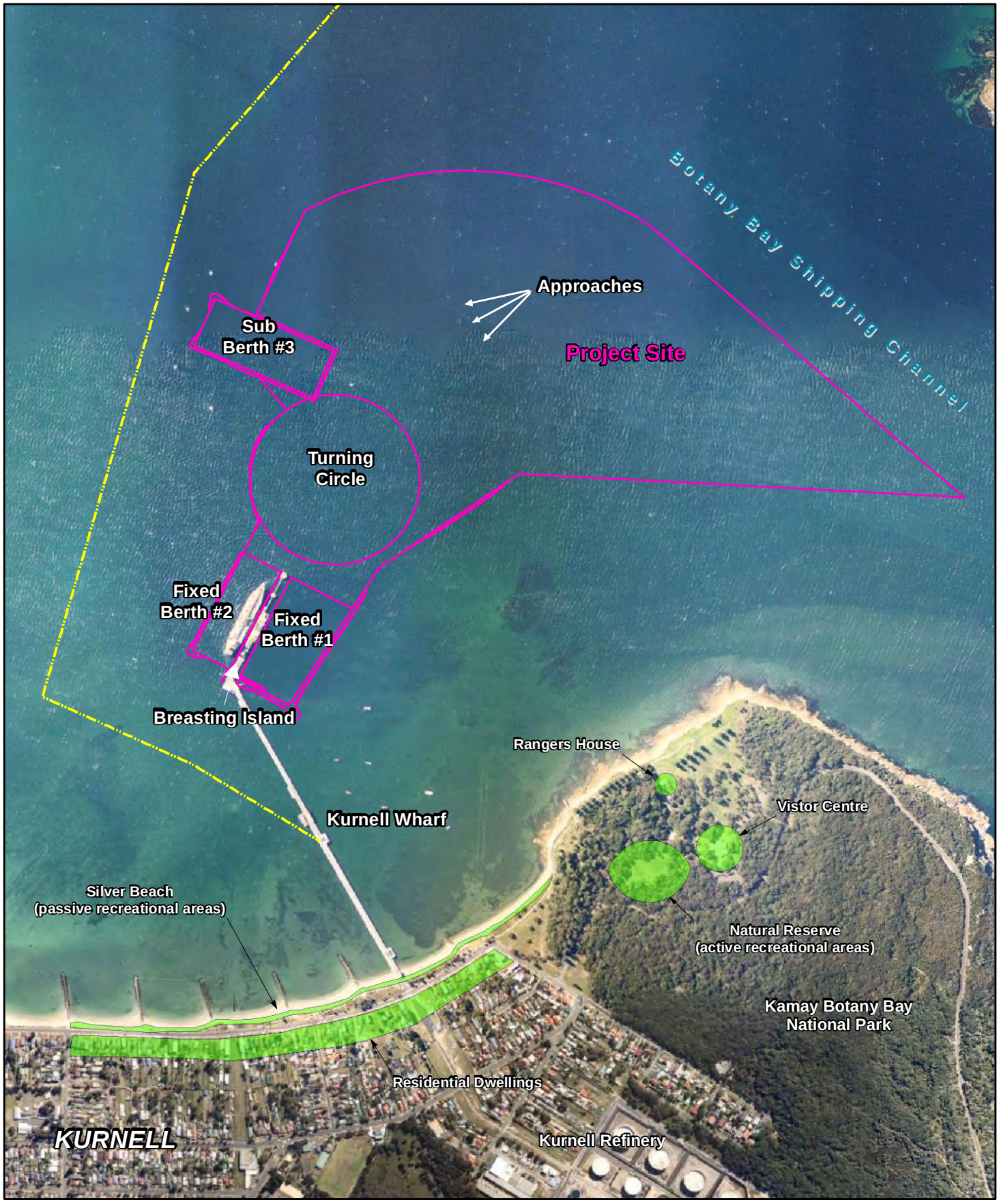
Sensitive Receptors

The nearest sensitive receptors are the residents located in the village of Kurnell and the users of the public spaces in the area. The nearest receptors (or receptor locations) and their minimum distances to the proposed works include:

- (the users of) Silver Beach (approximately 600 m);
- the residents of the Rangers House (located in the National Park) (approximately 700 m);
- the residents along Prince Charles Parade (No 2-174) (approximately 800 – 850 m);
- (the users of) Kamay Botany Bay National Park Recreational Park (approximately 800 m); and
- (the users of) the Botany Bay Educational Centre (located in the National Park) (approximately 900 m).

Figure 13-1 shows the locations of these receptors and their position relative to the project site.

[5] Greene, CRJ & Moore SE (1995) and Southall, BL *et al* (2007)
[6] Underwater noise is measured as a sound pressure level. The unit of pressure is the Pascal (Pa). In order to compare sound levels given in dB, a standard reference pressure must always be used. This has been agreed as being 1 microPascal (1 µPa). Measuring this pressure one metre from the source has been frequently adopted as used standard.
[7] Richardson *et al.* (1995)



N
W E
S

0 75 150 300 450 600 Meters

Datum: GDA94
Grid: MGA Zone 56

Legend

Project Site — Submarine Pipelines — Noise Sensitive Receptors

CALTEX
Caltex Australia

KURNELL PORT AND BERTHING PROJECT

SURFACE NOISE SENSITIVE RECEPTORS

URS

BOTANY BAY, NSW.

Figure: **13-1**

File No: 43177815.042.mxd Drawn: STB Approved: MD Date: 11/10/2012

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Existing Noise Environment

Ambient noise around Kurnell is dominated by the industrial activities of the Refinery, including the frequent transport movements to and from the facility. Intermittent noise is experienced through the frequent passing of aircraft overhead. Other noise sources include local vehicle movements and natural sounds such as wave action and fauna.

The activities of the existing port and berthing facility are also audible from the shoreline along Silver Beach with occasional wider ambient noise experienced from the recreational and commercial shipping traffic of Botany Bay. Ambient night time noise is also affected by the 24-hour operations of the Refinery and port and berthing facility, which tend to influence and dominate the baseline during this period.

The review of monitoring data covering the Kurnell Peninsula, backed by the monitoring undertaken at the Rangers House, confirms a number of RBLs (see table 5.1, **Technical Appendix G**), which have been applied to the sensitive receptors listed above (see table 5.2, **Technical Appendix G**).

From this monitoring data, and in line with the ICNG, noise management limits have been set for each receptor location. Management limits represent a limit that should not exceeded in any given 15-minute period.

Table 13-4 Noise Criteria Management Levels dB(A) ($L_{Aeq(15min)}$)

Sensitive Receptors	Standard Hours (Mon-Fri: 0700-1800 and Sat: 0800-1300)		Outside Standard Hours
	Noise Affected Management Level $L_{Aeq(15min)}$ [RBL + 10]	Highly Noise Affected Level $L_{Aeq(15min)}$	Noise Affected Management Level $L_{Aeq(15min)}$ [RBL + 5]
Residential Dwellings at No. 2-174 Prince Charles Parade	51 dB(A)	75 dB(A)	46 dB(A)
Rangers' House	51 dB(A)	75 dB(A)	46 dB(A)
Silver Beach (Passive recreational area)	60 dB(A) (when facilities are being used)		
Kamay Botany Bay National Park (Active recreational area)	65 dB(A) (when facilities are being used)		
Botany Bay Environmental Education Centre (Educational institutions)	55 dB(A) * (when facilities are being used)		
* A 10 dB(A) allowance has been made to account for the internal and external noise levels for building other than residences.			

13.5.2 Underwater Noise

Ambient Noise

In the case of the existing operations there would be a degree of ambient noise generated through the reasonably frequent ship (tanker) movements within the project site (10-13 per month) and the underwater noise generated through operational activities (potentially focussed on the movement of fuel through the subsea pipelines). A representative underwater ambient peak noise level in the vicinity of the

proposed works could be expected to be approximately 100-125 dB (re: 1 µPa)[8]. There would likely be more ambient noise close to the existing subsea fuels pipelines, potentially approximately 150-165 dB (re: 1 µPa)[7]. Ship-generated underwater noise would be intermittent and would vary depending on the type and size of ship. Large tankers (typical of those that berth at the existing Kurnell port and berthing facility) would generate up to a maximum of 190 dB (re: 1 µPa) attenuating to approximately 150 dB (re: 1 µPa) at approximately 100 m[9] with some expected variations due to the depth of water.

Sensitive Receptors

The sensitive marine fauna susceptible to underwater noise relative to this assessment include fish that would be located within the project site and its immediate environs, along with cetaceans (whales and dolphins), pinnipeds (seals) and Dugong (*Dugong dugon*), all of which have been recorded within the study area. These species were identified as being the main species of concern in relation to the Marine Mammal Management Plan developed for the Port Botany Expansion and remain relevant to this project as per the findings of the ecological assessment (see **Chapter 11, Ecology**).

13.6 Assessment of Impacts

13.6.1 Airborne Construction Noise

Standard Hours Working (Maximum Predicted Noise Levels)

The maximum predicted noise levels at the noise sensitive receptors shown on **Figure 13-1** are presented in **Table 13-5** below.

A 5 dB adjustment (penalty) has been made to all scenarios to reflect the tonality and impulsive character of the noise generated from hammer piling, drilling, grinding and cutting associated with elements of the proposed works (elements of which occur under all scenarios). This also applies conservatism to the modelling results.

This adjustment is in accordance with the ICNG and acts as a penalty for sound with a high degree of annoyance. This adjustment is not required for dredging as it is considered a 'broadband' activity with no special audible characteristics.

The following table presents the modelled construction noise levels resulting from the proposed works taking place during standard working hours.

[8] Savery & Associates Pty Ltd (2010)
[9] Bowles, A.E and Graves, S.K.(2007)

Table 13-5 Predicted Construction Noise Levels dB(A) ($L_{Aeq(15min)}$) Standard Working Hours*

Receptor	Noise Criteria Management Levels (dB(A))	Construction Noise Levels dB(A) $L_{Aeq(15min)}$							
	Standard Hours	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Residential Dwellings at No. 2-174 Prince Charles Parade	51	53-55	51-54	50-54	37-38	52-53	50-52	50-52	50-52
Rangers' House	51	47-49	46-47	46-48	34	48	48	48	47
Silver Beach (Passive recreational area)	60	56-57	54-56	54-56	40	55	55	54	54
Botany Bay Natural Reserve Oval (Active recreational area)	65	52-53	50-52	50-52	37	52	51	51	51
Botany Bay Environmental Education Centre (Educational institutions)	55	45-47	44-46	44-46	32	46	46	46	45

**Noise levels include a 5dB(A) penalty for all scenarios.*

The predictions show that the greatest sound power levels would be associated with the piling and rock revetment works that would occur under all scenarios except Scenario 4, which as noted in **Technical Appendix G**, are the two components of the proposed works that contribute to the noise exceedance due to their SWL and the fact that they incur a 5dB(A) penalty (see **Section 13.6.1**).

The reason for the variability in the noise levels is due to considering the dredger working in different locations in the footprint and the fact that the noise experienced along Prince Charles Parade would vary between No. 2 and 172 due to their relative distance from the limit of the project site.

Outside of Standard Working Hours (Maximum Predicted Noise Levels)

In order to assess the maximum noise that would be generated outside of the standard working hours specified by the ICNG, the eight scenarios were remodelled excluding all works except the upgrade of the sub berth and the dredging that would take place during Scenarios 1-4. Dredging would also take place at night. As Scenario 1 only includes the dredging this scenario is representative of the noise generated through dredging at night.

No 5 dB penalty would be incurred through working outside of the standard working hours as no activities with 'a high degree of annoyance' would be undertaken.

Table 13-6 Predicted Construction Noise Levels dB(A) ($L_{Aeq(15min)}$) Outside of Standard Working Hours

Receptor	Noise Criteria Management Levels (dB(A))	Construction Noise Levels dB(A) $L_{Aeq(15min)}$							
	Standard Hours	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8*
Residential Dwellings at No. 2-174 Prince Charles Parade	46	34-44	34-44	36-44	32-33	N/A	N/A	N/A	N/A
Rangers' House	46	35-38	35-38	36-39	29	N/A	N/A	N/A	N/A
Silver Beach (Passive recreational area)	60	42-46	42-46	43-47	35	N/A	N/A	N/A	N/A
Botany Bay Natural Reserve Oval (Active recreational area)	65	36-42	36-42	38-42	32	N/A	N/A	N/A	N/A
Botany Bay Environmental Education Centre (Educational institutions)	55	33-36	33-36	34-37	27	N/A	N/A	N/A	N/A

It is clear from **Table 13-6** that the predicted noise levels would reduce considerably (in some instances by 11 dB) by restricting the type of works that could take place outside of the ICNG standard working hours to dredging and the upgrade of the sub-berth. From the above data it is clear that neither activity would generate noise levels anywhere close to the noise management criteria.

Construction Noise Impacts

The results in **Table 13-5** assume that for each scenario all construction equipment would be operating continuously for a 15-minute period. In fact, the proposed working hours would differ depending on the working scenario being undertaken, and as discussed above, it would be unlikely for all the equipment to be operating continuously in any one 15-minute period.

Also as noted above, Caltex is proposing to complete the dredging activities continuously over a 24-hour period due to the reasons set out in **Section 2.5.6**. All other works would be constrained to the standard working hours excluding the sub berth works that would take place on Monday-Friday (0700h-1800h) and Saturday and Sunday (0800h-1800h).

Standard Working Hours

Table 13-7 shows where exceedances above the noise criteria management levels remain for each of the sensitive receptors during the standard working hours.

Table 13-7 Predicted Noise Construction Exceedances (Standard Working Hours)

Receptor	Construction Noise Levels dB(A) $L_{Aeq(15min)}$							
	Scenario 1#	Scenario 2*	Scenario 3*	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Residential Dwellings at No. 2-174 Prince Charles Parade	2-4	0-3	0-3	-	1-2	0-1	0-1	0-1
Rangers House	-	-	-	-	-	-	-	-
Silver Beach	-	-	-	-	-	-	-	-
Botany Bay Natural Reserve Oval	-	-	-	-	-	-	-	-
Environmental Education Centre	-	-	-	-	-	-	-	-

**Rock Revetment Works & # - Sheet Piling*

For the majority of the noise sensitive receptors there would be no impact during standard working hours. The exception would be where the proposed piling and rock revetment works would be taking place.

These following activities could result in an exceedance of the Noise Affected Management Level:

- up to 4 dB(A) at 2-174 Prince Charles Parade under Scenario 1 when sheet piling works were taking place, lasting approximately 3 weeks (which includes for stoppages to facilitate shipping and 9 days stand-down allowance for bad weather)l;
- up to 3 dB(A) at 2-174 Prince Charles Parade under Scenarios 2 & 3 when the rock revetment works were taking place, lasting approximately 4 weeks; and
- up to 1-2 dB(A) at 2-174 Prince Charles Parade under Scenarios 5-8 when the tubular piling works were taking place, lasting approximately 9 weeks (allowing 1 week during that period for bad weather).

As noted above, the variance in exceedance under each scenario is due to the distance of the residential dwellings along Prince Charles Parade relative to the project site and it accounts for the dredging taking place in different locations in the dredge footprint.

In all instances the predicted noise levels would remain well-below the Highly Noise Affected Management Level, which is representative of instances where there may be a strong community reaction to the noise impacts; seeing a need to introduce measures such as respite periods for these activities in to the works program.

During the rock revetment works the BHD (excavator) would continuously operate, as it would be required to initially install a geotextile membrane on which the rocks would be placed. Whilst the rock would be laid continuously, there would be breaks as new barge deliveries move alongside the BHD. In total the placement of the rocks would take approximately 4 weeks to complete.

Both activities are required to complete the proposed works and form a short term activity in the context of the whole construction program. Mitigation and management measures are considered in **Section 13.7**.

Outside of Standard Working Hours

As shown in **Table 13-6** there would be no exceedance of the Noise Criteria Management Levels for the activities undertaken outside of the standard working hours.

Continuous Working

Table 13-6 indicates that the activity of dredging on its own generates up to 44 dB(A) along Prince Charles Parade and 38dB(A) at the Rangers House; the two most sensitive receptors to the proposed works in terms of 'night-time' generated noise. In both cases this activity could proceed without the need for noise mitigation or management as it would not result in an exceedance of the relevant noise management criteria.

13.6.2 Airborne Operational Noise

On the whole it is anticipated that there would be limited operational changes to the Kurnell port and berthing facility as a result of the proposed works. The only notable change would be the reconfiguration of the berthing arrangement (see **Section 4.10**) resulting in fewer ships berthing at the facility in to the future, which would likely benefit the noise environment.

13.6.3 Underwater Construction Noise

Potential for Impact

Underwater noise has the potential to cause varying impacts on marine fauna. Behavioural disturbance is the mildest form of marine noise impact, evoking responses such as simply moving away from the source of noise. Physiological impacts are associated with high noise intensities or persistent and long-term underwater noise. Associated impacts are often described in terms of the effects on the auditory system.

The effects of sudden or cumulative noise exposure may cause the temporary loss of hearing. As a result, certain marine fauna may also have a less effective and sensitive response to danger or a reduced ability to aurally detect sources of food (i.e. moving shoals of fish). A more severe sudden or cumulative noise exposure may result in the permanent loss of hearing due to tissue damage. The most severe impact is mortality, which is limited close to where underwater explosions occur, as this can cause acoustic 'shock'. This has the potential to cause terminal vascular damage to critical organs, or terminal damage to air-filled cavities, such as swim-bladders in fish.

Behavioural responses changes are highly contextual, depending on the type, duration, extent and even depth of underwater noise. Another important factor is the prior experience of the subject marina fauna to a given noise event (i.e. the effects of habituation). Ship movements and dredging noise are not considered to cause significant behavioural response in mid-frequency cetaceans[10] or pinnipeds.

'An important conclusion of the scientific studies into underwater noise has documented both the presence and absence of behavioural responses of marine life to various sound signals. To date, no universal conclusion on the effect of sound has been drawn and is unlikely to emerge in the near future[11]. Certain conclusions about noise impacts are unlikely ever to be made, given the difficulty of observing marine mammals, fish and other marine life in the marine environment and the variability of responses[12]'.

[10] Savery & Associates Pty Ltd (2010)
[11] To put the difficulty of the assessment into context, a dose-response analysis of behavioural or physiological reactions has been difficult to gather even for humans in controlled experiments; while there is strong evidence of impacts of increased ambient noise on humans (Lercher *et al.* (2003), Stansfeld and Matheson, (2003)).
[12] Quote taken from Götz, *et al.,* (2009)

Assessment of Impact on Marine Fauna

Dredging

The reported noise source levels for general marine dredging operations range from 160-180 dB (re: 1 µPa). A study[13] that examined the underwater noise generated by bucket dredging (akin to backhoe dredging) showed that it was the effect of the bucket striking coarse gravels on the seabed that generated the most noise, with a recorded peak of 124 dB (re: 1 µPa) 150 m from the dredge site.

It would be reasonable to expect that the dredging associated with the Kurnell port and berthing facility upgrade would generate a similar noise profile. Assuming this to be the case, and recognising that the existing ambient peak noise level in the vicinity of the proposed works is expected to be approximately 100-125 dB (re: 1 µPa), the detectable underwater noise levels associated with the dredging works are likely to extend up to 150 m from the point of the dredging activities. Another study also confirmed that the majority of fish species would not be able to detect the noise made by dredging activity at a distance greater than 1 km from the activity[14].

Research indicates that acute damage to fish or disturbance to cetaceans/pinnipeds caused by the underwater noise generated through dredging does not occur below approximately 160 dB (re: 1 µPa)[15]. Underwater noise typically dissipates spherically in every direction close to the source[16]. Given the noise source data for the dredger provided above, a noise level of 160 dB (re: 1 µPa) or greater is only likely to occur within a few metres of the dredging operation (see **Technical Appendix G**). This would even be the case when dredging through partially consolidated rock or the harder peats associated with the fixed berths.

Pile Driving

Several studies have been undertaken to consider the impacts of piling. These confirm the peak noise produced by piling would typically range from between 185-225 dB (re: 1 µPa) (see **Technical Appendix G**). The other consideration is how this noise would dissipate underwater.

One study considered the effects of underwater noise resulting from impact piling[17] (similar to the hammer method of piling for the proposed works). This study considered a point 417 m from the piling location, where the recorded noise levels showed there to be no discernible increase in the background at any point during the piling operation (with recorded background levels periodically reaching 150 dB (re: 1 µPa)), but typically in the region of 110-120 dB (re: 1 µPa)). This conclusion is consistent with the findings of a study into the dissipation of underwater noise calculated by the Centre for Marine Science and Technology (CMST)[18].

An assessment of the potential behavioural and physical impacts on fish species from underwater noise generated through piling[19] (assuming 210 dB (re 1 µPa)) concluded that avoidance reactions would be likely to occur up to 30 m from the noise source (especially for species with swim bladders). Within 30 m this level the noise would have an ability to result in a temporary loss of hearing to such species as herring (*Clupea harengus*) and sprat (*Sprattus sprattus*). No other noise impacts were predicted.

[13] Dickerson *et. al.* (2001)
[14] Henderson (2003)
[15] Southall *et al.* (2007)
[16] Nedwell & Howell (2004)
[17] Nedwell *et. al.* (2003)
[18] See Maunsell/AECOM (2006)
[19] Engell-Sørensen (2000)

The data from this and other studies demonstrates that the underwater noise generated by piling works in the marine environment has the potential to cause temporary damage and even mortality to fish in very close proximity to the piling works. For pelagic (near surface) fish, cetaceans and pinniped, physiological damage is less likely, with the most likely behavioural response during piling being avoidance of the area when noise levels reach a threshold at which discomfort or annoyance would be experienced.

Pile driving is likely to be undertaken over a period of a few weeks, with the underwater noise generated being periodically persistent, with pauses while pile sections are being added and the work shifted to new piles. Underwater noise levels from piling would also vary depending on the substrate and the pile driving method used. Pile driving is arguably the most noise intensive activity of the proposed works, with its inherent repetitive, impulsive nature possibly accentuating its ability to startle or lead to avoidance behaviour by marine fauna. Any startle effects arising from pile driving would most likely be more acute during the initial start-up phase. Any potential for cumulative, long-term effects would be minimised by the intermittent nature of the activity, providing periods of respite for any sensitive marine fauna.

Rock Revetment Works

Poor and inconsistent information is available regarding the noise generated from rock revetment activities. However, it is reasonable to expect that any noise would be dominated by the turbulence of the rock fall and grinding of rocks. Given the normal pattern of rock revetment activities, it is anticipated that any noise would be intermittent and of relatively short duration.

It is reasonable to assume that underwater noise associated with the dumping, movement and settling of the rocks themselves would be low frequency and broadband. Intensity and period of the noise event would be influenced by factors such as the amount, size and mass of rocks dumped, the depth of water in which they were dumped and the type of surface upon which they landed and settled. Consistent with the findings of the limited range of studies, the impacts of the rock revetment works remains unknown, and therefore they require that the precautionary principle be adopted.

Summary

The proposed works would result in three notable sources of underwater noise. These are as a result of the dredging works, during the required piling works and whilst rock placement (dumping) is taking place.

From the above assessment, the effects of these activities confirm that:

- dredging would form a broadband continuous noise source (over a 23-week period) of up to 180 dB (re: 1 µPa) attenuating to ambient levels approximately 150 m from the location of active dredging works;
- piling would generate short bursts of intermittent noise up to a peak of 225 dB (re: 1 µPa) attenuating to ambient background levels approximately 420 m from the location of the piling works; and
- any tangible adverse noise-induced effects created through rock revetment would be unlikely but cannot be fully discounted in the absence of credible data.

Given this information, the following conclusions can be drawn.

Fish

Dredging: The proposed dredging would only cause acute damage to fish within a few metres of the dredger where noise levels are expected to exceed 160 dB (re: 1 µPa). Beyond this initial distance, fish are likely to avoid the area or display a startle response and move out of the area to a point where the noise levels would not cause any distress. It would be reasonable to assume that such reactions would occur up the point where ambient noise levels are reached (i.e. 150 m from the active area of dredging).

Piling: It is likely that fish would avoid coming within 30 m of any active piling until the piling had stopped. Beyond this initial distance, fish would display avoidance reactions whilst being potentially startled due to the impulsive instantaneous nature of piling. Fish within 30 m of the piling works could potentially suffer a temporary loss of hearing, and there is a chance that very close to the works, they could be injured or killed. However, this is likely to be rare and exceptional.

Cetaceans and Pinnipeds

Dredging: The proposed dredging would only harm cetaceans and pinnipeds (i.e. cause temporary/ permanent hearing loss or physiological impacts) within a few metres of the dredger where noise levels exceeded 160 dB (re: 1 µPa). Beyond this distance, the cetacean or pinniped would likely either avoid or move out of the area when noise levels reach a threshold at which discomfort or annoyance would be experienced.

Piling: For there to be any harm to a cetacean or pinniped from piling they would need to be within 250 m of any activity piling works for longer than 30 minutes[20]. Normally however, cetaceans would avoid or move out of this area on experiencing discomfort or annoyance. It would only be within a short distance of the piling works where cetaceans/pinnipeds could be harmed or injured. As this distance is poorly defined in the literature the precautionary principle has been adopted in identifying appropriate mitigation measures.

Dugongs

Any acoustic inducted effects on dugongs are likely to be similar to that anticipated for cetaceans/ pinnipeds. The conclusions above and the mitigation and management measures below would apply to Dugongs as well as cetaceans/pinnipeds.

13.7 Mitigation

13.7.1 Overview

Airborne Noise

The assessment confirms the potential for minor impacts associated with the proposed works that would lead to occasional exceedances of the ICNG limits. However, it should be noted that these works would be a short term activity in the context of a two-year construction program and sit within the context of an existing licenced facility that has an agreed EPL noise limit of 70 dB(A) (0700h-2200h) and 65dB(A) (2200h-0700h) (see **Chapter 5, Legislation and Planning Policy Context**).

[20] Cockenzie CCGT Power Station Project Environmental Statement (2009).

The above exceedances occur due to piling/rock revetment works (undertaken during standard working hours). To mitigate these impacts, the following measures would be provided for each activity.

Piling

There would be a responsibility on the works' contractor to validate the SWL of the piling operations prior to commencing the works in order that the following limits are achieved.

- Calculated 15-minute SWL of $L_{w,eq,15min} \leq 113$ dB(A) at source.
- Measured 15-minute sound pressure levels (SPL) $L_{p,eq,15min} \leq 85$ dB(A) measured at 10 m from the source in-situ or in a similar location where the works are to be carried out.

The above measurements would need to be carried out by a qualified acoustics consultant, (i.e. a member of the Australian Acoustical Society (AAS) or the Association of Australian Acoustical Consultants (AAAC)), and they must be undertaken in accordance with relevant Australian Standards for acoustic measurement of equipment in the field.

The above ratings are set to validate the noise predictions and to readily achieve the ICNG noise criteria. A 4 dB(A) exceedance attributed to piling was predicted in the assessment where a piling SWL of 117 dB(A) was used. A SWL of 113 dB(A) would reduce the noise levels to achieve the noise criteria. It would be unlikely that this level could be achieved without the need for additional mitigation. Reasonable and feasible measures to achieve the criteria could include physical measures such as the use of dampening non-metallic dollies (wooden blocks), acoustic shielding for the piling equipment, or measures to reduce the overall noise level by introducing periodic breaks in the works, such as:

- piling for 12 minutes and stopping for 3 minutes would give an overall reduction of 1 dB(A) when measured as $L_{Aeq,15min}$; or
- piling for 10 minutes and stopping for 5 minutes would reduce the noise levels by circa 2 dB(A).

These simple measures would be sufficient to ensure the works' contractor would achieve the guidance limits of the ICNG.

Rock Revetment Works

The same reductions in noise could be achieved by implementing similar respite periods as for the piling. However for such a short program (4 weeks) introducing breaks every few minutes would be impractical only serving to extend the duration of these works. Also the achieved reductions would not reliably meet the noise management levels with some level of exceedance remaining.

Beyond this there is little (reasonable and feasible) mitigation that could be implemented to manage the noise exceedance created through the rock revetment works. The exceedance would therefore need to be managed through effective community consultation and awareness.

Specific noise management measures for the rock revetment works would be included as part of a Construction Environmental Management Plan (CEMP) for the proposed works. The plan would:

- be prepared by a suitably qualified and experienced acoustic consultant and in consultation with NSW EPA;
- identify the nature, location and duration of the rock revetment works (including scheduled commencement of construction);
- identify the location of the potentially affected receptors;

- include a noise monitoring program that can be used to demonstrate the exceedances are limited to levels specified above in **Table 13-7**; and
- detail what management and/or contingency actions would be taken if noise emissions were found to be approaching or exceeding the levels in **Table 13-7**.

In addition, Caltex would include for a specific community consultation exercise ahead of undertaking the rock revetment works using the provisions set out below under General Noise Management.

Dredging

As part of the terms of contract established with the works' contractor there would be a requirement to confirm the SWL of the dredger and its consistency with the SWL used in the modelling for this assessment. A higher SWL would require additional modelling and consideration of the General Noise Management requirements set out below.

General Noise Management

In addition to the above mitigation the following management controls would be implemented.

- For works taking place outside the standard working hours, monthly-attended noise monitoring would be undertaken to verify levels along Prince Charles Parade. Any persistent exceedances (although unlikely with the above mitigation included) would require Caltex to include additional noise management controls in line with the ICNG.
- The proposed works would be incorporated into Caltex's current procedures for handling and managing complaints (see **Section 6.8**). This would involve handling complaints through an advertised 24-hour hotline, keeping a complaints register, and making a response within 48-hours.
- Caltex is proposing to keep the local community regularly informed of the proposed works (see **Section 6.8**). This would include specific communications with regard to scheduling noise-generating activities. Specific consultation would take place ahead of the piling, dredging and rock placement works. It would also set out the proposals for daytime working at the weekend and the night-time dredging.
- Works' contractors would be bound to Caltex's internal management procedures requiring appropriate training and awareness of all staff on the appropriate use and maintenance of equipment, including the routine use of provided shielding/screening etc.

Underwater Noise

The following procedures would be put in place to manage underwater noise impacts. These would be controlled through the fauna management plan (see **Chapter 11, Ecology**).

- During the proposed works, contact would be made with the whale migratory team within NSW OEH during June and October to confirm any reported whale sightings.
- During the proposed works observations would be made up to a distance of 420 m from the active working area (whilst dredging, piling or rock placement works were taking place). The observations would be made using the Whale and Dolphin Sighting Log[21] and be trained in the identification of

[21] Fulton., F (2008)

sighting cetaceans, pinnipeds or dugongs. The checks would also include any noted instances of shoaling fish in this area.

- Slow start up measures would be used for all submarine noise generating activities to ensure any noise-sensitive marine fauna would move away from the source of the noise if required. Works would not commence if cetaceans, pinnipeds or dugongs were sighted within 150 m of the dredging, piling or rock placement works.
- If, during the dredging, piling or rock placement works, cetaceans, pinnipeds or dugongs were to come within 420 m, the works' contractor would be put on standby to stop any associated underwater noise-generating works from taking place.
- If, during the dredging, piling or rock placement works, cetaceans, pinniped or dugongs were to come within 150 m, the works' contractor would stop any associated underwater noise-generating works until the sensitive marine fauna were to move more than 150 m away. Activities would not recommence until 30 minutes following the mammal leaving this 'exclusion' zone.

13.7.2 Residual Impacts

With the proposed mitigation in place there would be:

- a short-term exceedance of up to 3 dB(A) against the noise management criteria set by ICNG when the rock revetment works would be taking place during the standard working hours, lasting for approximately 4 weeks.

13.7.3 Summary

Table 13-8 outlines the mitigation and management measures that would be put in place to minimise the likely noise impacts resulting from the proposed works.

Table 13-8 Noise Mitigation and Management Measures

Mitigation and Management Measures	Implementation		
	Design	Implementation	Operation
The works' contractor would be required to validate the SWL of its piling, rock revetment and dredging operations.		✓	
Specifically for the piling and rock revetment there would be a requirement for the works' contractor to achieve the following limits. • Calculated 15-minute sound power levels $L_{w,eq,15min} \leq 113$ dB(A) at source. • Measured 15-minute sound pressure levels $L_{p,eq,15min} \leq 85$ dB(A) measured at 10 m from the source in-situ or in a similar location where the works are to be carried out. The above measurements would need to be carried out by a qualified acoustics consultant, (i.e. a member of the Australian Acoustical Society (AAS) or the Association of Australian Acoustical Consultants (AAAC)), and they must be undertaken in accordance with relevant Australian Standards for acoustic measurement of equipment in the field.	✓	✓	

Mitigation and Management Measures	Implementation		
	Design	Implementation	Operation
If the piling is shown to exceed the above limits, additional mitigation would be required for these activities. For the piling this may include physical measures (such as the use of wooden damping blocks or screening), whilst periodic breaks in undertaking the piling could reasonably reduce the noise to below the Noise Criteria Management Level along Prince Charles Parade.		✓	
Specific noise management measures for the rock revetment works would be included as part of a Construction Environmental Management Plan (CEMP) for the proposed works. The plan would: • be prepared in consultation with NSW EPA by a suitably qualified and experienced acoustic consultant; • identify the nature, location and duration of the rock revetment works (including scheduled commencement of construction); • identify the location of the potentially affected receptors; • include a noise monitoring program that can be used to demonstrate the exceedances are limited to 3 dB(A); and • detail what management and/or contingency actions would be taken if noise emissions were found to be approaching or exceeding 3 dB(A). Caltex would specifically consult with the residents of Prince Charles Parade and other local community groups ahead of starting the rock revetment works. The consultation would be managed through the measures set out below.		✓	
When works were to take place outside of standard working hours defined by the ICNG, there would be a requirement to undertake monthly-attended monitoring to verify noise levels along Prince Charles Parade where exceedances were predicted. Any persistent exceedances would require Caltex to include additional noise management controls in line with the ICNG.		✓	
Noise complaints would be handled through Caltex's 24-hour advertised hotline. A response would be made to complaints within 48 hours. Where required NSW EPA would be consulted.		✓	
The community would be regularly updated on the proposed work schedule. Specific consultation would be undertaken to inform residents and users of Silver Beach of the piling, dredging and rock placement works and to set out the proposals for daytime working at the weekend.	✓	✓	
The works contractors would be required to implement appropriate training to ensure staff awareness relating to the appropriate use and shielding of equipment.		✓	

Mitigation and Management Measures	Implementation		
	Design	Implementation	Operation
The following measures would be included in the *Fauna Management Plan* (see **Chapter 11, Ecology**). • During the proposed works, contact would be made with the whale migratory team within NSW OEH during June and October to confirm any reported whale sightings. • During the proposed works observations would be made up to a distance of 420 m from the active working area (whilst dredging, piling or rock placement works were taking place). The observations would be made using the Whale and Dolphin Sighting Log and be trained in the identification of sighting cetaceans, pinnipeds or dugongs. The checks would also include any noted instances of shoaling fish in this area. • Slow start up measures would be used for all submarine noise generating activities to ensure any noise-sensitive marine fauna would move away from the source of the noise if required. Works would not commence if cetaceans, pinnipeds or dugongs were sighted within 150 m of the dredging, piling or rock placement works. • If, during the dredging, piling or rock placement works, cetaceans, pinnipeds or dugongs were to come within 420 m, the works' contractor would be put on standby to stop any associated underwater noise-generating works from taking place. • If, during the dredging, piling or rock placement works, cetaceans, pinniped or dugongs were to come within 150 m, the works' contractor would stop any associated underwater noise-generating works until the sensitive marine fauna had moved out of this area. Activities would not recommence until 30 minutes following the mammal leaving this 'exclusion' zone.		✓	

14 Air Quality and Odour

14.1 Introduction

The following chapter assesses the likely air quality and odour impacts resulting from the proposed works. A separate air quality and odour report (see **Technical Appendix H**) has been prepared to support this EIS chapter.

14.2 Scope of the Assessment

Overview

The Director General's Requirements (DGRs) (see **Technical Appendix A**) requested that consideration be given to "…*air quality impacts associated with the dredging, handling, stockpiling and disposal of dredged material (as relevant), including odours beyond the site(s) boundary…taking into account the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC, 2005)…",* and *"changes to operational impacts, including air quality…".*

A number of associated issues have been raised by statutory agencies that are relevant to this chapter. They include:

- risks relating to environmental harm, human health and amenity;
- all processes that could result in air quality emissions; and
- consideration of the risks associated with fugitive and point source emissions.

The above requirements have been addressed through qualitative and quantitative assessment. A qualitative assessment has been undertaken to consider and scope the potential for significant air emissions associated with the proposed works. This assessment (see **Section 14.6.1**) has confirmed that the potential for significant impacts would be limited to the issues of odour generation. For this aspect, a quantitative assessment has been undertaken using odour dispersion modelling.

14.3 Legislation and Planning Policy

Protection of the Environment Operations Act 1997

Part 5.4 of the *Protection of the Environment Operations Act 1997(POEO Act)* defines air pollution.

It enables the Government to:

- make protection of the environment policies to prevent or minimise air pollution;
- allocate responsibilities for environmental protection between the state Government and local councils;
- provide a range of tools to address air pollution including orders and directions concerning clean-up and prevention notices;
- enable a function for notices to be issued to maintain and operate equipment in a proper and efficient manner; and
- make it an offence to carry out various activities that cause the emission of air pollution and/or breach the conditions of an order, direction or notice.

Two principal regulations have been formed under the POEO Act, one of which is relevant to this assessment and is discussed below.

Protection of the Environment Operations (Clean Air) Regulation 2010

The *Protection of the Environment Operations (Clean Air) Regulation 2010* sets the legislative context for air emissions associated with industrial and commercial developments. This Regulation is relevant to the proposed works as it sets out management responsibilities to minimise adverse air quality impacts.

14.4 Method of Assessment

14.4.1 Overview

This assessment has been undertaken in accordance with the above Regulation. It has involved:

- establishment of the study area;
- identification of relevant sensitive receptors within the defined study area;
- a qualitative review of potential air emitting sources and establishment of the modelling approach for the key pollutants of interest;
- identification of the existing air quality environment within the study area;
- a quantitative assessment of predicted impacts relating to the odour emissions compared against threshold limits (see **Table 14-2**); and
- assessment of the residual effects (if required).

14.4.2 Guidance and Standards

Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales 2005

The assessment of air emissions is set out within the Regulation. It specifies impact assessment criteria for a range of air pollutants and the assessment methods above that should be applied to model emissions. The key pollutant of relevance to the proposed works relates to odour (see **Table 14-2**).

14.4.3 Study Area and Timescales

The study area for the qualitative assessment has considered the emissions associated with the whole of the proposed works (which has included road transport emissions). This study area therefore considered potential receptors (and their sensitivity) across the broad area of Botany Bay. The odour assessment and modelling has focussed on the receptors within the odour emissions 'footprint' (i.e. the aerial extent of odour dispersion) (see **Figure 14-2**). This is limited to the project site and the residential area of Kurnell; with odours only being generated from within the fixed berths for the reasons discussed in **Section 14.6.1**. The assessment has therefore considered impacts for the approximate 16-week period during which the fixed berths would be dredged (see **Table 4-4**).

14.4.4 Baseline

Data relating to existing and background air quality have been obtained through long-term monitoring[1], recorded odour complaints[2] and licenced controls put in place to manage air quality impacts[2].

Average climate data for the area have been obtained from the Bureau of Meteorology (BoM) operated weather station at Sydney (Kingsford Smith) Airport. A brief discussion of the climatic data is provided below.

14.4.5 Modelling

The prediction of potential air quality and odour emission impacts has involved the use of the Ausplume dispersion model. This model is approved by NSW Environment Protection Authority (EPA) for use in most simple near-field applications. It is considered capable of representing the key dispersion mechanism in a manner appropriate for an assessment of this scale.

Odour emissions have been represented in the model as a single area source that signifies a full barge containing odorous sediment. Emissions have been assumed to take place continuously for each hour of the day for a single complete year of meteorological conditions. This is therefore more conservative than the intended program of works and dredging schedule (see **Table 4-5**).

The quantitative component of the assessment has provided an estimate of impacts at a series of discrete points along the Silver Beach shoreline (see **Figure 14-1**). These have been taken as to represent the impact on both recreational users of this area whilst providing the worst possible case for the residents of Kurnell (see **Section 14.5.1**).

14.4.6 Magnitude and Significance of Impact

Qualitative Air Quality and Odour Assessment

A qualitative air quality and odour assessment (see **Section 14.6.1**) has been conducted to understand the likely impacts associated with the proposed works. This assessment has identified the relevant sensitive receptors and examined what potential air quality impacts would be associated with the works. For each element of the proposed works, a conclusion has been made on whether the works would be likely to have a negligible, minor, moderate or major air quality and odour impact. Definitions for negligible, minor, moderate or major are provided in **Table 14-1** below.

[1] Gathered by the NSW Environmental Protection Authority (EPA) at a number of fixed monitoring stations in the Sydney Metropolitan area and data gathered by the Bureau of Meteorology.
[2] As discussed within the Caltex Environmental Protection Licence 837.

Table 14-1 Qualitative Air Quality Assessment Criteria

Rating	Emissions Potential	Potential for Adverse Air Quality Impacts
Negligible	-	Emissions generated from a source of low emissions potential lasting up to 6 months.
Low	Small/incidental emission sources (such as a grinder) that is not licensed or controlled[3].	Emissions generated from a source of low emissions potential lasting up to 2 years.
Moderate	Medium emissions source (such as the dredger) that is not licensed or controlled.	Emissions generated from a source of moderate emissions potential lasting up to 6 months.
Major	Licenced or controlled emissions source (such as an emissions stack).	Emissions generated from a source of moderate emissions potential lasting either up to 2 years or any emission from a source of major emission potential.

Quantitative Odour Assessment

The assessment of significance relative to odour emissions has been based on the evaluation of the sensitivity of the receptors and the magnitude of emissions using the methods set out in the Regulation (see **Section 14.4.2**). The Regulation sets criteria in relation to the impact of pollutants on public health and amenity values. The relevant assessment criteria for odour are set out in **Table 14-2**.

The use of odour units has been adopted in the absence of their being any available specific standards for odours generated from peat oxidation or acid sulfate soils (ASS) (as being the focus of the assessment see **Section 14.6.1**). The odour unit, its definition and assessment, presents a simple dilution factor that must reach the detection threshold of a 'panel of humans' using their noses as odour detectors.

Table 14-2 Odour Assessment Criteria

Population of Affected Community	Odorous Air Pollutants Impact Assessment Criteria (OU)
Urban (>2000 people affected) and/or schools and hospitals	2.0
~500	*3.0*
~125	*4.0*
~30	*5.0*
~10	*6.0*
Single rural residence (<= 2)	*7.0*
Note: Nose response time average, 99th percentile	

For the purpose of this assessment the most sensitive criterion of an 'urban community' has been selected.

In terms of the identified sensitive receptors, a significant impact has been considered where the above threshold criterion set for urban areas is exceeded. Such impacts are subject to mitigation and consideration of their residual effects.

[3] Controlled or licenced under the terms of the POEO Act.

14.5 Existing Environment

14.5.1 Sensitive Receptors

The nearest sensitive receptors to the project site are the residents located in the village of Kurnell. The nearest receptors to the fixed berths are located along Prince Charles Parade approximately 800-850 m to the south.

There are also a number of public spaces close to the proposed works including Silver Beach and Kamay Botany Bay National Park. These areas are used by the community, and therefore considered to be sensitive receptors. The National Park additionally includes a Ranger's Hut, which is an occupied residence.

14.5.2 Ambient Air Quality

The ambient air quality of Botany Bay is influenced by both local and regional pollutant sources, including road traffic, domestic sources, aircraft, shipping and industrial sources. The two key sub-regional influences relate to the bulk and container ship movements in and out of Port Botany (totalling 1,760 per annum[4]) and the airport's emissions.

With regard to the project site, it remains relatively isolated from the major industry and traffic of the Bay. Local air quality is primary influenced by the emissions generated from the Refinery, which are controlled under the terms and conditions set by the site's Environmental Protection Licence (EPL) Nº 837.

The emissions controlled under the EPL primarily include combustion products and Volatile Organic Compounds (VOCs) arising from both fugitive and combustion processes. The EPL requirements include a need to undertake a number of pollution studies and implement various emissions reduction programs. The EPL includes the need to manage and control odour following a noted incidence in 2010[5].

Beyond the Refinery, other industrial developments that have the potential to impact the local air quality baseline in and around Kurnell include the Cronulla Wastewater Treatment Plant (located on Captain Cook Drive), the Kurnell Desalination Plant and a number of other smaller scale industrial facilities on the Kurnell Peninsula.

14.5.3 Climate and Meteorology

Odour emissions are influenced by climatic and meteorological conditions. Regional wind patterns backed by local sea breezes can direct odour emissions towards, or away from, receptors, whilst factors such as temperature, humidity, rainfall and evaporation can influence the rate at which odours are generated.

The climate in the local area can be described as temperate, and is typified by warm to hot summers and cool to mild winters. The coastal nature of the project site means that it experiences stronger sea breeze effects and smaller seasonal and daily temperature ranges than more inland areas of Sydney.

The annual mean maximum and minimum temperatures are 22.1°C and 13.4°C respectively. January and February are generally the warmest months with temperatures of approximately 22°C at 9 am and 24°C at 3 pm. The mean relative humidity recorded is 69 % at 9 am and 57 % at 3 pm.

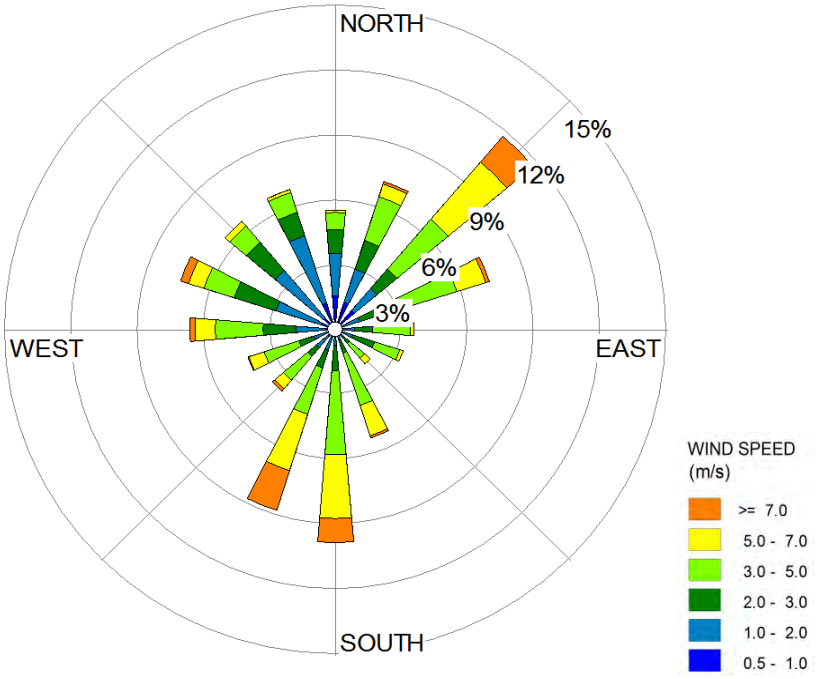
[4] Sydney Ports Corporation Trade Report 2010/11
[5] See Environmental Protection Licence 837.

The area experiences a mild seasonal variation in rainfall, with most of the rain falling in the late summer and autumn months. The average annual rainfall is 1,085 mm, with an average of 129 rain days per year. Highest monthly rainfalls occur in March and June, each recording a mean of 116 mm and 121 mm (per month) respectively. Lowest monthly rainfalls occur in September with a mean of 61 mm. The mean daily evaporation peaks in December at 7.4 mm.

Figure 14-1 shows the wind direction and speed for a typical year. As can be seen, dominant wind directions occur from the north east, south and south west, and remain seasonally and diurnally (daily) variable for the reasons discussed above.

For a mild climate such as this with reasonable rainfall, high humidity, and a wind climate that is both regionally dominant from the north east and locally further influenced by onshore sea breezes, there is a reasonable likelihood for odour to be readily generated and dispersed towards the identified receptors in Kurnell.

Figure 14-1 Wind Rose for Botany Bay



14.6 Impact Assessment

14.6.1 Potential Air Emission Sources

Table 14-3 provides an overview of relevant aspects of the proposed works, their duration and proximity to the sensitive receptors identified in **Section 14.5.1**. The table summarises a high-level qualitative assessment of the potential air quality impacts associated with the proposed works. Information relating to the proposed works is taken from **Chapter 4, Proposed Works Description**. The relevant criteria are described in **Section 14.4.6**.

Table 14-3 Consideration of Key Qualitative Air Quality and Odour Issues

Parameter	Dredging	Infrastructure Upgrade	
		Fixed Berth Upgrade	Sub Berth Upgrade
Proposed Works	Mechanical dredging using backhoe dredger (BHD) and split hopper barges.	Delivery of materials. Diesel generator use. Welding and cutting, including oxy-acetylene cutting. Tugboat and crew boat support vessels.	Delivery of materials. Diesel generator use. Welding and cutting. Tugboat and crew boat support vessels.
Pollutants of Interest	Odorous compounds or Volatile Organic Compounds (VOCs).	Particulate Matter (PM_{10}) and combustion products[6].	PM_{10} and combustion products.
Emissions potential	Moderate	Low	Low
Duration of works	~23 weeks total (~16 weeks for fixed berths).	24 months	4-6 month
Distance from site works to residential receptors.	Approximately 800 – 850 m from fixed berth dredging areas.	Approximately 800 – 850 m from fixed berth area.	Greater than 1 km.
Potential for adverse air quality impacts	Moderate	Low	Negligible

Infrastructure Upgrade

The infrastructure upgrade component of the proposed works would involve small-scale emissions from sources such as diesel generators, welding, and oxy-acetylene cutting rigs. Combustion products and particulate matter would be associated with these sources. However, given the scale of these emissions and the distance that they would be generated from any sensitive receptors (see **Section 14.5.1**), they are likely to have a negligible short-term impact on the local air quality. Subsequently, these sources have not been considered further in this assessment.

Combustion pollutants would be associated with the ships and road transport required to carry out the proposed works. While these would be considered a moderate emissions source compared to those previously mentioned, they should be viewed as negligible within the context of the existing environment. Subsequently, these sources have not been considered further in this assessment.

[6] For example oxides of nitrogen (NOx), oxides of sulphur (SOx), carbon monoxide (CO).

Dredging

The need to assess the air quality impacts resulting from the proposed dredging activities has been based on their potential to:

- release VOCs upon disturbing and lifting sediments;
- the resultant oxidation of iron-rich sediments (ASS) leading to the release of hydrogen sulphide (H_2S); and
- the disturbance of decayed organic matter.

Whilst sediments containing residual contamination such as VOCs have the potential to affect ambient air quality, comprehensive sampling and analysis of the proposed dredged sediments undertaken by Worley Parsons (see **Technical Appendix D1** and **D2**) has confirmed such compounds to be absent, with the exception of tributyltin (TBT). Tributyltin is not considered volatile hence it does not present a risk to local air quality. Recent studies into TBT within harbour sediments suggest this is the case[7]. Subsequently, these sources have not been considered further in this assessment.

The presence of peat within the fixed berths has been confirmed (see **Section 9.5.4**). Field data gathered during the sampling and analysis of these sediments recorded the notable occurrence of odours (in some instances reported as a H_2S odour (akin to a rotten egg smell) generated as a result of lifting and sampling the peat within the fixed berths. In addition, acid sulphate testing has indicated the presence of potential and actual ASS (see **Section 14.6.3**). This confirms the likely potential for some sediment to release odours on disturbance therefore warranting further consideration.

14.6.2 The Potential Generation of Odour Emissions

The proposed dredging works would be undertaken using a mechanical dredging technique. This would involve using a BHD to load the dredged materials onto split hopper barges. Following loading, the materials would be transported to the disposal areas where they would be unloaded from the bottom of the split hopper barge beneath the water.

It is proposed that four hopper barges would be used on a rotational basis. One barge would be loaded at a time, with a second being moored alongside the BHD. The remaining two barges would be either in transit to, or from, the disposal ground.

Odour emissions could be generated as a result of loading the dredged materials on the barges in the fixed berths. The potential for the emissions to be significant would depend on factors such as the load rate, the quantity of loaded organic matter, the level of disturbance during dredging, and the influence of the climatic and meteorological conditions discussed above. This would be a near continuous operation over the 16-week period. A single hopper barge would remain in place for approximately 10-12 hours to be replaced by another empty barge. Post loading, the hopper would be immediately transported out of the fixed berth area away from the sensitive receptors. The other barges would either be in transit or moored alongside the BHD.

[7] Vella *et al*. 2002

Should barges be unable to move away from the dredge area, an accumulation of odour is unlikely as the peak odour periods occur when the barge is initially being loaded, after which the odour level would drop off significantly.

It should be noted that the odour modelling has assumed a full stationary barge (of odorous sediment) at the southern extent of the dredging area, with a constant odour emission rate. This therefore assesses a conservative scenario that would be exceptionally unlikely to occur. Additionally, mitigation measures outlined in **Chapter 9 Spoil and Contamination** would help contain any potential for odorous build up.

14.6.3 Acid Sulphate Soils

Analysis has confirmed potential ASS to be present across the project site; with the confirmed presence of actual ASS in the fixed berths (see **Section 9.5.2** for a discussion on the definition of each). Mitigation has been included (see **Table 9-5**) to ensure no oxidation of these materials would occur whilst they would be loaded and transported for sea disposal.

A study by the Victoria Environment Protection Agency[8] reinforces the low risk of generating odour from ASS through noting that '…*odour from anaerobic sediments containing H_2S from dredging is rarely more than a temporary problem…When first discharged [the sediment] is grey in colour and may smell, but the smell is lost and the colour of the sand changes to yellow within a few days of its exposure to air…*'.

14.6.4 Decayed Organic Matter

The predicted odour impacts have been shown as a contour plot (see **Figure 14-2**). The results have shown that the threshold limit of 2 OU set for urban areas (see **Table 14-2**) is exceeded only up to 300 to 400 m from the modelled source, with the highest concentrations shown to occur during early morning and early evening periods. As such, this exceedance would occur 200 m from the nearest receptors (R4-R6) shown on **Figure 14-2**.

In the absence of NSW criteria, South Australia's Environmental Protection Authority[9] nominates a 300 m separation distance for air emissions associated with dredging activities (accounting for no correction for surface roughness or terrain-weighting factors). Even allowing for this as an additional buffer, it is clear that no impacts would occur to the sensitive receptors identified in this assessment.

It is recognised however that there would be potential for recreational water-based activities to take place immediately outside of the Marine Security (exclusion) Zone that surrounds the project site (see **Section 17.5.2**). Within these locations any users may be exposed to excessive odour emissions.

Under the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, these users are not deemed sensitive receptors that require consideration and mitigation. Such impacts would be short term and temporary.

[8] Victorian EPA(2001) *Recommended Buffer Distances for Industrial Residual Air Emissions*.
[9] Environment Protection Authority, South Australia (2007)

Aerial Imagery Sourced from Google Earth Pro

CALTEX
Caltex Australia

KURNELL PORT AND BERTHING PROJECT

ODOUR CONTOUR PLOTS
(1 HOUR AVERAGING)
(99TH PRECENTILE NOSE RESPONSE TIME)

URS

BOTANY BAY, NSW.

Figure: **14-2**

File No: 43177815.060.mxd Drawn: STB Approved: SM Date: 12/10/2012

Rev. **A** A4

14.6.5 Operation

On the whole it is anticipated that there would be limited operational changes to the Kurnell port and berthing facility as a result of the proposed works. The only notable change would be the reconfiguration of the berthing arrangement (see **Section 4.10**), which would result in fewer ships berthing at the facility in to the future.

14.7 Best Practice Management

The modelling has confirmed that there would be no impact to the identified sensitive receptors considered in this assessment.

Whilst no specific mitigation would be required, a number of measures would be adopted by Caltex to limit odour emissions, particularly if there were any delays to removing the dredged sediments offshore.

- Caltex has volunteered to limit the use of overflow dredging within the fixed berths. This control measure would reduce the amount of disturbance to these sediments at the surface and therefore prevent their breakdown and the associated potential release of odour emissions.
- The BHD would make use of a closed bucket therefore limiting the agitation and disturbance of sediments to minimise odours.
- The dredging program would be based on rotational working therefore preventing dredged sediments remaining within the project site for a long duration prior to their transport offshore to the disposal ground.
- The works' contractor would implement a process of odour screening to identify anomalous odours. When any adverse odour was recorded the works' contractor would notify Caltex and appropriate management would be implemented. Management would involve further investigation of the odour and its potential impact on receptors mindful of the prevailing wind direction and strength at the time. It may require more formal odour monitoring and in exceptional circumstances may require limits on the rate of dredging to reduce the odour emissions, with consideration being given to the prevailing wind conditions at the time.
- There would be continual observations for unanticipated odours occurring during proposed dredging works. Log books would be kept to record instances when odours were apparent, and what corrective action was taken.
- The proposed works would be incorporated into Caltex's current procedures for handling and managing complaints (see **Section 6.8**). This would involve handling complaints through an advertised 24-hour hotline, keeping a complaint's register, and making a response within 48-hours.

15 Hazards and Risk Assessment

15.1 Introduction

The following chapter sets out the assessment of hazards and their risk of occurrence associated with the proposed works and the continued operation of the Kurnell port and berthing facility following its upgrade.

This chapter is a summary of a preliminary hazards analysis (PHA) (see **Technical Appendix I**), which has been prepared to support this EIS.

15.2 Scope of the Assessment

The Director General's Requirements (DGRs) (see **Technical Appendix A**) requested that consideration be given to "*the hazards and risks associated with the upgrade of a major hazardous facility, including potential impacts on the fuel supply pipelines, and on the operations at Berth No. 2…"* taking into account the "*Hazardous Industry Planning Advisory Paper (HIPAP) 4 – Risk Criteria for Land Use Planning and HIPAP 6 - Guidelines for Hazard Analysis (DoP, 2011).*" The DGRs also requested that consideration be given to "*changes to operational impacts including hazards and risks…*'.

The other main issue raised by a statutory agency relevant to this chapter, along with **Chapter 9, Spoil and Contamination**, is the need to "*implement appropriate risk management measures to prevent [the] spillage of pollutants, including environmental management systems to prevent potential marine oil spills"*.

15.3 Legislation and Planning Policy

15.3.1 State Environmental Planning Policy No. 33 (Hazardous and Offensive Development) 1992

This State Environmental Planning Policy (SEPP) defines the approach used in NSW for planning and assessing industrial development proposals that include hazards or offensive components. Through this policy, the permissibility of an industrial proposal is linked to its safety and pollution control performance.

This SEPP applies to any proposals that fall under the policy's definition for potentially hazardous or offensive industry. As the proposed works relate to the upgrade of refinery infrastructure they qualify under the SEPP as a potentially hazardous industry.

For such proposals, this SEPP establishes a comprehensive test by way of a PHA to determine the risk to people, property and the environment at the proposed location and in the presence of controls (mitigation).

15.3.2 Hazardous Industry Planning Advisory Papers

Under the above SEPP a number of HIPAPs have been issued by the NSW Department of Planning and Infrastructure (DP&I). These advisory papers set out an integrated assessment process for the assurance of safety within development proposals that are potentially hazardous. Two HIPAPs are relevant to the proposed works. They are discussed below.

HIPAP Nº.4: Risk Criteria for Land Use Planning 2008

This HIPAP includes suggested risk assessment criteria that are to be considered when assessing the land use safety implications of potentially hazardous industrial development. The suggested criteria are equally relevant and applicable to the consideration of land use planning and development in the vicinity of potentially hazardous facilities. These criteria have formed the basis of assessment for this chapter.

HIPAP Nº.6: Guidelines for Hazard Analysis 2011

This HIPAP provides advice on the general approach recommended for hazard analysis, which has been adopted in this EIS. This analysis can be applied to proposed or existing development.

15.3.3 Work Health and Safety Act 2011

This Act and its supporting Regulation amongst other things identifies measures to prevent accidents occurring within, or associated with, major hazard facilities (MHF).

The Kurnell Refinery, including its port and berthing facility, is classified as a MHF. Any works to, or modifications of, a MHF requires the consent and approval of WorkCover NSW as the administrators of this Act. WorkCover NSW has been informed of the proposed upgrade of the Kurnell port and berthing facility.

The notification process behind obtaining the consent and approval of WorkCover NSW has required that Caltex demonstrates that suitable controls would be implemented to prevent the occurrence of a major accident. To do this Caltex has prepared a risk assessment for the proposed works identifying associated potential hazards. A *Safety Case* has also been provided to WorkCover NSW. This contains commitments that appropriate safety management systems and emergency and security plans would be put in place for the proposed works.

15.4 Method of Assessment

15.4.1 Overview

The PHA has been undertaken in accordance with the policy guidance set out in the above Acts, Policy and HIPAPs. The aims of the PHA are to:

- provide an assessment of the hazards and risks associated with the proposed works;
- determine the incremental change (increase or decrease) in the risk-levels associated with the proposed port and berthing upgrade; and
- evaluate the resulting risk levels against *As Low As Reasonably Practicable* (ALARP)[1] criteria.

These aims align with the requirements within the DGRs and the management of hazards presented in the Safety Case made to WorkCover NSW.

[1] As defined in HIPAP 4 (2008)

The risks associated with the proposed works have been assessed qualitatively using the *Chevron* (*Caltex) Integrated Risk Prioritisation Matrix* (see **Table 15-1**). This has involved seven detailed hazard and risk assessment reviews covering all aspects of the proposed works. These have been conducted by multidisciplinary teams with representatives from Caltex, the process design team, barge operations team, Sydney Ports Corporation (SPC) and others (see **Technical Appendix I**). The teams have reviewed each component of the proposed works and identified the potential hazards and risk management strategies as well as the developed risk profile for the proposed works. Each identified potential risk has been taken forward and summarised into the PHA.

The PHA has involved four stages:

- identification and review of all potential hazards associated with the proposed works;
- estimation of the consequences and likelihood of significant incidents;
- identification of mitigation and management measures through a process of risk reduction and tolerability; and
- assessment of the residual hazards with the mitigation and management measures in place.

15.4.2 Hazard Identification

The hazard identification process has included a critical examination of the potential '*Incident Scenarios*' that could occur as a result of the proposed works. This has involved the identification of possible causes for potential incidents and the subsequent consequences to public safety (in terms of injury or fatality), damage to property and/or harm or impact to the biophysical environment. The hazard identification process has also outlined proposed operational and organisational safety controls that would be required to mitigate the likelihood of hazardous events occurring.

15.4.3 Consequence, Likelihood and Risk Analysis

Any identified incident scenario has been subject to a process of risk analysis. This process has involved use of the *Chevron* (*Caltex) Integrated Risk Prioritisation Matrix*. The *Prioritisation Matrix* has been used to quantify risk priority rankings from 1 to 10 (See **Figure 15-1**). These rankings have defined risk as a product of the severity of the consequence of the hazard should it occur, and the probability that such a consequence would occur (likelihood). The assessment has also considered any residual risk on assuming the various mitigation controls to be in place and effective.

15.4.4 Risk Reduction and Tolerability

Where the risk ranking requires either a short or long-term risk reduction strategy, or has a low likelihood yet high consequence, risk reduction recommendations have been provided. Further recommendations have also been provided for risks where they would eliminate or mitigate the potential cause and/or consequence predicted for the identified hazard. These support current operational safeguards at the port and berthing facility to manage hazard and risk. Each resulting risk level is compared against Kurnell Refinery established MHF criteria to ensure that the resulting risk profile for the project is ALARP.

15.4.5 Evaluation of Magnitude of Impact

The evaluation and magnitude of risk has been based the ratings shown in **Table 15-1**.

Table 15-1

Chevron Integrated Risk Prioritization Matrix

For the Assessment of HES & Asset Risks from Event or Activity

Likelihood Descriptions & Index
(with confirmed safeguards)

Legend

Legend applies to identified HES risks
(see guidance documents for additional explanations)

1, 2 , 3, 4 - Short-term, interim risk reduction required. Long term risk reduction plan must be developed and implemented.

5 - Additional long term risk reduction required. If no further action can be reasonably taken, SBU management approval must be sought to continue the activity.

6 - Risk is tolerable if reasonable safeguards / management systems are confirmed to be in place and consistent with relevant requirements of the Risk Mitigation Closure Guidelines.

7, 8, 9, 10 - Manage risk. No further risk reduction required. Risk reduction at management / team discretion.

Likelihood Descriptions	Likelihood Indices		Decreasing Likelihood						
Event can reasonably be expected to occur in life of facility	1	Likely		6	5	4	3	2	1
Conditions may allow the event to occur at the facility during its lifetime, or the event has occurred within the Business Unit	2	Occasional		7	6	5	4	3	2
Exceptional conditions may allow consequences to occur within the facility lifetime, or has occurred within the OPCO	3	Seldom		8	7	6	5	4	3
Reasonable to expect that the event will not occur at this facility. Has occurred several times in the industry, but not in the OPCO	4	Unlikely		9	8	7	6	5	4
Has occurred once or twice within industry	5	Remote		10	9	8	7	6	5
Rare or unheard of	6	Rare		10	10	9	8	7	6

Consequence Descriptions & Index
(without safeguards)

Consequence Indices

Decreasing Consequence/Impact

Consequence Descriptions		6	5	4	3	2	1
		Incidental	**Minor**	**Moderate**	**Major**	**Severe**	**Catastrophic**
Safety		**Workforce:** Minor injury such as a first-aid. *AND* **Public**: No impact	**Workforce:** One or more injuries, not severe. *OR* **Public**: One or more minor injuries such as a first-aid.	**Workforce**: One or more severe injuries including permanently disabling injuries. *OR* **Public**: One or more injuries, not severe.	**Workforce:** (1-4) Fatalities *OR* **Public**: One or more severe injuries including permanently disabling injuries.	**Workforce**: Multiple fatalities (5-50) *OR* **Public**: multiple fatalities (1-10)	**Workforce**: Multiple fatalities (>50) *OR* **Public**: multiple fatalities (>10)
Health (Adverse effects resulting from chronic chemical or physical exposures or exposure to biological agents)		**Workforce:** Minor illness or effect with limited or no impacts on ability to function and treatment is very limited or not necessary *AND* **Public:** No impact	**Workforce**: Mild to moderate illness or effect with some treatment and/or functional impairment but is medically managable *OR* **Public**: Illness or adverse effect with limited or no impacts on ability to function and medical treatment is limited or not necessary.	**Workforce**: Serious illness or severe adverse health effect requiring a high level of medical treatment or management *OR* **Public**: Illness or adverse effects with mild to moderate functional impairment requring medical treatment.	**Workforce** (1-4): Serious illness or chronic exposure resulting in fatality or significant life shortening effects OR **Public**: Serious illness or severe adverse health effect requiring a high level of medical treatment or management.	**Workforce** (5-50): Serious illness or chronic exposure resulting in fatality or significant life shortening effects *OR* **Public** (1-10): Serious illness or chronic exposure resulting in fatality or significant life shortening effects.	**Workforce** (>50): Serious illness or chronic exposure resulting in fatality or significant life shortening effects *OR* **Public** *(>10)*: Serious illness or chronic exposure resulting in fatality or significant life shortening effects.
Environment		Impacts such as localized or short term effects on habitat, species or environmental media.	Impacts such as localized, long term degradation of sensitive habitat or widespread, short-term impacts to habitat, species or environmental media	Impacts such as localized but irreversible habitat loss or widespread, long-term effects on habitat, species or environmental media	Impacts such as significant, widespread and persistant changes in habitat, species or environmental media (e.g. widespread habitat degradation) .	Impacts such as persistent reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.	Loss of a significant portion of a valued species or loss of effective ecosystem function on a landscape scale.

The above legend applies only to HES risks, where risk levels 1-6 are actionable and mandatory.
For risks that may result in facility damage, business interruption, loss of product, the "Assets" category below should be used.
Asset risk reduction is at the discretion of management. Under no circumstances may a direct or indirect translation of Asset loss to HES consequences, or between any discrete categories of HES consequences be inferred.

Consequence Descriptions & Index
(without safeguards)

Consequence Indices

Consequence Descriptions		6	5	4	3	2	1
		Incidental	**Minor**	**Moderate**	**Major**	**Severe**	**Catastrophic**
Assets (Facility Damage, Business Interruption, Loss of Product)		Minimal damage. Negligible down time or asset loss. Costs < $100,000.	Some asset loss, damage and/or downtime. Costs $100,000 to $1 Million.	Serious asset loss, damage to facility and/or downtime. Costs of $1-10Million.	Major asset loss, damage to facility and/or downtime. Cost >$10 Million but <$100 Million.	Severe asset loss or damage to facility. Significant downtime, with appreciable economic impact. Cost >$100MM but <$1billion.	Total destruction or damage. Potential for permanent loss of production. Costs >$1billion

This matrix is endorsed for use across the Company.
It is not a substitute for, and does not override any relevant legal obligations.
Under no circumstances should any part of this matrix be changed or modified, adapted or customized.
This matrix identifies health, safety, environmental and asset risks and is to be used only by qualified and competent personnel.
Where applicable it is to be used within the Riskman2 structure and governance of an OE Risk Management Process. If applied outside of these Processes, it is also mandatory to manage identified intolerable risks and comply with the Risk Mitigation Closure Guidelines.

15.4.6 Assessment of Significance

A hazard has been assessed as significant where its risk is ranked 6 or below (1 being the most significant ranking). Such risks are subject to controls and consideration of their residual effects. Risks ranked above 7 (indicating a low risk) may include volunteered commitments; however no further risk reduction is required.

15.5 Existing Environment

15.5.1 Introduction

The proposed works would include interfacing with elements of an existing facility that has a number of intrinsic hazards as a result of current operations. In order to manage these, Caltex has implemented a Safety Management System as discussed below. This system would be applied and updated to accommodate the proposed works both during their construction and operation.

15.5.2 Existing and Proposed Safety Management Systems

Caltex has a commitment to comply with its work, health and safety obligations as stipulated by the Work Health and Safety Act 2011. Caltex has numerous policies and procedures to create a safe workplace.

The proposed works would comply with current and relevant safety codes and statutory requirements with respect to safe working conditions. There would be no changes to the existing precautions observed at the project site. In particular, this would include standards and requirements relating to the handling and management of flammable liquids. All personnel required to work with these substances would be trained in their safe use and handling and are provided with all the relevant safety equipment.

Emergency procedures have been developed and would be reviewed in the light of the proposed works. The emergency procedures include responses to emergency evacuation, injury, major asset damage or failure, critical failures, spillages, major fire, and threats.

The Refinery has a manager with overall responsibility for safety, who is supported by experienced personnel trained in the operation and support of the plant and associated facilities. This approach to safety management extends to the port and berthing facility and therefore would include the proposed works.

A Permit to Work (PTW) system, including Hot Work Permit and a Management of Change system, are currently in use and would be extended to include the proposed works.

Procedures are currently in place to manage incidents and injuries. This includes an established incident reporting and response process. This process, along with its adoption for use for the proposed works, is discussed further in **Section 6.8**.

The current Kurnell port and berthing facility includes a range of safety equipment (alarms, detectors, relief devices etc.) along with other protection systems that are routinely tested. This equipment would be used during the construction and operation of the proposed works.

All persons involved in current operations would be provided with appropriate personal protective equipment (PPE) suitable for use with the specific hazardous substances.

Personnel who are first-aid trained are advertised on company noticeboards across the Refinery site and port and berthing facility.

15.6 Impact Assessment

15.6.1 Hazard Identification

In total 17 hazards have been identified that could arise as a result of the proposed works.

- Fourteen of these would be associated with the proposed dredging and facility upgrade.
- Three would be associated with the operational function of the upgraded sub berth and the fixed berths.

Those hazards that would be associated with the proposed dredging and facility upgrade would have a limited life and would span the two-year construction phase of the proposed works (see **Table 4-5**).

Those hazards that would be associated with operational activities would remain in place for the operational life of the facility. **Table 15-2** provides a summary of the identified hazards.

Table 15-2 Summary List of Identified Hazards

No.	Hazard
Dredging and Facility Upgrade	
1	Spreading of noxious weeds in Botany Bay
2	Hazardous interaction between marine ships and commercial/recreational ships
3	Extreme weather
4	Disturbing sediments containing tributyltin (TBT)
5	Loss of containment of environmental polluting material (diesel, oil etc.)
6	Injury during facility upgrade activities
7	Electrical hazards
8	Generation of sediment plumes
9	Hazardous interaction with ongoing operations at the Kurnell Wharf
10	Generation of acid sulfate soils (ASS)
11	Failure to remove flammable gas and liquid at fuel lines at fixed berth #1 prior to the proposed facility upgrade
12	Failure to isolate flammable material from existing operational supply lines
13	Loss of containment of displaced water flushed through the fuel lines at fixed berth #1
14	Generation of excessive noise levels
Continuing Operation of the Port and Berthing Facility	
15	Hazardous interaction between the marine ship and operations at the wharf
16	Extreme weather
17	Hazardous interaction between moored ships/ships transferring through Botany Bay and commercial/recreational ships in the area

A *Hazard Identification Word Diagram* has been prepared to support the PHA (see table 3, **Technical Appendix I**).

This *Word Diagram* has examined the hazards listed in **Table 15-2** and has described the instances under which these hazards may occur. These are referred to as 'incident scenarios'. The expected risks associated with each incident scenario have been evaluated for the 'before the proposed works' and 'after the proposed works'. The *Prioritisation Matrix* (see **Table 15-1**) has been used to identify and rank the hazards to allow preparation of the *Word Diagram*.

15.6.2 Incident Scenarios and Risk Analysis

Risk Assessment

The corresponding incident scenarios are set out in **Table 15-3** along with each scenario's risk prior to the upgrade and the risk post upgrade as taken from the *Word Diagram* (see table 3, **Technical Appendix I**).

Table 15-3 Summary List of Incident Scenarios

Dredging and Facility Upgrade		Risk Prior to Upgrade	Risk Ranking After Upgrade
Scenario 1	The spread of noxious weeds within the marine environment during dredging and as a result of the reuse of sediments within the Bay, with potential for long-term or persistent environmental harm.	Introduced by project	5
Scenario 2	Hazardous interactions between ships involved in the proposed dredging and upgrade works and the current commercial and recreational ships that use the area, with the potential for personnel injury or the loss of personnel overboard.		6
Scenario 3	Extreme weather resulting in damage to ships involved in the proposed dredging and upgrade works, with the potential for personnel injury or the loss of personnel overboard.		6
Scenario 4	Disturbing sediments containing TBT, and loading and reuse of these sediments within Botany Bay, potentially leading to contamination and long-term environmental harm.		6
Scenario 5	Loss of containment event (diesels, oils, lubricants and hydraulic fluids) from ships as a result of the proposed works.		6
Scenario 6	Workplace injuries.		6
Scenario 7	Electrical hazards during the proposed upgrade of the electrical system, leading to injury and/or fire.		6
Scenario 8	Generation of sediment plumes leading to contamination, coating with sediment, degradation of seagrass habitat and impacts on other sensitive marine species and receptors.		7
Scenario 9	Hazardous interaction between ongoing port and berthing activities leading to impacts on submerged submarine fuel pipelines, hoses, risers etc., resulting in the loss of containment of crude oil and petroleum products.		7
Scenario 10	Removal of ASS leading to short-term localised environmental harm and impacts on the marine environment.		7
Scenario 11	Failure to remove flammable liquid at fixed berth # 1 during the facility upgrade leading to a loss with the potential to pollute the marine environment and/or cause personnel injury.		7

Dredging and Facility Upgrade		Risk Prior to Upgrade	Risk Ranking After Upgrade
Scenario 12	Failure to isolate the operational supply lines when connecting to the proposed upgraded manifold on the Kurnell Wharf leading to a loss a flammables.		7
Scenario 13	Loss of displaced water flushed through the existing fuel lines and pipework that would be removed through the proposed upgrade of fixed berth #1, resulting in the pollution of the marine environment.		7
Scenario 14	Excessive noise, impacting sensitive receptors in Kurnell or underwater marine fauna.		8
Continuing Operation of the Port and Berthing Facility			
Scenario 15	Hazardous interaction between moored ships and the sub berth equipment (including manifolds), wharf equipment (including risers) and the hydraulic loading arm, leading to an oil spill with consequential marine pollution and/or personnel injury.	5	5
Scenario 16	Extreme weather resulting in damage to ships, with the potential for personnel injury or the loss of personnel overboard.	6	6
Scenario 17	Hazardous interaction between commercial and recreational ships and either moored ships or ships that are in transit to and from the port and berthing facility, with the potential for personnel injury or the loss of personnel overboard.	7	7

The above demonstrates that for scenarios 1-7, 15 and 16 the risks are significant. requiring the development of mitigation measures, risk reduction plans and/or the introduction of a management system.

Proposed Works

The majority of the incident scenarios have the potential to cause environmental harm, with others relating to safety concerns involving staff and ships' crew as well as pleasure crafts and commercial ships in the vicinity of the proposed works.

The range of identified hazards are all well-known and understood by the staff and works' contractors that would be involved with the proposed works, with a number of established safeguards already in place to manage current operations, which would be modified to incorporate the proposed works.

A number of technical assessments, undertaken as part of this EIS, have also considered and mitigated the above incident scenarios 'likely impacts'. These include:

- the spreading of noxious weeds (see **Chapter 11, Ecology**);
- hazardous interactions between ships (see **Chapter 17, Amenity, Land Use, Recreation and Navigation**);
- disturbing sediments containing TBT (see **Chapters 9, Spoil and Contamination** and **10, Water and Sediment Quality**);
- generation of sediment plumes (see **Chapter 10, Water and Sediment Quality**);

- generation of ASS (see **Chapter 9, Spoil and Contamination**); and
- generation of excessive noise (see **Chapter 13, Noise**).

Continued Operations

Scenarios 15 and 16 have the potential to generate environmental harm, with Scenario 17 relating to safety concerns involving staff and ships' crew as well as people operating pleasure crafts and commercial ships in the vicinity of the Kurnell port and berthing facility (outside of the Marine Security Zone (see **Chapter 17, Amenity, Land Use, Recreation and Navigation**)).

These hazards are not new and are applicable to the existing port and berthing facility. There is a small decrease in risk levels associated with the operational phase of the proposed works due to the reduced number of ships required to continue operations. As with the identified construction hazards, all are well known and understood by Caltex, SPC and the ships' operators; with appropriate safeguards being largely established to control these hazards.

15.7 Mitigation

15.7.1 Risk Reduction Recommendations

The following risk reduction commitments are proposed. Proposed mitigation is provided for incident scenarios ranked 6 or lower, as set out in their MHF Safety Case report. Additional recommendations are provided for incident scenarios ranked 7 or higher. Current safeguards that form part of Caltex's operational procedures are shown in bullets. Only incident scenarios a where mitigation measure or recommendation has been provided are included in **Table 15-4**. Therefore incident scenarios 7, 11, 12, 13 and 14 have been excluded. The *Hazard Identification Word Diagram* (table 3, **Technical Appendix I**) provides the full detail.

Table 15-4 Risk Reduction Recommendations

No.	Hazard	Safeguards/Recommendation
Dredging and Facility Upgrade		
1	Spread of Noxious Weeds	• Ballast water discharge is not controlled in accordance with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (of which Australia is a signatory). **Mitigation:** Measures would be put in place to control the presence and or spread of *Caulerpa taxifolia* as per the mitigation and monitoring measures included in **Chapter 11, Ecology**.
2	Hazardous interaction between marine ship and commercial/ recreational ships	• The Sydney Ports Corporation Control Tower issues warnings for maritime activities. • A speed limit of < 4 knots is set in place when within 200 m of maritime activities at the port and berthing facility. • Ships are lit at night. **Mitigation:** A review of working procedures would be developed by the works' contractor for the berths. This would be undertaken ahead of the proposed dredging works. The recommendations coming out of the review would be agreed with Caltex and relevant stakeholders. The results of this may involve installing additional hardware (such as protective buoys) as well as the introduction of procedural safeguards.

No.	Hazard	Safeguards/Recommendation
3	Extreme weather conditions	• The weather forecast communicated to all ships. • There is the ability to relocate and moor safely in extreme weather conditions and at short notice. • The dredger, split hopper barges and all other ships would be fully manned. • A working procedure would be prepared for the operation of the barges and dredger in consultation with SPC. • Personal flotation devices are a requirement for all staff on ships mooring at the port and berthing facility. **Mitigation**: A procedure would be developed for the safe operation of the dredger and hopper barges. This procedure would be undertaken to determine the need to develop a works-specific operation safety plan for extreme weather conditions. It would be undertaken in conjunction with all stakeholders (including SPC). This procedure would form part of the *Port Operating Procedure* (POP) discussed in **Chapter 17, Amenity, Land Use, Recreation and Navigation**.
4	Sediment Disturbance	• Dredging activities are managed through a process of development application approval baked by the preparation of this EIS, which contains corresponding mitigation and management measures to prevent the occurrence of a significant impact. The loading, transport and dumping is permitted under the *Commonwealth Environment Protection (Sea Dumping) Act 1981* as supported by the *National Assessment Guidelines for Dredging 2009* **Mitigation:** A *Dredge and Spoil Management Plan* (DSMDP) would be prepared (see **Chapter 10, Water and Sediment Quality**). It would contain controls and measures to ensure no overflow dredging operations within parts of the turning circle and approaches along with the whole of the fixed berths. It would also include measures to ensure the sediments would be lifted and loaded so as to prevent any excessive disturbance and agitation, whilst preventing excessive spillage.
5	Loss of Containment	**Mitigation:** Biodegradable oil would be used within the pile rig. Prestart checks would be undertaken prior to commencing piling. Regular servicing and maintenance would be scheduled as part of the works. **Mitigation:** Materials would be available to provide spill containment if required. This would be in accordance with Caltex's Emergency Response Plan (STD 4.02.01.01) and Oil-Spill Callout and Response Work Procedure (PROC 120.05.001). **Mitigation:** Any off ship incidents would be managed as per current established operating procedures in place for the existing port and berthing facility.

No.	Hazard	Safeguards/Recommendation
6	Workplace Injuries	• A Work Method Statement (WMS) would be prepared. This would include Job Safety Analysis (JSA), which would be undertaken consistent with current working practices. The WMS would also include that safe working loads are established, that adequate support is provided for cranes and that an assessment of the capacity and performance of marine equipment is undertaken to account for working conditions (currents, movements over water, working on water). • A naval architect would be used to assess the lifting and performance of the equipment (cranes, hooks etc.). • There would be a requirement to check the safety performance of the past performance of the works' contractor(s). • For all works, a pre-start meeting would be held to forewarn of any hazards and provide guidance and advice on safe working methods (i.e. tool-box talks). • Restricted areas would be established and set out. These would be highlighted during the pre-start (tool-box) talks. • The weather would be regularly monitored and no works would proceed during adverse and unsafe weather conditions. • Appropriate PPE would be provided to all personnel. This would include ensuring all works' contractors provide a personal floatation device to staff. **Mitigation**: No additional measures are proposed.
8	Generated Sediment Plumes	• A dredging method has been adopted that minimises sediment dispersion of possible alternatives (see **Chapter 2, Project Need and Alternatives**). • Global Positioning Systems (GPS) would be used to ensure accurate dredging and placement of the proposed reuse and dumping locations. • Barge unloading activities would be closely monitored. • Turbidity monitoring would be carried out during dredging operation in accordance with the mitigation and management measures included in **Chapter 10, Water and Sediment Quality.** **Recommendation:** A *Port Operation Procedure* (POP) would be developed (see **Chapter 17, Amenity, Land Use, Recreation and Navigation**). Part of this would include information on the prevailing weather conditions and when works are not permitted to take place within Botany Bay. **Recommendation:** The dredging program would be audited to ensure the works' contractors are responding to incidences of high turbidity to ensure the effective prevention of sediment plumes being generated. Further controls would be included by way of the DSDMP (see **Chapter 10, Water and Sediment Quality**).
9	Hazard Interaction	• Type and design of the proposed dredger reduces the risk of inaccurate dredging during heavy seas. • There is the ability to isolate the underwater equipment from the wharf breasting island. • A working procedure would be prepared for the operation of the barges and dredger in consultation with SPC. • The existing hose locations in the sub berth would be identified. **Recommendation**: A review of safeguards would be undertaken relating to the submerged equipment during detailed project development. This would likely involve considering the further isolation of submerged equipment and pipelines and removal of pollutant material contained in the equipment (e.g. through water flushing) prior to dredging and/or positively removing submerged equipment from the area during the works.

No.	Hazard	Safeguards/Recommendation
10	Acid Sulfate Conditions	• Short residence time is unlikely to cause sulphides contained in the sediments to oxidise. • Sediments covered by a layer of water. **Recommendation:** Measures to ensure the dredged sediments would be monitored during transit would be put in place to ensure they would not dry out (see **Chapter 9, Spoil and Contamination**).
Continuing Operation of the Port and Berthing Facility		
15	Hazardous interaction between marine ship and commercial/ recreational ships	• Marine ships are secured at the fixed berths through the use of port anchor, tug and mooring lines. • Ships are only berthed during the run-in tide requiring a clearance of about 1 m (from the bottom of the ship to seabed) in any berth. • The provision of a sub berth warning system provides safe berthing for the ship. • Pilots provide assessment of the berth safety. • Buoys are provided as a navigation aid to ships to avoid the riser (upwards pipeline) located on the seabed of the sub berth. • There is the presence of an existing wharf emergency shutdown system. This includes provisions for the isolation of underwater equipment from a safe location at wharf breasting island. • The wharf and ship both include fire-fighting system. • A port and berthing facility oil spill emergency response plan is in place to manage current operations. • An emergency plan relating to the berthing operations is managed by the ship masters. **Mitigation**: No additional measures are proposed.
16	Extreme Weather	• Only double-hulled ships (i.e. a ship with a double layer) are allowed at the Kurnell port and berthing facility. Caltex approval is required for ships to be allowed to moor at the sub berth. • The warning system on the sub berth is used warn ships. • Pilots are provided with an independent assessment of the berth safety prior to mooring. • Ships are prevented from mooring and casting off during poor weather (high wind/low visibility). The loading and ship masters would determine accessibly during these conditions on a case-by-case basis. • Ships are escorted by tugs during their approach to berths. There is the ability to place tugs on standby during extreme weather conditions. **Mitigation**: No additional measures are proposed.
17	Hazardous interaction between marine ship and commercial/ recreational ships	• All buoys remain visible during the day time. • A speed limit of < 4 knots is set in place when within 200 m of maritime activities at the port and berthing facility. • Ships are lit at night in accordance with safety navigation requirements. **Recommendation:** A review of operational requirements for the berths would be undertaken during mooring activities. This would involve the visibility of pimple buoys at night.

Provided the mitigation listed in **Table 15-4** is implemented, the hazards associated with the proposed works are considered to be ALARP (i.e. there would be no significant residual effects). This is in accordance with the definitions in the Caltex Refinery Safety Case.

15.7.2 Summary

Table 15-5 outlines the mitigation and management that would be put in place to control the identified hazards associated with the proposed works.

Table 15-5 Hazard Mitigation and Management Measures

Mitigation and Management Measures	Implementation		
	Design	Implementation	Operation
A review of working procedures developed by the works' contractor for the berths would be undertaken ahead of the proposed dredging. These procedures would be agreed with Sydney Ports Corporation. The results of this may involve installing additional hardware (such as protective buoys) as well as the introduction of procedural safeguards.		✓	
A procedure would be developed for the safe operations of the dredger and hopper barges. This work would be undertaken to determine the need to develop a works-specific operation safety plan for extreme weather conditions. This would be undertaken in conjunction with the above stakeholders and form part of the *Port Operating Procedure* (POP).		✓	
The DSDMP would contain controls and measures to ensure no overflow dredging would occur within parts of the turning circle and the whole of the fixed berths. It would also include measures to ensure the sediments would be lifted and loaded so as to prevent any excessive disturbance and agitation, whilst preventing excessive spillage.		✓	
Biodegradable oil would be used within the pile rig. Pre start checks would be undertaken prior to commencing piling. Regular servicing and maintenance would be scheduled as part of the works.		✓	
Materials would be available to provide spill containment if required. This would be in accordance with Caltex's *Emergency Response Plan* (STD 4.02.01.01) and *Oil-spill Callout and Response Work Procedure* (PROC 120.05.001).		✓	
Any off ship incidents would be managed as per current established operating procedures in place for the existing port and berthing facility.		✓	

16 Waste and Resource Management

16.1 Introduction

The following chapter assesses waste and resource management issues relating to the proposed works.

16.2 Scope of the Assessment

This chapter has been prepared to respond to a number of issues raised by statutory agencies. They include:

- the requirement for the proposed works to include a detailed waste management plan, including any reuse options, waste classification in accordance with appropriate guidelines, and details surrounding waste disposal;
- consideration of the waste management measures (relating to the proposed works) in accordance with appropriate principles, and to ensure waste management does not produce negative impacts to the amenity or environment; and
- the provision of adequate detail regarding water use and management measures to be implemented.

In response, this chapter has considered:

- waste management in accordance with the principles of the waste hierarchy and cleaner production;
- the handling, processing and storage of materials;
- options for beneficial reuse;
- waste identification, classification and characterisation; and
- a waste management plan as a provision required to support the proposed works.

The dredged sediment has been excluded from consideration in this chapter as a permit is being sought from the Commonwealth, under the *Environment Protection (Sea Dumping) Act* 1981, to dispose of it at sea (as a waste) and reuse a portion of it in Botany Bay (see **Chapter 9, Spoil and Contamination**). Part of that application requires an assessment of the likely environmental impacts resulting from its loading, transport and disposal. It also requires the preparation of a remediation action plan (RAP) under SEPP Nº. 55: Remediation of Land 1998 (see **Section 9.3**).

It is anticipated that the proposed upgraded port and berthing facility would neither generate significant additional waste (streams or volumes) nor require any significant additional resource to maintain ongoing operations. As such, the operational phase of the proposed works has not been assessed as part of this EIS.

It is anticipated that Caltex would continue to operate under the terms of its current environmental protection licence (EPL) with regard to waste management.

16.3 Legislation and Planning Policy

16.3.1 Introduction

Reference has been made to the following Acts, Regulation and Strategy, which largely focus on initiatives and measures to control and manage waste and resource. These initiatives have been adopted in the mitigation and management measures for the proposed works.

16.3.2 Commonwealth Requirements

National Environment Protection Measures (Implementation) Act 1998

Under the *National Environment Protection Measures (Implementation) Act 1998*, the National Environmental Protection Council (NEPC) was established to set national environmental goals and standards for Australia through the development of National Environment Protection Measures (NEPMs). The NEPMs outline a set of national objectives for protecting or managing particular aspects of the environment, through a combination of goals, guidelines, standards, and protocols.

The NEPM also provides a framework for the assessment and management of site contamination. Under this framework a number of land use categories have been developed for which screening limits are set for the detection of contamination. **Chapter 9, Spoil and Contamination**, has made use of these categories in its assessment of the suitability to reuse the dredged sediments on land.

The National Environment Protection (National Pollutant Inventory) (NPI) Measure (also form part of the NEPM) also remains relevant to the proposed works It establishes goals to assist in reducing existing and potential impacts of certain substances being emitted to air, land and water. Where the use of an NPI substance triggers the established threshold for that substance, emissions of that substance must be reported to the NPI. An internet database provides publicly available information on the types and amounts of certain substances being emitted. In 2008, the NPI NEPM was varied to require mandatory reporting of NPI substances in waste transferred to a destination for containment or final disposal. Emissions to land, air and water from the Project will be reported annually in accordance with the NPI Guide (SEWPAC, 2011).

National Waste Policy: Less Waste, More Resources (EPHC, 2009)

The *National Waste Policy: Less Waste, More Resources* (EPHC, 2009) builds on the 1992 *National Strategy for Ecologically Sustainable Development* (ESD) (COAG, 1992). It includes commitments to improve the range, variety and quality of environmental resources and reduce the environmental impacts of waste disposal.

The aims of the National Waste Policy are to:

- avoid the generation of waste and reduce the amount of waste (including hazardous waste) for disposal;
- manage waste as a resource;
- ensure that waste treatment, disposal, recovery and re-use is undertaken in a safe, scientific and environmentally sound manner; and
- contribute to the reduction in greenhouse gas emissions, energy conservation and production, water efficiency and the productivity of the land.

This policy drives accurate business reporting to the NPI.

16.3.3 NSW Requirements

NSW Protection of Environment Operations Act 1997

The 'POEO' Act defines waste for regulatory purposes and establishes associated management and licensing requirements.

Waste management requirements are further regulated via the *Protection of the Environment Operations (Waste) Regulation* 2005 and the *Protection of the Environment (General) Regulation 2009*.

This Act and its Regulations require that this EIS considers:

- the protection of the environment policies;
- pollution caused, or likely to be caused, by the proposed works and the likely impact of that pollution on the environment;
- practical measures that could be taken to prevent pollution and environmental harm;
- licence application issues;
- the waste strategy in force under the *Waste Avoidance and Resource Recovery Act (WARRA)* (2001); and
- the reporting of waste under the NPI.

This Act also includes certain scheduled activities that require an EPL. Caltex currently operates under EPL licence N^{o}: 837. The licence includes a number of conditions relating to the management of waste associated with Caltex's current scheduled operations.

The proposed works include for the reuse of a certain amount of the dredged materials. Whilst this is a scheduled activity under the POEO Act the intent to only reuse up to 6,000 m^3 (see **Section 4.4.9**) does not meet the threshold limit that would require its need to be licensed. However, there is a requirement under this Act to consider if the works would pollute water, whereby a licence would be required under Section 120 of the POEO Act. The requirement for such a licence is considered in **Chapter 10, Water and Sediment Quality**.

NSW Waste Avoidance and Resource Recovery Act 2001

The 'WARRA' promotes waste avoidance and resource recovery in NSW. It defines the waste hierarchy ensuring that resource management options are considered against the following priorities:

- avoidance, including actions to use resources efficiently and reduce the amount of waste generated;
- resource recovery, including reuse, recycling, reprocessing and energy recovery, consistent with the most efficient use of the recovered resources; and
- disposal, including management of all options in the most environmentally responsible manner.

This Act confers a responsibility on Caltex and others to avoid waste production and recover resources for beneficial reuse in line with the principles of Ecologically Sustainable Development (ESD).

NSW Protection of the Environment Operations (Waste) Regulation 2005

This Regulation introduced mechanisms to encourage resource recovery in NSW. It sets out provisions covering waste management in terms of storage and transportation, as well as for reporting and record keeping for waste facilities.

It is the responsibility of those generating waste to classify it. To assist waste generators, the NSW Office of Environment and Heritage (OEH) has developed *Waste Classification Guidelines (DECCW, 2009)*. These provide a clear process for classifying waste in line with the POEO Act and above Regulation.

NSW Waste Avoidance and Resource Recovery Strategy 2007

The previous NSW Waste Strategy was issued in 2003. It provided a framework for reducing the generation of waste and improving the efficient use of resources. Broad targets included in the strategy aimed at:

- preventing and avoiding waste;
- increasing the recovery and reuse of secondary resources;
- reducing toxic substances in products and materials; and
- reducing litter and dumping.

The 2003 Strategy was superseded in 2007. The 2007 strategy retained the 2003 targets whilst introducing a number of key actions and programs that would be implemented by the NSW EPA to support meeting these targets.

The targets set by the above Strategy can be directly applied to the proposed works. They require that the proposals:

- achieve 76% recovery (the target for the construction and demolition sector);
- avoid using any of the 'priority substances' that are considered toxic; and
- ensure appropriate waste management processes are in place to prevent littering/dumping.

NSW Protection of the Environment Legislation Amendment Act: 2011

This Act amends the POEO Act so as to improve the reporting and management of pollution incidents in NSW. These changes apply to holders of EPLs and persons who undertake activities that result in a pollution incident.

This Act also introduces Part 5.7A into the POEO Act. This requires that licensees prepare *Pollution Incident Response Management Plans* (PIRMPs) in relation to each licensed activity. Licensees must also ensure that the PIRMP is kept at the premises to which it relates, is tested in accordance with the supporting POEO Regulation, and is implemented when a pollution incident occurs.

PIRMPs would be either prepared or expanded to include (activities of) the proposed works that are scheduled under the POEO Act.

16.4 Method of Assessment

16.4.1 Overview

The existing environment has been defined in terms of the main waste and resource streams resulting from current operations at the port and berthing facility. This has been compared against the predicted waste and resource streams resulting from the proposed works.

The purpose of this comparison has been to identify any additional waste and resource management measures required to support the proposed works that are not already covered by Caltex's existing waste and resource management practices.

The assessment has also considered impacts that could result from undertaking the works due to poor or atypical working practices, such as an accident or emergency situation. The mitigation measures reference back to the objectives, targets and requirements set out in the above legislation and planning policy.

16.4.2 Study Area and Timescales

The assessment has considered the waste generated and resource consumed over the two-year duration of the proposed works (see **Table 4-5**). It has excluded supply chain waste and resource inputs given the short duration, nature and intent of the proposed works.

16.5 Existing Environment

16.5.1 Overview

There are two main waste/resource streams currently generated, received and managed by the existing port and berthing facility. These relate to ship generated waste and the waste and resources used for maintenance and current operations.

16.5.2 Ship Generated Waste

Caltex maintains a *Standard for Terminal Berthing* (ref: STD 122.10.01.001) to ensure the wide range of ships that access the berths at Kurnell undertake their operations in accordance with relevant environmental and safety requirements and the waste management provisions of its EPL. The safeguards contained in the *Standard* include measures to:

- manage pollution and report pollution incidents;
- restrict and control repair works;
- limit and control the discharge of tank washing to the Refinery;
- control bunkering activities;
- control and limit emissions;
- control and permit crude oil washing; and
- prevent the discharge of general and putrescible (food) waste overboard.

A fundamental principle of the *Standard* is that all general waste collected from the ships is quarantined at the Wharf, picked up by *Trans Pacific Industry*, and transported by *Sea Waste* to a facility at Meadowbank for destruction.

16.5.3 Operations Waste Management

The wharf operations generate liquid, solid and general waste. A number of these waste streams are included on Caltex's EPL. They are generated in small quantities from processes and activities relating to fuel sampling, tank washings and localised fuel-spill containment.

Other operational waste streams include:

- paper and cardboard (which are recycled);
- putrescible waste (which is collected); and
- comingled waste (cans and bottles) (which is recycled).

16.5.4 Operational Resource Requirements

The existing port and berthing facility is subject to a routine maintenance program. This requires the use of the following resources:

- paints;
- timber and metal;
- premixed concrete;
- very small quantities of oils and lubricants; and
- a range of support materials (nuts, bolts, gaskets, rags etc.).

The wastes resulting from use of these materials are managed through existing management plans and procedures, which form part of Caltex's overall operational environmental management system process.

These management plans and procedures include:

- waste management plans;
- management of waste streams;
- management of used and empty drums;
- management of slop drums;
- management of waste skip bins;
- oil spill call out and response;
- refinery emergency response plans; and
- a standard for terminal berthing (see **Section 16.5.2**).

The above waste management plans and procedures are regulated through a waste disposal permit system, which puts in place controls to monitor and track waste generated from Caltex's whole operation. The permit system is overseen and administered by Caltex's internal environment group.

16.6 Impact Assessment

16.6.1 Waste/Resource Balance

The proposed works cover a two-year period. During this time, the following activities would influence waste and resource streams. These are discussed in more detail in **Sections 4.4 - 4.7**.

- The resource, materials and associated waste required/generated to undertake the proposed dredging works (other than the dredged sediments themselves).
- The resource required to upgrade the berths.
- Waste generated as a result of upgrading the berths.
- Traffic and transportation waste.
- General construction waste.

Table 16-1 presents an estimate of the main wastes/resources that would be generated and used in executing the proposed works. These estimates have been provided by Caltex.

As noted under **Section 4.4.1**, approximately 153,000 m^3 of sediment would be dredged under the proposed works. This is excluded from the following table as it would be managed as a waste in accordance with the *Environment Protection (Sea Dumping) Act* 1981 and subject to separate permitting and approval by the Commonwealth (see **Section 16.3**). For reference, this material has been assessed as being suitable for disposal offshore or for reuse within Botany Bay (see **Chapter 9, Spoil and Contamination**).

Table 16-1 Waste/Resource Balance

Type	Classification[1]	Description	Estimated Annual Volume	Notes (including end use/management)
Waste				
General Waste				
General and putrescible waste (all works)	General solid waste (putrescible)	General and putrescible waste generated by the construction workforce totalling 62 people. This would generally comprise food scraps, paper, cardboard, glass, cans, plastics and packaging.	Approx. 20 tonnes	Estimate based on each person generating 1.25 kg of waste per day over works period.
Sanitary/ greywater (ballast and bilge water)	Liquid Waste	Appropriate regulation, control and containment of these wastes to ensure they would be appropriately collected for treatment and disposal.	All regulated wastes would be managed through existing management plans and procedures (see **Section 16.5.3**).	

Type	Classification[1]	Description	Estimated Annual Volume	Notes (including end use/management)
Ship Waste	Could include all waste categories	Ship derived waste diesels, oils, lubricants, hydraulic fluid and cooking oil. These wastes would be controlled and quarantined contained for appropriate disposal onshore.		
Waste oils, fuels & lubricants	Liquid Waste	Waste oil, fuels and lubricant would be generated through the upgrade of the fixed berth infrastructure on the Wharf, from activities such as pipework flushing.		
Hazardous wastes (oily rags, spent chemical containers etc.)	Hazardous Waste	Hazardous wastes would comprise materials contaminated with oils, hazardous chemicals and paints. Such materials would be segregated, stored and treated as controlled waste.		
Inert & Recyclable Materials				
Construction Material (offcuts, timber, pallets etc.).	General solid waste (non-putrescible)	Construction material includes waste created as a result of undertaking the proposed works. It includes metal from the pipe offcuts, redundant loading arms, and timber and pallets used to deliver equipment.	100 tonnes	All material were possible will be recycled
Scrap metal	General solid waste (non-putrescible)		500 tonnes	-
Wood, paper & packaging	General solid waste (non-putrescible)		100 tonnes	-
Plastic	General solid waste (non-putrescible)		0.5 tonnes	
Resource Consumption				
(Semi) Renewable resource				
General Construction Materials (concrete, timber, plastic, wiring)	General solid waste (non-putrescible)	General construction materials would inevitably be required to undertake the proposed works, which include small to medium quantities of plastic, wood, timber, paper, food, fresh water etc.	100 tonnes	-

Type	Classification[1]	Description	Estimated Annual Volume	Notes (including end use/management)
Key non-renewable resource				
Metal (various)	General solid waste (non-putrescible)	Required to construct the, dolphins, moorings, anchors and piles.	400 tonnes	The quantity of metal required for the main structures has been limited through the use of engineering designs backed by the ability to use recycled materials.
Stone	General solid waste (non-putrescible)	Required to construct the rock revetment.	2,500 tonnes	Whilst the rock is a non-renewable resource it would remain in place for the operation of the port and berthing facility with little need for maintenance and renewal.
Plastic	General solid waste (non-putrescible)	Required as a general infrastructure component.	1 tonne	The quantity of required plastic and plastic derivatives would be a small component of the overall resource requirement. High density plastic would be used therefore limiting the requirement to maintain and replace it on a regular basis.
Fossil fuel derivatives (oils, lubricants, diesel, petrol, acetylene)		Fossil fuel derivatives required for ships, road transportation, machinery, equipment, lubrication, glues, welding, lighting, heating/cooling etc.	Consistent with any development would be the required use of fossil fuels (and their associated derivatives). The works would be scheduled to minimise transport movements (assisted by delivering some of the equipment to site by barge) (see **Section 4.6**), whilst including a number of construction management requirements to limit excessive fossil fuel consumption.	

Note 1: Indicative classification based on NSW Waste Classification Guidelines (DECCW, 2009). This classification should be confirmed during the construction works, once the waste is generated and prior to reuse, recycling or disposal

16.6.2 Waste and Resource Impacts

The following potential impacts could occur under atypical conditions or as a result of an accident or emergency.

- Pollution due to a release or spillage in, or over, water.
- Contamination resulting from a release or spillage on land due to handling, storage, transportation and disposal mismanagement.

Additional resource requirements may arise due to:

- an overrun to the works program;
- inefficient resource use;
- engineering difficulties (leading to the requirement for additional materials etc.); and
- design under-specification requiring additional resources.

16.7 Mitigation

16.7.1 Overview

The works would be managed under the existing waste and resource management controls implemented by Caltex (see **Section 16.5.3**). A works-specific waste and resource management plan (WRMP) would be produced for this proposal. This would form a sub-plan of the main construction environmental management plan (CEMP). This would be prepared in accordance with Caltex's *Construction Management Plan Standard* (ref: 4.20.03.001). The WRMP would contain specific controls for each works' contractor tailored to their roles and responsibilities on site. The plan would also be written in accordance with the WARRA, the POEO Act, and the NSW EPA's *Waste Classification Guidelines 2009*. The plan would also reflect Caltex's EPL requirements.

The WRMP would be based on the following overarching objectives, principles, strategies and plans to deliver effective waste and resource management throughout the two-year undertaking to deliver the port and berthing facility upgrade works.

16.7.2 Waste and Resource Management Plan Objectives

The environmental objectives for the management of waste would be to:

- minimise the wastes generated and resources used throughout the life of the proposed works, and maximise opportunities for reduction, reuse and recycling; and
- store, handle, transport, and employ resources/dispose of waste in a manner that does not lead to environmental harm, pollution or contamination.

16.7.3 The Waste/Resource Management Plan Principles

The WRMP would make specific reference to the hierarchy of:

- avoidance, by identifying appropriate materials and effective procurement;
- reduction of waste by optimising construction and operation methods;
- reuse of waste by identifying sources that can utilise the waste;
- recycling waste by identifying facilities that are able to recycle waste;
- recovery of energy from waste; and
- disposal of waste at an appropriate licensed facility.

Resource management would consider:

- resource minimisation through design and project execution; and
- responsible construction practices to prevent mismanagement.

16.7.4 Cleaner Production Strategies

Cleaner production is a process designed to maximise resource efficiency and minimise waste across the works' lifecycle by conserving resources (raw materials, energy, water etc.), eliminating the use of hazardous and/or regulated materials, and reducing the toxicity of emissions and waste. Cleaner production includes:

- limiting the volume of waste close to the proposed works through installing a number of prefabricated components;
- Caltex's embedded commitment to sustainable procurement to ensure waste is eliminated before it is generated;
- the inclusion of resource efficiency and waste minimisation procedures in contractual terms so as to ensure and encourage the works' contractors to achieve specific and achievable environmental management objectives in executing the proposed works;
- ensuring the forward detailed design executes the works by reusing elements of the decommissioned infrastructure relating to the berths;
- informed procurement to ensure the development of accurate bill-of-quantity specifications to limit resource stockpiling whilst ordering off-the-shelf materials that prevent offcuts and excess waste onsite; and
- clear demarcation and colour-coding for waste storage and management along with the provision of separate waste containers/skips to ensure effective segregation and maximise opportunities for reuse and recycling.

16.7.5 Waste Recovery, Reuse and Recycling Strategy

Waste reuse and recycling opportunities would link with Caltex's wider waste targets, building on already identified and contracted end user markets as set out **Table 16-2**. During construction generated waste would tie into these established management processes thereby providing a channel for reusing packaging and recycling surplus material, waste, scrap metal and timber.

The following table provides an indication of the key recyclable waste/resource streams, potential end uses and a qualitative view of their marketability.

Table 16-2 Recyclability/Recoverability of the Identified Project Waste Streams

Waste/Resource	Potential End Use	Marketability
Other Construction material	Handled by a licensed third-party contractor.	Low marketability, dependent on the nature of the waste.
Scrap metal (ferrous/non-ferrous).	Handled by a licensed third-party contractor. Waste metal would be stored within the main Refinery site prior to being recycling offsite.	High marketability. Continual high demand from local to global markets however price per tonne can vary significantly.
Wood, paper & packaging	Handled by a licensed third-party contractor. A central collection point would be identified for this material for transfer back to the Refinery, where it would be combined with the wider collected packaging waste for transfer to a materials recovery facility.	Medium marketability. Fluctuating demand due to global market unpredictability.
Plastic		
Waste oils, fuels & lubricants	Handled by a licensed third-party contractor. As a comparatively small waste stream, these would be collected for refinement on the main Refinery site in a parallel with other recycled hydrocarbons and recycled at the Refinery.	Medium marketability, however key opportunity for recycling.
Putrescible waste	Handled onsite through the collection of food waste.	Low marketability. No demand other than for compositing materials.
Bitumen	Taken offsite for recycling by a licensed contractor.	Low marketability, however dependent on the nature of the waste.
Concrete	Recycled as road base.	Medium marketability. Fluctuating demand due to global market unpredictability.

16.7.6 Waste Disposal Strategy

Disposal would be the last option considered for dealing with waste streams arising from the proposed works.

Where disposal would be required this would be undertaken in accordance with the POEO Act, WARRA and POEO Regulation. This would include consideration of the proximity principle when considering disposal requirements. The objective of the principle is to dispose of waste (and procure primary resource) as close to the Kurnell Refinery as possible.

The waste generated as a result of the proposed works would be transported to the nearest landfill located in Kurnell where possible (2 km from the project site), the SITA facility in Rockdale, or the landfill at Erskine Park for reprocessing/disposal. The contribution to landfill across the Sydney Metropolitan Area as a result of the works would be negligible (less than 0.1%) over the two-year works' period.

Controlled waste would be managed by a licensed contractor who would transport it to a licensed waste facility.

16.7.7 Procurement and Resource Efficiency

Measures to reduce the reliance on natural resources would be undertaken during the detailed design of the proposed works. Materials selection would form a key part of the design to ensure the minimal use of materials to return the appropriate engineering performance. An additional criterion would be the specification and selection of durable materials to reduce maintenance schedules during the ongoing operation of the port and berthing facility.

A commitment is already in place to source materials locally. The noted exception is the piles, which would be imported for economic reasons.

16.7.8 Waste and Resource Management Plan

The WRMP would:

- identify opportunities for avoidance, reduction, reuse and recycling (in accordance with the targets set out in **Section 16.3**);
- provide procedures for the handling, management (including management over water), storage and reuse of waste;
- identify safe disposal routes and treatment options;
- set out procedures for meeting legislative and regulatory requirements;
- detail the processes for tracking, storing and segregating waste effectively;
- set out procedures for obtaining the required approvals for the management of waste;
- include processes to limit resource-use through effective construction management; and
- set out the methods for quantifying how the above waste management and resource efficiency targets have been met (in line with regulatory requirements).

Table 16-3 sets out key resource efficiency and waste management targets for inclusion in the WRMP, which align to the 2007 Waste Strategy targets set out in **Section 16.3**.

Monitoring and auditing would be employed to assess the actual waste and resource streams, appraise the success of planning waste and resource management strategies, respond to changing circumstances (new waste and resource streams), and understand and mitigate any potential impacts. The process would also allow the WRMP to be improved as required. The monitoring would link it to Caltex's annual waste reporting under the terms of the EPL and the NPI (see **Section 16.3**).

Inspections of the waste management, storage and temporary laydown areas and key temporary storage sites (see **Section 4.4.8**) would be conducted on a weekly basis to ensure that correct procedures and opportunities were being followed. Monitoring and auditing processes would be appropriately documented, consistent with Caltex's existing procedures.

An inventory would be kept of all waste and resource volumes arising/used during the course of the proposed works. A waste database would be used to obtain waste management solutions from Caltex Environment Department and record keeping of the types and volumes of waste being generated, the quantum and type of resourced being used, recovery volumes, reuse and recycling rates and the types and quality of substances emitted to land, water and air.

Table 16-3 Waste and Resource Management

Type	Waste Classification	Description	Management Options
Waste			
General Waste			
General waste	General solid waste (putrescible) or General solid waste (non-putrescible)	• General waste would be temporarily stored within the Wharf's general waste storage area prior to transport to the right away until the waste service provider collection date. Existing waste management practices employed on the Wharf are in place to prevent water contamination and access for vermin. • The existing licensed waste management contractors would supply additional bins, transport waste and dispose of non-recyclable waste at various facilities including the Kurnell landfill, the SITA site and the waste management facility at Erskine Park.	Transported by the current waste contractor to the Kurnell landfill, SITA facility in Rockdale or the landfill at Erskine Park for reprocessing/disposal.
Sanitary/ greywater (ballast and bilge water)	Liquid Waste	• In accordance with the International Maritime Organisation (IMO) all ships are required to have in place a Ballast Water and Sediment Management Plan. Ships are required to carry a Ballast Water Record Book and carry out ballast water management procedures that accord with International Convention for the Control and Management of Ships' Ballast Water and Sediments (of which Australia is a signatory), the IMO Guidelines for the Control and Management of Ships' Ballast Water (2004), and the Australian Ballast Water Management Requirements (Version 5) (DAFF, 2011). • The Department of Agriculture, Fisheries and Forestry (DAFF) who oversees ballast water management in Australia, discourages the discharge of high-risk (polluted) ballast waters in areas like Botany Bay favouring methods to manage the water in territorial seas (12 nautical miles from the coast) where the environment allows for sufficient dilution and mixing. • Bilge water discharge would not be permitted. All bilge waters generated during the works would be pumped and collected for disposal onshore within the Refinery's waste water treatment plant (WWTP). • Staff working off the Wharf would use the ablutions housed in the Wharf control room.	Waste to be transported and transferred to the Refinery's WWTP where possible. The alternative would be transportation by a licensed contractor to a sewage waste disposal facility. Ballast water would be managed in accordance with international standards.

Type	Waste Classification	Description	Management Options
Ship Waste	Could include several waste categories	• Shipping activities would be tightly controlled in accordance with the existing Caltex *Terminal Berthing & Safety Information Standard*. This would include measures to control bunkering, and the handling and transfer of waste fuels, lubricants etc. • In the unlikely event of needing to bunker materials, this would only be allowed with the permitted consent of Sydney Ports Corporation (SPC). • All operations would conform to the requirements of the Marpol Convention (see **Section 4.7.2**) with regards to the statutory controls placed on ships to prevent marine pollution in addition to the pollution prevention requirements set out under Section 120 of the POEO Act. In addition, the works' contractors would need to adhere to Caltex's own *Emergency Response Plan* (STD 4.02.01.01) and *Oil-spill Callout and Response Work Procedure* (ref: 120.05.001). • DAFF do not permit the discharge of solid waste overboard within Australian Waters. All such waste would be bagged for collection and disposal onshore. The Wharf already has waste management controls in place to handle solid wastes. The dredgers and associated tugboats would follow these same procedures.	Collected for treatment and disposal onshore via licensed approved regulated contractors. Ship wastes would be managed through existing practices employed at the Wharf and Refinery.
Waste oils, fuels & lubricants	Liquid waste	• Shipping activities would be tightly controlled in accordance with the existing Caltex *Terminal Berthing & Safety Information Standard*. This would include measures to control bunkering, and the handling and transfer of waste fuels, lubricants etc. • Fuel, oil and/or lubricant transfer or draining would be undertaken within bunded areas and collected in separate trays for transfer into clearly labelled drums/containers. These would be suitably stored (in bunded areas) prior to collection for onward temporary storage at the Refinery in its designated waste management area. • Appropriate spill kit (backed by training in its use and management) would be provided on the Wharf, and aboard each operating ship. Specific booms would be kept on the Wharf and aboard each ship should an emergency occur requiring the management of significant spills. • Storage would accord with Australian Standard: AS1940. • The works' contractors would need to adhere to Caltex's own *Emergency Response Plan* (ref: 4.02.01.01) and *Oil-spill Callout and Response Work Procedure* (ref: 120.05.001).	Either processed for reuse on the Refinery site or transported by a licensed contractor to a licensed facility for recycling, where possible. All waste generated from the use of spill kits and of cleaning of spills will be managed under the current Refinery waste management system.

Type	Waste Classification	Description	Management Options
		• Waste oil generated from flushing the redundant fuel lines would be directed to specific 'slop drums' on the Wharf. The oily water would then be pumped to the dedicated 'slop line' using the existing 'slop pumps' installed on the Wharf. The oily water would be transported to the Refinery's WWTP prior to disposal under the terms of the site EPL.	
Hazardous wastes (oily rags, spent chemical containers etc.).	Hazardous waste	• Bins and/or drums would be designated for the storage of empty containers. • Chemical wastes would be stored separately to solid wastes to remove cross contamination. • Bins and/or drums would be sealed, labelled and stored within appropriately bunded areas in accordance with AS1940 and located within designated waste management areas within the Refinery site. • Spill kits would be strategically located on the Wharf and supporting ships undertaking the works.	Transported by a licensed contractor to a licensed facility.
Inert & Recyclable Materials			
Construction material (offcuts, timber, pallets etc.).	General solid waste (non-putrescible)	• Scrap metal, paper, cardboard, plastics and timber would be collected locally and then segregated and stored (principally in skips) within its' designated areas. • Skips would be closed during rainfall events to prevent land and water contamination. • Existing contracted waste companies would supply additional bins/skips, transport waste and dispose of non-recyclable inert waste at various facilities including the Kurnell landfill, the SITA site and the waste management facility at Erskine Park. • Recycling would be undertaken in accordance with existing contracts for the Refinery site to uphold sustainable waste management opportunities. • Timber would be largely reused onsite or mulched for use within the gardened areas surrounding the Refinery. Unusable timber would be landfilled. • Caltex would extend its sustainable procurement and waste strategy to include the proposed works to ensure suppliers upheld sound waste management practices.	Recyclates would be managed in accordance with existing Caltex waste management practices. Non-recyclates would be reprocessed/disposed at the Kurnell landfill, SITA facility in Rockdale or the landfill at Erskine Park, adopting existing contract arrangements.
Scrap metal	General solid waste (non-putrescible)		Transported by a licensed contractor to a recycling facility.
Wood, paper & packaging	General solid waste (non-putrescible)		
Plastic	General solid waste (non-putrescible)		
Accident/ emergency	-	• During an accident or emergency situation, such as a pipe break or rupture, spillage or unplanned overflow dredging, operations would cease immediately, with the requirement for the works' contractors to undertake any required repairs, modify their working methods and report the incident under the terms of the EPL.	This would depend on the nature of the accident and emergency and agreed in line with NSW EPA requirements.

Type	Waste Classification	Description	Management Options
Resource Consumption			
(Semi) Renewable Resource			
Resource efficiency	-	• Procurement of pre-fabricated materials would be encouraged to reduce the quantity of waste where practicable. • Resource management reviews would coincide with construction program reviews to monitor and track resource consumption creep. • Resource design efficiency would be employed during the detailed design to limit the need for excess resource. • Off-the-shelf design specifications would be adopted to ensure resource efficiency. • Buy back initiatives would be employed to ensure surplus materials are reused elsewhere.	
Fossil fuel derivatives (oils, lubricants, diesel, petrol, acetylene)	-	• Measures to introduce transport efficiencies would be included within the detailed design. These would include; full load transfer, opportunities to prevent 'empty return trips', the adoption of the proximity principle in seeking project resources and transporting project wastes and opportunities to promote car sharing during the works etc.	

Note 1: Indicative classification based on NSW *Waste Classification Guidelines 2009*. The wastes' classification should be confirmed during the construction works, once the waste is generated and prior to reuse, recycling or disposal

16.7.9 Summary

Table 16-4 outlines the mitigation and management measures that would be put in place to minimise waste impacts and maximise resource efficiency.

Table 16-4 Hazard Mitigation and Management Measures

Mitigation and Management Measures	Implementation of mitigation measures		
	Design	Implementation	Operation
The proposed works would be integrated into existing resource efficiency, waste management and handling, emergency response and preparedness plans for the port and berthing facility.	✓	✓	
A *Waste and Resource Management Plan* (WRMP) would be compiled as part of the CEMP prior to the works commencing.	✓	✓	
The WRMP would: • identify requirements consistent with the waste and resource hierarchy; • ensure resourcing efficiency is delivered through the design and responsible construction practices; • provide consistent clear direction on waste and resource handling, storage, stockpiling, use and reuse management measures (consistent with current management practices relating to Caltex's CEMP procedures); • identify disposal and management routes consistent with current management practices as adapted for the proposed works; • set out clear requirements for meeting legislative and regulatory requirements;	✓	✓	

Mitigation and Management Measures	Implementation of mitigation measures		
	Design	Implementation	Operation
• define requirements to support Caltex's sustainable procurement objectives through effective, design, construction and procurement; and • set out processes for disposal, including onsite transfer, management and the necessary associated approvals.			
The WRMP would incorporate the requirements of the waste and resource hierarchy and cleaner production initiatives.	✓	✓	
The WRMP would include a process for auditing, monitoring and reporting, which would include regular inspections of site activities and the waste management area(s). The WRMP would be subject to regular auditing and a system would be used to record and report the types, volumes and management measures for all waste and resource arising from/used for the works.	✓	✓	
Works-generated waste would be segregated at source and stored in accordance with current site practices. This would extend to ship-generated waste. Site management practices would potentially need adapting to consider additional storage requirements. Regardless, all waste would be stored in suitable containers and designated waste management areas. Waste would be stored (and segregated) to accord with the *Waste Classification Guidelines* 2009.		✓	
Ballast water would be controlled in accordance with the management provision included in the International Convention for the Control and Management of Ships' Ballast Water and Sediments (of which Australia is a signatory), the IMO Guidelines for the Control and Management of Ships' Ballast Water (2004) and the Australian Ballast Water Management Requirements (Version 5) (DAFF, 2011).		✓	
Bilge water discharge would not be permitted.		✓	
Any refuelling taking place at the Wharf would be undertaken in accordance with existing procedures and permits.		✓	
All operations would conform to the Marpol Convention to prevent marine pollution in addition to the requirements of Section 120 of the POEO Act.		✓	
The discharge of any solid waste overboard would not be permitted.		✓	
Caltex's existing procedures for the disposal of sewage, greywater, controlled waste, general waste and recyclable materials would be adopted for the proposed works (and modified if required). This would include using licensed contractors to remove and transport waste from the site.		✓	
The works would feed into Caltex's annual reporting of waste.		✓	
Design efficiency would be employed to limit the need for excess resource.	✓		
A procurement strategy would be included to manage the works.		✓	

17 Amenity, Land Use, Recreation and Navigation

17.1 Introduction

The following chapter assesses the potential impacts of the proposed works on amenity, land use, recreation, navigational safety and the aquaculture industry.

17.2 Scope of the Assessment

17.2.1 Overview

The Director General's Requirements (DGRs) (see **Technical Appendix A**) requested that consideration be given to:

- *"effects of the development on commercial and recreational fishing and aquaculture, aquaculture leases and oyster farming;*
- *Port Botany operations, including impacts on shipping lanes and queues; and*
- *the operation of Port Botany".*

A number of associated issues have been raised by statutory agencies, which are relevant to this chapter. They include:

- potential impacts on popular recreational fishing sites;
- the ongoing maintenance of angler access in Botany Bay; and
- navigational safety issues (including moorings and anchoring).

Impacts on the condition and health of recreationally fished and aquaculture species have been considered in the ecological assessment (see **Chapter 11, Ecology**).

The study area for this assessment includes the coastal areas, users and communities of Botany Bay, the recreational shoreline and the locations where aquaculture activity takes place. The assessment considers impacts resulting from the proposed works and any effects due to the continued use of the site as a port and berthing facility. Recreational and navigational impacts and issues relating to the proposed disposal ground have been considered as part of the sea dumping permit (SDP) application due to the ground's location in Commonwealth waters.

17.3 Legislation and Planning Policy

The following legislation and policy applies to the issues of amenity and navigation in the context of the proposed works.

Management of Waters and Waterside Lands Regulation 1972

This regulation was made under the *Maritime Services Act 1935*. Clause 67 of this regulation requires the approval of the Harbour Master if the proposed works are to: disturb the seabed; require the installation of moorings and/or port installations; or impact commercial shipping operations.

Marine Pollution Act 1987

This Act sets out requirements to protect the State's maritime environment from pollution caused by recreational, trading and commercial ships operating in NSW's waters. It implements Australia's commitment to the *International Convention for the Prevention of Pollution from Ships (MARPOL)*. This Act requires that controls relating to oil pollution, noxious liquids, harmful substances; sewage, garbage and air pollution are put in place for marine-based works.

Marine Safety Act 1998

This Act sets out the requirements for marine navigation and shipping safety. The following provisions are of relevance to the proposed work:

- regulations for the prevention of collisions;
- speed limits and no wash zone areas;
- restrictions on the operation of ships;
- reckless, dangerous or negligent navigation;
- protection of navigation aids;
- approvals required for aquaculture leases over navigable waters;
- regulations for organised aquatic activities; and
- regulations relating to the safety of navigation.

Maritime Services Act 2010

This Act remains relevant to the proposed works as it has required Caltex to obtain landowners consent from NSW RMS prior to lodgement of the development application (DA). It also requires that Caltex obtain a licence to dredge the seabed from NSW RMS prior to starting the proposed works.

In order to gain a 'permission to lodge' from NSW RMS, there has been a requirement for Caltex to demonstrate that the associated activity/development would:

- not cause a danger or obstruction to navigation safety;
- not result in a significant risk of a marine accident;
- be able to promote and maintain water recreation and sport;
- allow public access to foreshore areas (and conserving heritage);
- achieve a high-quality design;
- maintain a working harbour; and
- be an appropriate use of land.

These issues have been considered in this assessment. The issues of heritage have been considered in **Chapter 12, Heritage**. Permission to lodge was granted on 27 November 2012 (see **Technical Appendix L**).

17.4 Recreation and Amenity

17.4.1 Method of Assessment

This assessment has been informed through a review of published data, consultations (with special interest groups, the local authorities and state agencies) and data interpretation.

Recreation

The assessment has involved:

- identification of recreational activities that take place close to the project site and within the wider area of Botany Bay;
- identification of any specific fishing areas or fishing grounds that may be potentially impacted by the proposed works;
- identification of any specific special interest groups that may be affected by the proposed works;
- evaluation of the temporary/permanent loss of recreation due to the proposed works; and
- the consideration of any residual impacts and effects (if required).

Amenity

Amenity has been taken to represent the enjoyment and sense of place. The assessment of how that would be impacted by the proposed works has involved:

- identification of land and areas of Botany Bay that are currently used by the community and special interest groups;
- analysis of the extent to which the proposed works would directly or indirectly affect these areas including their current and continued use;
- evaluation to establish the potential impacts on amenity and the community to identify appropriate design measures and mitigation controls; and
- assessment of the residual effects on the community and amenity of the area (if required).

Amenity has been defined by considering a number of parameters including risk, safety, use, noise, air quality and visual impacts.

The following significance criteria have been used to assess the likely impacts on amenity and recreation.

Table 17-1 Magnitude of Impact Assessment Criteria (Amenity/Recreation)

Impact Rating	Criteria
Beneficial Impact	• Demonstrable improvement in recreational use or patterns, with possible attraction to use. • Amenity improvement that promotes use.
Negligible Adverse Impact	• Indiscernible change to recreational use or patterns, with no change to associated assets. • Amenity change is indiscernible to the community and users of the area.
Minor Adverse Impact	• Limited change to recreational assets that do not compromise recreational use or patterns. • Loss of amenity that does not compromise use.
Moderate Adverse Impact	• Modification to recreational asset reducing their use or availability, temporary changes to recreational patterns and a temporary detraction from use. • Amenity change that comprises but does not preclude use.
Major Adverse Impact	• Loss of recreational assets, changes in recreational patterns, detraction from use. • Amenity of the area is completely changed or unrecognisable and precludes previous use.

17.4.2 Existing Environment

Recreational and Competitive Fishing Activities

Botany Bay is used for recreational and competitive fishing throughout the year. The Bay is regarded as one of the primary recreational fishing areas within NSW. Its popularity is a result of its maintained fish stocks and the Bay providing a safe sheltered area to fish.

The whole Bay was declared a recreational fishing haven (RFH) in 2002[1]. This followed substantial public investment ($10 million) in buying out the Bay's commercial fishing rights[2]. In the past decade the use of the Bay for recreational fishing has continued to grow as further investment has taken place through the creation of artificial reefs and restocking initiatives.

Fishing Locations and Restrictions

Despite Botany Bay being declared a RFH there are some restrictions that either prevent or restrict recreational fishing activities at certain locations.

There is a notable *fishing closure area* around Towra Point and Quibray Bay, where a *sanctuary zone* has been declared that prohibits fishing of any kind. A wider *refuge zone* extends in to the Bay area, which only permits fishing by hook, line and recreational nets.

Other restrictions include a limit on *bait digging* south of the project site close to Silver Beach, and the designation of an *intertidal protected area* around the Kamay Botany Bay National Park headland (Inscription Point). This has been established to allow the shoreline ecology to populate and re-establish. Removal of invertebrates from this area is prohibited.

[1] The ban was imposed under the *Fisheries Management Act 1994* and prevents ships greater than 35 m in length from fishing in the Bay area.
[2] Reported by DPI (Fisheries) as $10 m and the Recreational Fishing Alliance of NSW as $20 m.

The above locations are illustrated in **Figure 17-1**.

Other occasional temporary fishing restrictions are put in place in the Bay. These restrictions are often as a result of the associated nutrient loading that takes place (which occurs as a result of surrounding runoff from land) or following the introduction of marine pest species.

A Marine Security Zone (see **Section 17.5.2**) has been declared around the project site (see **Figure 17-2)**. Permitted shipping is only allowed within this area preventing its use for recreational and competitive fishing and other recreational purposes. The areas around the limit of the Zone are fished however[3], and recreational ships frequently pass by the project site to reach other areas of the Bay.

Estuarine Artificial Reefs

Botany Bay contains a number of estuarine artificial reefs (EARs), which are used to extend fish stocks and to enhance angler catch. In Botany Bay, four artificial reefs have been created north of the project site close to Congwong Bay and Yarra Bay (see **Figure 17-1**). The NSW Department of Primary Industry (DPI) (Fisheries) constructed these artificial reefs between 2005 and 2007. Each reef is constructed of 'reef balls', which are specially-designed concrete modules that promote marine growth and provide fish with a complex habitat. A quarterly monitoring program undertaken between 2006 and 2008 confirmed use of these reefs by an unusual collection of recreational and competitive species. In total, 9,664 individual finfish, comprising 67 species were recorded at Yarra Bay during this period, of which 22 species were deemed recreational fishing target species. These reefs have thrived despite the heavy commercial and industrial use of the Bay demonstrating the ability for these two activities to co-exist.

Re-Stocking

In addition to the above reefs, DPI (Fisheries) restocked Botany Bay with recreationally fished species in 2006. Following this initiative, the total number of fish stocked in the Bay was in excess of 13,000[4]. Whilst no further restocking has taken place since (as DPI (Fisheries) continues to observe the natural increase in fish stocks) this program further demonstrates the commitment by the Recreational Fishing Trusts to improve fishing in the Bay.

Key Recreational and Competitive Fishing Groups

Fishing and angling clubs use Botany Bay. Whilst they fish over a wide area, the closest and most significant clubs to the project site include:

- St Georges and Sutherland Shire Anglers Club;
- Botany Bay Game Fishing Club;
- South Sydney Fishing Club; and
- Botany Bay Sports Fishing Club.

These clubs undertake a range of recreational and competitive fishing activities and have registered members and boats. Whilst each club (or its representatives) has been contacted in preparing this EIS, the overall interests of recreational fishing are represented through the wider Recreational Fishing Alliance (RFA) of NSW.

[3] As per incidental observations by the staff at the Kurnell Wharf.
[4] http://www.fishnet.com.au/default.aspx?id=227&anglerreportId=4427&memberId=21

Caltex is currently in contact with the RFA. The RFA has raised a number of concerns relating to the proposed works and their impact on the viability of fishing in the area both in the short and long term, the ongoing commercial and industrial pressures on the Bay and potential impacts on the commercial investment made in the area. These concerns have been addressed in a number of the EIS chapters (see **Chapter 6, Consultation**). The ecology chapter (see **Chapter 11, Ecology**) focusses on the impact on the fishing resource of the Bay. This chapter assesses the potential impacts of the proposed works on recreational use of the Bay.

Aquaculture Activities

The NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS) identifies *Priority Oyster Aquaculture Areas*. The closest areas to the proposed site are located within Quibray Bay, Towra Point and Woolooware Bay, all of which are located west of the project site (see **Figure 17-1**). Further sites are located within the Georges River. Oyster aquaculture in these areas can be undertaken on the basis of 'development without consent', simply requiring an aquaculture permit and lease to be obtained from NSW DPI (Fisheries).

A separate fish farm aquaculture lease is located next to the Kurnell Wharf; approximately 100 m from the limit of the project site (see **Figure 17-1**). Whilst currently non-operational, it has the potential to be reactivated at some point. The site was previously used to farm mulloway, yellowfin bream and snapper. It is currently permitted for use as a (pearl) oyster farm.

Other Recreational Uses of Botany Bay

Wider Recreational Uses

In addition to angling and fishing, the most popular pursuits undertaken in Botany Bay include kayaking, sea-kayaking, power boating, kite surfing, wake boarding, sail boarding and surfing. These activities take place largely towards the inner part of the Bay, off the beaches fronting Ramsgate, Monterey and Brighton-le-Sands (namely Lady Robinsons Beach). However, these activities have also all been observed close to the project site[5].

The two main recreational pursuits of relevance to the proposed works are sailing and diving.

- Sailing involves various events in and around Botany Bay, including in locations close to the project site. Sailing tends to increase in the summer months and at the weekend. However, the clubs operate all year round, including on weekdays.
- Diving is not common around the project site, with the main diving sites located around the Kurnell headland reefs (close to shore) and the La Perouse peninsula headland and off Bare Island. Diving is undertaken all year round with most diving taking place at the weekends.

Silver Beach

Silver Beach is used for recreational activities, and tends to be used primarily by local residents from Kurnell. It has considerably fewer users than other beaches around the Bay. People exercise, (dog) walk, paddle, and swim off the beach, whilst angling takes place from the groynes. There is also occasional lobster trapping undertaken off the sea walls. Activity is seasonal, with a greater number of users incidentally observed[2] during the summer months, during the evening and at weekends.

[5] Observations made by the Caltex Wharf staff.

Coastal/Shore-Based Activities

Kamay Botany Bay National Park comprises two principal areas located on the Bay's two headlands. The southern part (located east of the project site) includes the Captain Cook memorial, a number of walking routes, an educational and discovery centre and an open recreational area (Commemoration Flat), which is used for barbeques and picnics. The park is a noted tourist attraction receiving visitors in greater numbers over the summer months and at weekends.

Other recreational activities commonplace around Kurnell include cycling (with local cycling clubs using the flats of the Peninsula to recreationally cycle and train), triathletes using the area to train and whale watching (which takes place in autumn).

Legend

- Project Site
- Dredge Footprint
- Priority Oyster Aquaculture Areas **
- Artificial Reef *
- Intertidal Protected Area *
- Sanctuary Zone *
- Refuge Zone *
- No Bait Digging *
- Silver Beach Aquaculture

Note: *1 in 4 profile to the existing seabed floor except at rear of Fixed Berth #1.*

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Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

0 0.5 1 2 Kilometres

Source: Aerial Imagery - Bing Maps © 2010 Microsoft Corporation and its data suppliers.
* Sydney South Recreational Fishing Guide
** NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS)

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FILE NO: 43177815.056

DRAWN: STB/SB APPROVED: CF DATE: 7/01/2013

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KURNELL PORT AND BERTHING PROJECT
BOTANY BAY

FISHING, AQUACULTURE AND RECREATION

URS

Figure: **17-1**

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17.4.3 Predicted Impacts

Recreational Use (During the Works)

The works (excluding part of the dredging works) would take place within the confines of the Marine Security Zone (see **Figure 17-2**). As noted above, unauthorised shipping is not allowed to enter or anchor within these areas. As a result there would be no direct impact on recreational use or fishing.

There are two areas where dredging is required outside of the Marine Security Zone; the eastern arm of the approaches, and the northern limit of the turning circle. Dredging of these areas would take approximately 1 week to complete at each location. Within these areas there would be a **minor adverse** impact on recreational use over a short period whilst they were being dredged. Immediately, following dredging there would be no additional restrictions on use.

The areas around the project site important for recreational purposes would not be directly affected by the proposed works. An indirect impact would be additional shipping movements for periods over the two-year works' program.

The greatest number of additional ship movements would occur during dredging and when the fixed berths were being upgraded. During this period there would be up to 10 ship movements within the project site (and Marine Security Zone) at any single point in time[6], however actual numbers are likely to be lower as not all the delivery and support ships would be required all the time. Outside of the project site the only effect would be the periodic regular movement of split hopper barges as they move spoil offshore to the disposal ground.

When not in use these additional ships would be moored to the east of the Wharf on the edge of the Marine Security Zone (see **Chapter 4, Proposed Works Description**). This area is currently used to moor ships.

All shipping required to undertake the proposed works would comply with the safety and management policies of Sydney Ports Corporation (SPC) and NSW Roads and Maritime Services (RMS). This would require general navigational safety controls to be put in place to ensure there would be no risk to any other users of the area. This would be most significant where the ships travel to and from the project site in the main shipping channel.

Recreational Use (Following the Works)

In total, the dredge footprint comprises an area of some 172,000 m^2. Caltex is currently working with the NSW RMS, as the managers of the Crown Estate, to agree an extension to its leased area. The only area that would be lost due to the proposed works (which sits outside of the current Marine Security Zone) would be part of the expanded footprint of fixed berth #1 (see **Figure 17-2**). This would equate to an area 35 m by 310 m (10,850 m^2) expanding the footprint of the existing berth to the east and north to allow ships to be guided into the fixed berth.

This loss of this area to the port and berthing facility represents an exceptionally small area of Botany Bay (less than 0.1%) and would be next to the existing limit of the Marine Security Zone. The recreational value of this small area is therefore considered negligible, the impact being considered **minor adverse**.

[6] As included in **Table 4-4**. In total there would be 7 ships associated with the dredging works (including the split hoppers and supply ships) and the barges, cranes and support boats required for the upgrade of the fixed berths.

Following the works there would be a reduction in shipping (see **Chapter 4, Proposed Works Description**). Such a reduction is considered a **beneficial impact** as it would reduce the use of the Bay and reduce shipping pressure on the area. This conclusion is further supported by the fact that the overall size of ship accessing the facility would remain the same, the only difference being that fixed berth #1 would provide a safer mooring over the sub berth (see **Chapter 4, Proposed Works Description**).

Indirect Impacts

Recreational fishing and dredging tend to come into conflict '*when there is an extraction of sand and gravel from the seabed and when the dredged material has to be disposed of at sea*' (Bray *et al*., 1997). This has a number of associated issues, the most relevant of which are:

- the dredging having the potential to lead to the destruction, or covering of habitat with sediment, which may harm fish and shellfish or cause them to be displaced and by association result in increased resource pressure on other communities; and
- the potential for fish stocks to be affected as a result of the interruption to fish breeding due to the removal of habitat, changes in water quality, or the impedance of migration during the dredging and disposal process.

These impacts have been considered in detail in **Chapter 11, Ecology** as supported by the hydrodynamic modelling presented in **Chapter 10, Water and Sediment Quality**. The conclusion of these studies firstly demonstrates that the area directly affected by the works does not form a critical or important habitat resource for fish (recreational or otherwise) and does not support any spawning or nursery grounds. Secondly, the areas likely to be affected by sediment dispersion and deposition are relatively localised to the project site (see **Figure 10-3**). For these reasons there would be no impact to viability of recreational fishing as a result of the proposed works.

This would extend to any impact on the There would be no displacement of recreational boats from the heavily fished artificial reef areas, simply due to there being no anticipated change to the water quality and hydrodynamics in these northern Bay areas (see **Sections 8.6** and **10.6**) or the need for future shipping to manoeuvre any closer to these established grounds.

Other recreational and commercial uses of the Bay (including aquaculture viability, swimming and in-water activities) are unlikely to be affected providing the mitigation controls in **Chapter 19, Mitigation and Management Measures** are correctly implemented. This is again due to the localised sediment and water quality effects resulting from the proposed works. This includes any impacts on recreational diving.

Divers rely on the clarity and visibility of the water. The lowest concentration of sediment generated as a result of the natural conditions that occur in Botany Bay is about 5 mgL^{-1}. In terms of the proposed works, the maximum concentration of sediment generated would be around 10 mgL^{-1} beyond the immediate Marine Security Zone (see **Chapter 10, Water and Sediment Quality**). This concentration would decrease quickly over a short distance contributing little to the background (see **Figure 10-1**)**.** As such, any suspended sediment would not impact the key diving areas discussed in **Section 17.4.2**.

Overall, the indirect impacts on wider (non-fishing) recreational use and patterns are likely to be **minor adverse**.

Another indirect benefit of the works is the creation of the rock revetment as this would introduce an additional artificial reef structure within the Bay (see **Section 4.5.1**). This would create a **beneficial impact** through its likely colonisation by recreational fish species over time, consistent with the reintroduction of species at the artificial reefs (see **Section 17.4.2**).

Amenity

The impact assessment for the amenity of the area has considered the findings of a number of the other technical assessments.

In terms of the identified project hazards, it has been concluded that there would be a **negligible** impact on the community or users of the area as a result of the proposed works and ongoing operations at the port and berthing facility (see **Section 15.6**).

Odour has been considered and determined not to be a concern in relation to the proposed dredging (see **Section 14.6.1**).

The proposed works would result in exceedances of the construction noise guideline limits due to the need to pile and construct the rock revetment (see **Section 13.6.1**). The impacts would be short term and reversible affecting the amenity of the area for a few weeks.

No detrimental amenity impacts are expected from use of the right of way (see **Section 3.5.2**) for temporary storage and laydown area purposes. This does not represent a diversion from the existing use of the area at present. Further, there would be no actual construction activities taking place in this area other than loading and unloading.

The other consideration would be the visual impact of the proposed works.

Whilst the works would be visible from the northern shoreline of the Kurnell Peninsula and for people undertaking water-based activities in the Bay, their size and nature would mean that the works would be contained within a consistent visual envelope as created by the current port and berthing facility operations. It is therefore concluded that there would be no additional visual impact or distraction extending beyond the influence of the current operations. Following the upgrade of the facility and its continuing operation, the only visual change would be the addition of a third mooring dolphin extending from the Wharf by approximately 50 m as well as the reconfigured berthing that would allow larger ships moor in fixed berth #1 than at present. Neither of these changes would affect the context or setting of the facility in the wider environment or the visual relationships that are already established. In effect the facility's visual impact would remain unchanged at a distance, with any impacts being **negligible**. The proposed works would also not alter the seascape character or have any effect on the landscape or shorescape character of the surrounding areas. Further specific comment on the visual impact to the heritage value of the area is considered in **Chapter 12, Heritage**.

In conclusion, there would only be a **minor adverse** impact on the amenity of the area as a result of the proposed works. It is not anticipated that the proposed works would compromise the use of the area or force a change in recreational patterns.

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0 250 500 1,000 1,500 2,000 Meters

Datum: GDA94
Grid: MGA Zone 56

Source: Aerial Photography - Nearmap Hypertiles 2012.

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KURNELL PORT AND BERTHING PROJECT

NAVIGATION AND SHIPPING ACCESS RESTRICTIONS

URS

BOTANY BAY, NSW.

Figure: **17-2**

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Rev. **A** A4

17.4.4 Mitigation

Recreation

The navigational exclusions imposed on the majority of the project site (see **Section 17.5.2**) limits the requirement to include mitigation.

Ongoing consultation with sailing, diving and recreational user groups would help inform Caltex (and the works' contractors) of any activities and events that are likely to be occurring within the areas of the project site not covered by the Marine Security Zone. These would be accommodated by either timing the works to avoid an event, or more likely, relocating the event if there is a substantiated claim of a potential impact. This commitment is consistent with the approach taken with other development projects that have taken place in the Bay over recent years[7].

As the recreational value of the areas of works is limited, and there are considerable other areas of the Bay that could be used as alternatives to the project site, no residual effects are anticipated other than a very small section of the Bay being given over to accommodate the expansion of the fixed berths.

Ecological impacts and their effect on recreational fishing are discussed in **Chapter 11, Ecology**.

Amenity

Various mitigation commitments have been included in this EIS to ensure the works would not present a risk to the community (see **Chapter 15, Hazards and Risk Assessment**), result in a pollution incident (see **Chapters 10, Water and Sediment Quality** and **15, Hazards and Risk Assessment**) or lead to unacceptable construction noise (see **Chapter 13, Noise**). These commitments are considered sufficient to mitigate any amenity impacts.

To implement the above controls effectively would require Caltex to work with the community throughout the proposed works. This would include consulting with the community and those that use the Bay for recreational purposes. It would include providing project updates at the existing monthly community meeting (see **Chapter 6, Consultation**) whilst providing notification of the up and coming program of works and a broad works' schedule as per the proposal set out in **Section 6.8**. This would include the ability for the community and users of the Bay to provide feedback to Caltex through the use of a 24-hour hotline.

The provision of this hotline facility forms part of an established feedback process where comments and concerns are relayed back to the Refinery Manager, Community Relations Manager and the head of the Environmental Group, depending on the nature of the feedback. Any comments would fall under the established governance process whereby they would be logged, tracked and responded to.

[7] Molino Stewart & Energy Australia (2007)

17.5 Navigation, Port and Shipping Operations, and Traffic Movements

17.5.1 Method of Assessment

The assessment of effects on navigational and port and shipping operations has included:

- a review of navigation and shipping movements and restrictions, including major shipping numbers in and out of Botany Bay and changes over time;
- an analysis of the extent to which the proposed works and continued operations at the port and berthing facility would impact on navigation, access, delays and safety;
- an assessment of both temporary and permanent impacts on navigation and port operations; and
- the significance of any residual effects (if required).

The following significance criteria have been used to assess the impacts on navigation.

Table 17-2 Magnitude of Impact Assessment Criteria (Navigation)

Impact Rating	Criteria
Beneficial Impact	A demonstrable improvement in navigation and operations. A reduction in delays beyond existing shipping movements or a demonstrated safety improvement.
Negligible Adverse Impact	Navigation and operations remain unchanged. No delays beyond the existing shipping movements and no safety issues.
Minor Adverse Impact	Navigation compromised only in the short-term with no requirement for alternatives. An acceptable level of delay consistent with current operations in Botany Bay. Safety issues are in line with standard management practices.
Moderate Adverse Impact	Navigation affected requiring temporary use of alternatives or long-term modifications. Unacceptable shipping delays not necessarily incurring onward economic losses to Port Botany. Notable safety issue that require significant and bespoke management.
Major Adverse Impact	Navigation is wholly compromised requiring both short and long term alternatives. Shipping delays are substantial leading to consequential economic losses to Port Botany. Significant safety issue leading to pollution incident, contamination or major injury/fatality.

17.5.2 Existing Environment

Port Operations and Shipping Channels

The Botany Bay shipping channel (see **Figure 17-2**) forms the northeast perimeter of the project site. It is maintained to a depth of 17.9 m below Chart Datum (CD) and is approximately 200 m wide. It is used by a range of commercial and charter vessels to access Port Botany, along with the tanker ships that load and unload at the Kurnell Wharf. A total of approximately 1,940 ships use the channel each year[8], making it one of the busiest routes in NSW.

[8] 2010-2011 (the latest available data)

The channel is predominantly used by container ships, bulk liquid and gas carriers and oil tankers. Ships that enter Port Botany do so under the control of SPC pilots. Tug boats usually pick up the ships at Molineaux Point. Tugs also navigate the ships into and out of the Kurnell port and berthing facility.

The other major user of the shipping channel is Port Botany (maintained and operated by SPC). The Port comprises two container terminals, a bulk liquids facility and a bulk liquids storage and distribution complex. Approval has been granted to expand the facility to include a third container terminal. The site is currently under construction and due to commence operation this year. Whilst final shipping estimates are still being defined it is likely that numbers would not exceed 10 additional movements per day, equating to one or two movements per hour.

Navigation Restrictions

Navigation and access is heavily regulated in Botany Bay (see **Figure 17-2**). Commercial ships need to have a SPC pilot aboard within the main Botany Bay Shipping Channel. Each ship needs to have a dedicated course and designation. Recreational ships are also not allowed to anchor within the shipping channel.

A Marine Security Zone is enforced around the project site, which would remain in place (and would not be extended) following the proposed works. The Marine Security Zone was implemented in 2005[9].

Road Traffic Movements

The main arterial route on to the Kurnell Peninsula is Captain Cook Drive. It connects Kurnell with the wider Sydney road network including Taren Point Road. It comprises three lanes in each direction west of Gannons Road reducing to two lanes between Gannons Road and Woolooware Road and an undivided single carriageway east of Woolooware Road. At the time of writing works are taking place to upgrade the road to a dual carriageway between Woolooware Road and Elouera Road. Some 38,000 vehicles use this route each day. There are a number of major and minor roads within Kurnell that provide access to the Wharf. The likely access to both the Wharf and the laydown area in the right of way would be from Prince Charles Parade which links to Captain Cook Drive.

17.5.3 Predicted Impacts

Proposed Works

Integration with Current Shipping Operations

The proposed works would take place whilst the Caltex's port and berthing facility remains operational. As such, the shipping required to undertake the works would need to coordinate with Caltex's loading and unloading operations, which equate to approximately 10-13 tanker ship movements in and out of the berths each month.

In total, some 10 ships could be operating within the project site when the dredging and fixed berth upgrade works are taking place (see **Table 4-4**). The movement of ships related to proposed works would be managed by Caltex in accordance with its standard management shipping schedules and operations. Allowance has been made in the program to stand down operations as ships enter and leave the berths.

[9] As confirmed through discussions with NSW RMS.

Shipping Channel

The most significant potential impact would be allowing for an additional 400 or so ship movements within the Botany Bay Shipping Channel during the proposed works. These additional ships would deliver construction equipment and remove dredged materials.

With regard to shipping movements within the main channel, the majority of these would occur during the approximate 23 week dredging program. As continuous dredging is proposed, this would equate to 3 additional ships needing to use the channel each day[10]. Whilst this is a notable increase to the existing 5 daily commercial movements[11], such an increase would not compromise existing movements or cause delays. Therefore it is considered a **negligible adverse** impact. Priority would be given to commercial ship movements, with delays being absorbed by Caltex's program.

As no works are required to take place within the main shipping channel or its interface with the project site, there is no potential for obstruction. This is further supported by there being no requirement to temporarily moor or anchor in these areas whilst the works are taking place.

Overall there would be no anticipated danger or obstruction to navigational safety or a significant risk of a marine accident occurring as a result of the proposed works.

Ongoing Operations

One key objective of the proposed works is to optimise shipping economics. The proposed works would provide operational flexibility to Caltex. Whilst there would be no change to the maximum size of ship that would access the facility overall, the upgrade of fixed berth #1 would allow larger ships to berth alongside the Wharf than can do so at present, whilst allowing smaller ships to use the sub berth. This would facilitate safer unloading during heavy seas. Conversely, smaller capacity ships could use the sub berth than those that do so at present.

This flexibility would reduce overall shipping numbers in the short term and mitigate the number of shipping movements required to meet future anticipated growth in demand for petroleum products in NSW and the ACT (see **Section 2.2**). Consequently it is anticipated that following the works there would be a likely reduction in shipping numbers (see **Chapter 4, Proposed Works Description**). This would reduce demand on the use of the shipping channel, and is therefore considered a **beneficial impact** of the proposed works. As noted above, this reduction in shipping pressure in the Bay is also likely to bring a secondary benefit to recreational users in the area.

The proposed works and ongoing operation of the port and berthing facility would ensure there is no impact on navigational safety or commercial shipping operations. This requires the approval of the Harbour Master (in this case SPC) prior to starting works. Harbour Master approval is being sought in parallel with the DA.

Road Traffic Movements

In total 60-100 truck movements would be required to support the works on an ad hoc basis. Deliveries would result in a single truck movement arriving at the Wharf laydown area each day. The impact would therefore be negligible. Also, the construction workforce movements would generate a low volume of

[10] This assumes dredging per week over a 20-23 week period (allowing for maintenance and refuelling), therefore between 120-138 days. At 400 ships this is approximately 3 ships per day.
[11] This assumes 1940 ships per year, which is approximately 10 ships per day.

traffic (see **Section 4.6.2**) that would arrive and leave site at set periods over the course of the day (due to rotational shift working). Therefore it can be concluded that the associated impacts would be **negligible**.

Of greater consequence would be the requirement for 100 trucks to access the Wharf when the concrete pouring works would take place (see **Section 4.6.2**). Concrete pouring activities would occur over nine days, within a 6-8 week period. The amount of concrete required for each 'pour' would vary. On the majority of the days 8-9 trucks would be required for each pour, however the largest pour could see 25 trucks arriving at site on one day. The impacts would be short term only and would affect movements on the peninsula for 9 days out of the construction program. Over these nine days, these truck movements may result in highly localised delays along Prince Charles Parade as the trucks await access to the Wharf. In the event of any delay, trucks would park in the laydown area or at the Refinery to minimise the disturbance to local traffic.

No operational changes to traffic movements are expected as a result of the proposed works.

17.5.4 Mitigation

Caltex is currently working with NSW RMS and SPC to discuss management and interfacing requirements with shipping and the port operations. Standard controls required for any shipping activities would be implemented consistent with current practices (i.e. shipping movements would need to be notified to SPC harbour control). Caltex is proposing the following actions to ensure the works would have no impact on commercial and recreational shipping.

- Commercial Shipping
  - Caltex's Shipping and Planning Procedure would be revised to accommodate the works, including dredging. A *Port Operating Procedure* (POP) would be developed by the selected works' contractor in conjunction with SPC and RMS prior to commencing the dredging works. The POP would be prepared in accordance with the required regulations. This would be supported by a *Marine Works Management Plan* (MWMP).
  - The MWMP would include appropriate safety controls that accord with the requirements of the Harbour Master and the SPC's Port Procedures Guide to ensure the safety of waterway traffic during the proposed works.
  - In order to minimise shipping delays, Caltex would liaise with the Harbour Master throughout the proposed works to communicate its intended shipping movements. This would involve Caltex and the works' contractor communicating proposed shipping movements, timings and pilotage, whilst providing their shipping schedules to other mariners in the area.
- Recreational and Other Shipping
  - For shipping not using the main shipping channel, it would be proposed that a temporary exclusion zone be created when working outside of the Marine Security Zone (principally including the dredge vessel, the hoppers when placing sediments over the exposed pipeline, and anchor point and when working on the moorings and lines outside of the sub berth). The exclusion zone would be managed in consultation with NSW RMS, SPC and the NSW Water Police.
  - The temporary exclusion zone would also apply to other users. As part of the consultation process, these zones would be communicated via the methods discussed in **Section 6.8**.

- Traffic

  In order to mitigate and manage vehicles on the 9 days when the concrete pours would be taking place a traffic management plan would be put in place. The plan would include:

  – designated routes for the trucks to access the Wharf through the village of Kurnell;

  – a community consultation plan (consistent with the provisions in Chapter 6) to ensure residents principally along Prince Charles Parade (but also in Kurnell) would be informed of the days on which concrete pouring would take place;

  – designated areas where the concrete pouring trucks would park up in the event of a delay;

  – provisioning for temporary traffic management controls during the concrete pouring days; and

  – procedures and/or principles to ensure the concrete pouring tucks adhered to speed limits.

17.6 Mitigation

Table 17-3 outlines the mitigation and management measures that would be put in place to safeguard the commercial and recreational shipping, navigation, the community and other users of Botany Bay, Silver Beach and the coastal and foreshore areas.

Table 17-3 Amenity, Land Use, Recreation and Navigation Mitigation and Management Measures

Mitigation and Management Measures	Implementation		
	Design	Implementation	Operation
Caltex would continue to communicate to the public throughout the works via existing channels. Communications would include project updates, the program of works and any atypical disruption or changes not anticipated in this EIS.	✓	✓	
A *Port Operating Procedure* (POP) and *Marine Works Management Plan* (MWMP) would be implemented in consultation with SPC and NSW RMS to accommodate the works, ship movements and safety requirements.	✓	✓	✓
Caltex would use the current methods of communication with the Harbour Master to manage the additional ship movements within the Botany Bay Shipping Channel during the proposed works. Shipping schedules would be forwarded and agreed in advance.		✓	
Temporary exclusion zones would be created around the works taking place outside the Marine Security Zone (principally including the dredging vessel), the hoppers (when placing sediments over the exposed pipeline and anchor point), and when working on the mooring lines outside of the sub berth.		✓	

Mitigation and Management Measures	Implementation		
	Design	Implementation	Operation
A Traffic Management Plan (TMP) would be developed and implemented for the concrete pouring works. The TMP would comply with all relevant regulations and bylaws and in particular address safe access and egress to Prince Charles Parade when arriving and leaving the wharf and/or laydown area. The plan would include: • hours of permitted vehicle activity; • designated routes for the trucks to access the Wharf through the village of Kurnell; • a community consultation plan (consistent with the provisions in Chapter 6) to ensure residents principally along Prince Charles Parade (but also in Kurnell) would be informed of the days on which concrete pouring would take place; • designated areas where the concrete pouring trucks would park up in the event of a delay; • provisioning for temporary traffic management controls during the concrete pouring days; and • procedures and/or principles to ensure the concrete pouring tucks adhered to speed limits.		✓	
Ongoing consultation with sailing, diving and recreational user groups identified in this EIS would help inform Caltex (and the works' contractors) of any activities and events that are likely to be occurring within the area during the works. These would be accommodated by either timing the works to avoid an event or more likely relocating the event if there was a substantiated claim of an impact.	✓	✓	

18 Cumulative Effects

18.1 Introduction

This chapter considers potential interactions and cumulative effects. The chapter has considered the cumulative effects generated by the proposed works alone and the cumulative effects that could potentially be generated in combination with other likely future approved and committed development.

18.2 Scope of Assessment

The Director General's Requirements (DGRs) (see **Technical Appendix A**) request that '*an identification be made of how relevant planning, land use and development matters have been considered in the impact assessment* [with regard to] *direct, indirect and cumulative impacts'*.

In addition, both the NSW Department of Primary Industry (DPI) (Fisheries) and NSW DPI (Office of Water) (NOW) have requested that cumulative impacts be considered as part of the assessment.

Additionally, the NSW Environmental Protection Authority (EPA) has specified in its request that this EIS "*describe mitigation and management options that will be used to prevent, control, abate or mitigate identified environmental impacts (including any cumulative impacts) associated with the project…*' and that the EIS should … *"consider the potential for any cumulative impacts to occur as a result of the proposed dredging activities*". NSW EPA has also requested cumulative noise and vibration impacts be considered, taking into account the works being undertaken at both the Kurnell Refinery and Banksmeadow Terminal under the Jet Fuel Pipeline Upgrade Project.

18.3 Legislation and Planning Policy

Environmental Planning and Assessment Act 1979

Under Part 5 of the EP&A Act there is an explicit duty for a determining authority to consider the environmental impacts of proposed works. The supporting *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) states that '*for the purpose of the [EP&A] Act, the factors to be taken in to account when consideration is being given to the likely impact of an activity on the environment includes…any cumulative environmental effect with other existing or likely future activities*'.

There is no provision in Part 4 of the EP&A Act explicitly requiring consideration of the cumulative environmental effect in determining a development application. However, when determining a development application, the consent authority is required, under section 79C(1)(b) of the EP&A Act, to take into account the '*likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality*'.

There are is also case law[1] where the consideration of cumulative impact assessment has been successfully contested under the EP&A Act.

[1] Environmental Law News, Spring 2009

18.4 Method of Assessment

18.4.1 Introduction

Cumulative effect assessment (CEA) is a receptor based assessment, whereby in order to have a cumulative effect two projects or impacts (cumulative impacts) need to affect the same receptor. CEA focusses on impacts that have not been fully managed or mitigated (i.e. residual impacts).

Cumulative effects can be formed antagonistically[2], synergistically[3] or additively[4]. They are often caused by an action in combination with other past, present, and reasonably foreseeable future human actions[5].

Where two (or more) residual impacts from a single project combine this is termed an 'in isolation' cumulative impact. Where two (or more) residual impacts combine from multiple projects this is termed an 'in combination' cumulative impact. The result of a cumulative impact could lead to a potential cumulative effect (change in the environment). This effect could influence one or multiple receptors.

Another consideration is where residual impacts can change the effectiveness of the mitigation and management measures of a project.

For these reasons, in order for the proposed works to have the potential to generate an adverse cumulative effect, it must:

- have an adverse residual effect; and/or
- result in another project's mitigation measures being less effective.

18.4.2 Approach

The first stage of CEA is to understand the adverse residual impacts of the proposed works. The second stage is to identify any other development nearby that may affect the same receptors as the proposed works and/or change the effectiveness of each other's mitigation and management measures.

Other relevant projects that may generate a cumulative impact with the proposed works have been identified using the following assessment parameters.

- *Spatial parameter*. The spatial parameter will depend on the characteristics of the environmental impact and the likely area over which any residual impact would occur. For example, an air quality impact would potentially affect a wider area than a noise impact and would therefore affect different human or environmental receptors.
- *Temporal parameter*. The temporal parameter relates to how far into the future or the past the assessment considers cumulative proposals or activities. Projects that are operational have already been considered as they form part of the existing environmental baseline for each environmental aspect assessed in this EIS (see **Chapters 8-17**). Projects that are either at an early feasibility stage or have been issued with DGRs (referred to as committed development), but are not yet on exhibition, have also been discounted from this assessment due to a lack of certainty about whether

[2] Opposing each other potentially resulting in a lower overall environmental effect.
[3] Where two or more impacts produce a total impact greater than the sum of the individual parts. For example oxides of nitrogen and volatile organic compounds each have impacts on human health, but when they combine they form ozone, their combine d impact is potentially greater and of more concern to human health.
[4] For example two sources of noise can combine to create a greater overall impact.
[5] Defined by the European Commission 1999

they will go ahead and a lack of precise detail about their environmental impacts. Their inclusion in the CEA would jeopardise its robustness. This CEA has therefore considered proposals and development applications that are on exhibition, development applications that have completed exhibition but are not yet determined, and applications that have gained development consent but are not yet (fully) operational.

In order to identify relevant development, two databases have been reviewed in December 2012:

- the Major Project Assessments register on the NSW Department of Planning and Infrastructure (DP&I) website; and
- public notices and the 'invitations to comment' register on the Commonwealth Department of Sustainability, Environment, Water, Population and Communities' (SEWPAC) website.

This review is an effective way of identifying future projects that are likely to have residual impacts (significant or otherwise), and would therefore be likely to generate a cumulative effect in combination with the proposed works.

Projects identified through the consultation processes have also been included as part of this assessment.

18.4.3 Guidance and Standards

There is no guidance on undertaking interactive or cumulative impact/effect assessment in NSW or Australia. Therefore, this assessment has made reference to the European Commission (EC) *Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions 1999* and the Canadian Environmental Assessment Agency *Cumulative Effects Assessment Practitioner's Guide 1999*.

18.4.4 Evaluation of Magnitude of Impact

The criteria adopted in each of the technical assessments (see **Chapters 7-18**) have been used to assess the significance of any cumulative impact.

18.5 Cumulative Impact Assessment

18.5.1 In Isolation Cumulative Impacts

The receptors affected by one or more residual impacts resulting from the proposed works include:

- the resources and users of Silver Beach;
- Pearl Oyster Farm (100 m south of the limit of the fixed berths);
- the resources, users and values of Kamay Botany Bay National Park;
- the waters of the Bay (and their associated heritage, recreational and ecological values);
- the residents of Kurnell;
- the existing Kurnell port and berthing facility (as a heritage-listed item); and
- the Botany Bay Shipping Channel.

The proposed works have the potential to cause a number of environmental impacts (some of which are residual impacts). These have been grouped, assessed and discussed under ten environmental aspects (see **Chapters 8-17**). For the majority of these aspects, providing the proposed mitigation and management measures (and design controls) are put in place (see **Chapter 19, Mitigation and Management Measures**), and remain effective, there would be no likely residual impact. This is true for the following aspects:

- hydrodynamics and coastal process (see **Chapter 8**);
- spoil and contamination (see **Chapter 9**);
- air quality and odour (see **Chapter 14**);
- hazards and risk assessment (see **Chapter 15**); and
- wastes and resources (see **Chapter 16**).

For the following aspects, the proposed works may generate an 'in isolation' cumulative impact (with two impacts affecting a single receptor). These aspects also have the potential to generate an 'in combination' cumulative impact with another project (see **Section 18.5**). For the reasons discussed in **Section 20.3**, none of these residual impacts are considered significant.

Water and Sediment Quality

In order to achieve the objectives of the proposed works, sediment contaminated with tributyltin (TBT) would need to be removed from the project site, and in the process, disturbed. Whilst favourable dredging methods and controls on the use of overflow dredging operations would be implemented to limit the extent of disturbance and dispersion, there would be a residual concentration of TBT (either sediment-bound or dissolved in the water column) that would affect the project site and its immediate environs (see **Chapter 10, Water and Sediment Quality**). This would likely result in highly localised exceedances of the protection limits set by the *Water Quality Guidelines for Fresh and Marine Waters 2000.* This is due to the existing sediment already being notably contaminated (see **Chapter 9, Spoil and Contamination**).

The dredging would also generate a suspension of sediments within the project site (immediately around the dredging works) that would exceed the threshold turbidity limits set under the above Guidelines. These exceedances would be localised to an area where there are no sensitive receptors.

Providing the proposed mitigation and management measures and design controls remain effective; neither the suspension of sediments, the deposition of sediment-bound TBT, nor the dispersion of dissolved TBT in the marine waters would occur at concentrations that would exceed the threshold limits beyond the above spatial parameters. Nonetheless, as there would be some adverse residual impact within the project site and its immediate environs there would be a potential for cumulative impacts to occur in combination with other developments.

Ecology

The proposed works would result in the direct removal of sub-tidal habitat and the loss of biota within the project site (see **Chapter 11, Ecology**). However, these losses do not include significant areas of seagrass, macroalgae, reef or intertidal habitat nor include any threatened biota. Also, these losses do not represent critical habitat for threatened and important biota.

The lost habitat represents a negligible area in the context of the total available un-vegetated soft sediments that exist within the Bay. The wider soft sediment habitat within the Bay would provide suitable alternatives for any foraging species displaced during the works. Recolonisation of the project area is expected to rapidly occur after the works are completed.

Similarly, the residual adverse impacts on areas outside of the project site (principally to the south) are expected to be negligible due to restricting the use of overflow dredging in the fixed berths, the separation distance between the proposed overflow dredging operations and these receptors, and the range of additional water and sediment quality measures that would be put in place to mitigate and manage any potential impacts (principally on the seagrass beds and aquaculture site found in this area) (see **Chapter 10, Water and Sediment Quality**).

As the proposed works are not predicted to have any adverse ecological residual impacts, no cumulative impacts with other developments are anticipated given the location, extent and duration of the proposed works and the wider habitat resource available in Botany Bay for what are widely found biota.

Heritage

The only residual impact occurring as a result of the proposed works would be the loss of part of the fabric that makes up the Wharf structure given its local listing as a heritage item (see **Chapter 12, Heritage**). The proposed preservation by (photographic) record constitutes an appropriate method of mitigation consistent with the requirements of the *Heritage Act 1977*. Despite this being an adverse residual impact, it would be mitigated in accordance with standard and recognised practice to ensure its effects were not significant. Therefore, no cumulative impacts with other developments are anticipated.

There remains a residual potential for maritime heritage to be discovered during the works due to the limited dredging and disturbance that has taken place in the western part of the turning circle and approaches. This would be managed during the works against principles that are consistent with the requirements of the *Heritage Act 1977*. This is unlikely to result in any residual impact providing the mitigation and management measures are successfully implemented. Therefore, no cumulative impacts with other developments are anticipated.

Noise

The noise environment surrounding the project site is as descried in **Chapter 13, Noise**. The noise assessment has already considered eight working scenarios to account for occasions when the various components that make up the proposed works would coincide. This assessment has therefore considered the potential for ‘in isolation’ cumulative impacts.

As a result of certain proposed activities either being undertaken on their own or in combination with other activities, the works could result in a short-term exceedance of the *Interim Construction Noise Guidance (ICNG) 2009* due to the need to undertake piling works and the need to install the rock revetment. The piling works would take place for 15 weeks and the rock revetment works 4 weeks. The works would be intermittent during this period allowing for shipping deliveries and moving equipment in to place, and periods of bad weather. Such a residual impact has the potential to cause a cumulative effect with other developments projects and actions.

The proposed works would also generate underwater noise at levels that would likely result in some degree of avoidance behaviour from a range of marine mammals that have the potential to pass through the project site while dredging, piling and/or rock revetment works are taking place. The implementation of various measures would be used to limit the impacts. However, there is considered some residual short-term impact (as the underwater noise would still be generated). This has a minor potential to give rise to a cumulative impact if other developments are also affecting these receptors.

Amenity, Land Use, Recreation and Navigation

The proposed expansion of fixed berth #1 would see the loss of a very small area of Botany Bay. This area is not used for any particular purpose and does not contain (or support) any sensitive receptors. As such, it is not considered to generate an adverse residual impact and would not result in the potential for a cumulative impact.

There would be an effective reduction in shipping movements in the Botany Bay Shipping Channel as a result of the proposed works leading to a reduced number of shipments to the Kurnell port and berthing facility once upgraded. This would be a positive residual impact of the proposed works and therefore has no potential to result in an adverse cumulative impact with other developments.

Conclusions

A number of environmental aspects have been assessed as part of this EIS. These assessments have all concluded that the proposed works are unlikely to result in any significant residual impacts (see **Section 20.3**). However, there would be adverse residual water, sediment quality and noise impacts that could give rise to potential cumulative impacts in combination with other development.

In addition, certain of the noise impacts would be formed as the result of several activities combining. The promoted measures discussed in **Chapter 13, Noise** would be put in place to mitigate and manage any impact thereby removing the potential for any of these to be significant.

18.5.2 In Combination Cumulative Impacts

Approved and Committed Development

The following section considers approved and committed developments that are not yet fully operational that could therefore give rise to potential cumulative impacts in combination with the proposed works.

Based on the above section this assessment has considered:

- marine-based development affecting the southern part of Botany Bay denoted by the area on **Figure 10-3**; and
- marine or land-based development affecting the same noise sensitive receptors shown on **Figure 13-1,** or with the potential to affect marine fauna within 420 m of the proposed piling and dredging activities (see **Section 13.6.3**).

Table 18-1 identifies projects that meet the requirements.

Table 18-1 Approved and Committed Development

Project Name	Reference No.	Location	Proposed Works	Approximate Commissioning Date	Status
Marine-Based Works					
Botany Bay Cable Crossing and modifications	MP 06_0284 Mod 3	Bunnerong Rd, Matraville to, Captain Cook Drive, Kurnell	Ausgrid propose to construct five rock mounds over a 50 metre section of the cable that cannot be buried to the required depth below the sea floor.	Modification 3: Committed Development (DGRs Issued) Cables have been laid. Remaining work at Kurnell substation to be completed in 2015.	Modification 3: 12/08/ 2011
Port Botany Expansion and Modifications 7 - 12 Proposed changes to the initial approved Project	08-03-2009, 494-11-2003-i MOD 8, 494-11-2003-i MOD 9, DA-494-11-2003-i MOD 10, DA-494-11-2003-i MOD 11, DA-494-11-2003-i MOD 12	Port Botany	Proposed modifications to existing project including additional dredging, changes to first flush stormwater management system and changes to maintenance buildings.	Approved Development. Construction on the remaining 18ha “knuckle area” is expected to begin at the end of 2012/early 2013 following the construction tender process.	Mod 7: 20/03/2009 Mod 8: 30/05/2009 Mod 9: 18/06/2009 Mod 10: 13/07/2009 Mod 11: 21/11/2011 Mod 12: 06/06/2012 Mod 13: 16/11/2012
Land-Based Works					
*Concept Plan - Mixed Use Development, Cronulla Sharks	10_0229	461 Captain Cook Drive , Woolooware	Concept Plan application seeking approval for a mixed use development.	Approved Development.	27/08/2012
*Stage 1 - Retail Development, Cronulla Sharks	10_0230	461 Captain Cook Drive , Woolooware	Construction of a Neighbourhood Retail Centre and redevelopment of the existing Sharks Leagues Club facilities.	Committed Development (DGRs Issued)	25/03/2011
Kurnell Refinery Conversion	SSD 12_5544	2 Solander Street , Kurnell	Converting Kurnell Refinery to a finished fuel terminal facility.	Committed Development (DGRs Issued)	14/09/2012
Jet Fuel Pipeline Upgrade Project	MP 11_0004	2 Solander Street , Kurnell	Upgrade to the Jet Fuel Line.	Completed and Fully Operational	05/09/2011

Conclusions

None of the above approved developments share the same spatial or temporal parameters as the proposed works.

- The mixed use development next to the Cronulla Sharks ground is a land based development 6 km to the west of the project site and therefore does not share any of the same spatial parameters as the proposed works.
- The Port Botany expansion is near completion, with any residual effects being considered as part of the existing environment for this EIS and the remaining proposed works not affecting the spatial parameters of the proposed works.
- The approved Jet Fuel Pipeline Upgrade Project upgrade is fully completed and operational and therefore does not share any of the temporal parameters as the proposed works.

The cable crossing works, the retail development at Cronulla and the Refinery conversion are only committed developments at this stage. Therefore there is a lack of certainty about whether they will go ahead and a lack of precise detail about their likely environmental impacts. The works associated with the Refinery conversion and cable crossing modifications have the potential to generate noise affecting the same spatial and temporal parameters as the proposed works. However, the potential for any cumulative effects with the proposed works could only be reliably confirmed once the relevant environmental assessments were completed.

For the above reasons, as there are no approved developments that share any of the spatial or temporal parameters as the proposed works there would be no predicted ‘in combination’ cumulative impacts or associated effects should the works proceed.

19 Mitigation and Management Measures

19.1 Introduction

The preceding chapters of this EIS describe the potential impacts of the proposed works and identify a range of measures to manage risk, and avoid, mitigate or offset impacts. This chapter provides a summary of those proposed mitigation and management measures. These measures would provide a basis for the conditions of consent that would be issued to Caltex should the proposed works be approved.

This chapter details how these mitigation and management measures would be implemented and monitored through a Construction Environmental Management Plan (CEMP) that would be prepared and implemented for the proposed works. An additional specific Dredging and Spoil Disposal Management Plan (DSDMP) would be prepared and implemented to guide the loading, transport and disposal components of the dredging works. Any operational measures included in these plans would be incorporated into existing management plans and operating procedures currently in place at the port and berthing facility (as discussed in **Chapter 4, Proposed Works Description** and **Chapter 15, Hazards and Risk Assessment**).

19.2 Draft Mitigation and Management Measures

The adoption of the mitigation and management measures discussed in **Chapters 8-17** is an important component of the proposed works and reinforces Caltex's commitment to controlling its impact on the environment. The mitigation measures would be complemented by an ongoing process of community and regulatory engagement, before and during the timeframe covered by the proposed works. The details of the proposed engagement process are set out in **Chapter 6, Consultation**.

Table 19-1 presents the proposed mitigation and management measures, and confirms the proposed timeframe for their implementation. If required, these measures may be modified following review of any formal submissions received during the Project EIS exhibition, and as a result of subsequent discussions with NSW Department of Planning and Infrastructure (DP&I) and other stakeholders.

Table 19-1 Mitigation and Management Measures

Item	Mitigation and Management Measures	Implementation of mitigation measures		
		Design	Implementation	Operation
General				
A1	Caltex would carry out the proposed works in accordance with the EIS and the approval conditions.	✓	✓	✓
A2	Caltex would implement reasonable and practicable measures to avoid, or minimise impacts to the environment that may arise as a result of the proposed works.	✓	✓	✓
A3	Caltex would ensure that the works' contractor prepares and implements a *Construction Environmental Management Plan* (CEMP) and a *Dredging and Spoil Disposal Management Plan* (DSDMP) to manage the proposed works. This would be reviewed and approved by a Caltex Environmental Management Representative (EMR).		✓	

Item	Mitigation and Management Measures	Implementation of mitigation measures		
		Design	Implementation	Operation
A4	Caltex would appoint an EMR to monitor the implementation of all required environmental mitigation and management measures. The EMR would ensure that all measures were being effectively applied during the proposed works and that the work would be carried out in accordance with the CEMP, DSDMP, all environmental approvals and legislative conditions.		✓	
A5	Caltex and the various works' contractor personnel would undergo training in accordance with the CEMP, DSDMP and currently implemented environmental and safety measures agreed as part of the proposed works' approval.		✓	
A6	This requirement would also ensure that excess materials are cleared from the decks before the dredger is moved, adequate freeboard is maintained to ensure the decks are not washed by wave action, and that any excess dredged sediments not cleanly loaded in to the hoppers are removed and actively washed into the hopper.		✓	
A7	During an accident or emergency situation, such as a pipe break or rupture, spillage or unplanned overflow dredging, operations would cease immediately, with the requirement for the works' contractors to undertake any required repairs, modify their working methods and report the incident under the terms of the current environmental protection licence (EPL) (see Chapter 5, Legislation and Planning Policy Context).		✓	
Hydrodynamics and Coastal Processes				
B1	Overflow dredging would not be permitted within the fixed berths during the dredging works.		✓	
B2	The detailed design would include measures to minimise the potential for localised erosion or scour around the berths and Wharf structure. The design would be in accordance with the AS4997: Guidelines for the Design of Maritime Structures.	✓		
Spoil and Contamination				
C1	The DSDMP would contain controls and measures to ensure that no overflow dredging operations were to take place at the contaminated area in the approach to the sub berth and in the fixed berths. Further restrictions on spill rate could be introduced, or in extreme cases, overflow dredging would be halted temporarily in favour of removing excess water offshore to further limit sediment dispersion. The DSDMP would also include measures to ensure the sediments would be lifted and loaded so as to prevent any excessive disturbance and agitation, whilst preventing excessive spillage. This would include a need for the following measures. • The dredger would make use of a closed bucket to minimise sediment spill when lifting the backhoe through the water column and when undertaking slewing. • Accurate positioning systems (e.g. GPS) would be used on the dredgers to ensure direct impacts are restricted to the approved dredging area and to ensure the over-dredging limit is minimised.	✓	✓	

Item	Mitigation and Management Measures	Implementation of mitigation measures		
		Design	Implementation	Operation
	• Hopper doors would be kept in good condition to minimise loss of sediment during transport. • Dredging activities would be restricted to locations shown on the dredging plan(s). Dredging activities would be conducted using equipment that is regularly serviced and registered, and which complies with the conditions of relevant approvals.			
C2	A remediation action plan (RAP) would be prepared and submitted with the DA. The RAP would contain information relating to the control and removal of dredged sediments to address the requirement of SEPP Nº55: Remediation of Land. The RAP would be consistent with the information that would be included in the Sea Dumping Permit (SDP) application to managing the loading, transport and disposal of the sediment along with information in the CEMP and DSDMP to manage the removal of the dredged sediments.	✓	✓	
C3	With regard to the management of acid sulphate soils, the dredged sediments would be monitored during transit to ensure they would not dry out (particularly during the summer months or when there was any delay in moving the hopper offshore). Spraying the sediments with sea water would be undertaken if there was evidence of drying. These measures would be included in the CEMP and DSDMP specifications.		✓	
Water and Sediment Quality				
D1	A *Sediment and Water Quality Monitoring Program* (SWQMP) would be developed and implemented prior to, and during, the proposed dredging works. This would form part of the DSDMP.		✓	
D2	The SWQMP would include that turbidity monitoring be undertaken for the duration of the dredging works. This would be undertaken at the limit of the project site, within the aquaculture site and at a number of locations within the limit of the seagrass beds. The sampling would include: • obtaining background concentrations during dry weather conditions prior to dredging to confirm the limit of 5 mgL^{-1} as being representative of the baseline; and • live monitoring during the dredging works to ensure limits of 50 mgL^{-1} were achieved at the outer limit of the project site and 10 mgL^{-1} at the aquaculture lease site and seagrass bed locations.		✓	
D3	The SWQMP would include a monitoring program for pH and dissolved oxygen at the limit of the project site, to be undertaken for the duration of the dredging works. These parameters would be compared against the limits set by the *Water Quality Guidelines for Fresh and Marine Waters 2000*. The sampling would include: • obtaining background concentrations prior to dredging; and • live monitoring during the dredging works to ensure the above limits were achieved.		✓	

Item	Mitigation and Management Measures	Implementation of mitigation measures		
		Design	Implementation	Operation
D4	Should any of the monitored parameters persistently exceed the threshold limits within the *Water Quality Guidelines for Fresh and Marine Waters 2000,* works would temporarily stop and either the spill rate would be reduced, or in extreme cases (i.e. where more than three exceedances were detected in a 24-hour period), overflow dredging would be halted temporarily in favour of removing excess water to the Sydney Offshore Spoil Ground.		✓	
D5	A licence would be obtained under Section 120 of the POEO Act prior to commencing the works.	✓		
D6	Further structural investigations would be conducted during the detailed design phase of the project to confirm the design specifications of the Wharf, whilst highlighting the need for any additional strengthening and stability requirements.	✓		
D7	A *Spill Control Plan* (SCP) would form part of the DSDMP and CEMP. It would include controls currently in place at the port and berthing facility to manage spill risks. The SCP would include: • the requirement for staff to understand the limitations, controls, and methods to manage and prevent spills; • the protocol for reporting spills and the consequential actions to cease works immediately; • the need for regular inspections by the works' contractor to ensure the adoption of the relevant spill-management controls; • the need to plan for regular equipment maintenance; and • the requirement for spill containment provisions to be available to support the proposed works.		✓	
Ecology				
E1	To minimise the direct removal of habitat: • all project operations personnel would be fully trained in the use of the equipment and would undergo training in accordance with the CEMP, DSDMP and environmental measures agreed as part of the proposed works' approval; • dredging activities would be restricted to locations shown on the dredging plan(s); and • an accurate positioning system (GPS) would be used on the dredger to ensure direct impacts would be restricted to the approved dredging area and to minimise over-dredging.		✓	

Item	Mitigation and Management Measures	Implementation of mitigation measures		
		Design	Implementation	Operation
E2	To minimise the creation of sediment plumes and the risk of contamination: • a Sediment and Water Quality Monitoring Program (SWQMP) being developed as part of the DSDMP and implemented prior to, and during, the proposed dredging works; • as part of the SWQMP, turbidity monitoring would be undertaken for the duration of the dredging works, with monitoring of background concentrations and live monitoring to ensure suspended sediment limits are not exceeded during the works; • the SWQMP would be used to guide any requirement for adaptive management of measures during the project, including the cessation of overflow dredging if required; • the DSDMP would contain controls and measure to ensure that no overflow dredging operations take place at the contaminated areas in the approach to the sub berth and in the fixed berths; • further controls on the spill rate would be introduced if required, or in extreme cases overflow dredging would be halted temporarily in favour of removing excess water to the Sydney Offshore Spoil Ground; • a remediation action plan (RAP) would be prepared and approved ahead of undertaking the proposed dredging works; and • the CEMP and DSDMP would contain measure for the management of ASS.		✓	
E3	To minimise the risk of ship strike: • all project operations personnel would be fully trained in the use of the equipment and would undergo training in accordance with the CEMP, DSDMP and environmental measures agreed as part of the proposed works' approval; • observations for marine turtles, Dugong and cetaceans would be undertaken during the dredging, piling and rock revetment works and, where marine fauna approach within the precautionary exclusion zones designated in the DSDMP, dredging operations would temporarily cease until the animal has left the exclusion zone; and • ship speeds would be restricted to not more than 4 knots within the project site.		✓	
E4	To minimise the risk of light impact: • lighting on ships and dredging equipment would be minimised to that required for safe operations and to meet regulatory navigational safety requirements; • the only operations continuing through the hours of darkness would be dredging activities, with no additional shore-side lighting associated with the proposed works; and • the proposed works would be designed to prevent excess light spill outside areas not required to be lit.	✓	✓	

Item	Mitigation and Management Measures	Implementation of mitigation measures		
		Design	Implementation	Operation
E5	To minimise the risk of marine pest species being introduced: • regular inspections of the active working areas and of equipment during maintenance for the presence of *C. taxifolia* and treatment of any *C. taxifolia* in accordance with the NSW *Control Plan for the Noxious Marine Alga Caulerpa taxifolia 2009*; • regular inspections by the Department of Agriculture, Fisheries and Forestry (DAFF) at the port and berthing facility; • any dredge equipment sources from outside the region would be subject to hull cleaning and/or inspection for marine pests prior to the commencement of works; and • adherence to DAFF requirements for the transfer of ballast water, with no 'high risk' ballast water or sediments from ballast tanks being discharged in to Botany Bay.		✓	
E6	To minimise the risk and impact of marine oil spills: • biodegradable oil would be used within the pile rig; • all fuel and hydraulic oils would be stored in secure, bunded areas and precautions would be taken during any refuelling or oil transfer operations to avoid oil entering the marine environment; • prestart checks would be undertaken prior to commencing piling works; • all ships used for the proposed works would hold current certifications in accordance with their class and function; • all ships and hydraulic equipment would be maintained in good condition with regular servicing and maintenance scheduled as part of the works; • all ship crew would be fully qualified and trained for their respective roles; • all ships would be operated in full accordance with international, Commonwealth and State navigational safety and environmental protection standards and regulations; • all ships would have an on-board Ship-Oil Pollution Emergency Plan (SOPEP) or equivalent applicable to their class; • oil spill response equipment would be located at the Wharf, and trained oil spill response personnel would be available at all times throughout the works; • spill kits would be held on board barges, dredges and workboats; and • all ships would not exceed a speed of 4 knots within the project site.		✓	

Item	Mitigation and Management Measures	Implementation of mitigation measures		
		Design	Implementation	Operation
Heritage				
F1	A photographic record of the existing fabric and operation of Kurnell Wharf would be prepared prior to the proposed works. This would focus in particular on the existing infrastructure at fixed berth #1. This record would become part of the history of the place and would be maintained for the appreciation of present and future generations.	✓		
F2	A management control would be included in the DSDMP and the CEMP for the works' contractor to monitor for heritage items or relics during dredging. If relics were to be discovered in the dredging areas, the works would immediately cease at that location and the relics would be reported to NSW Heritage Council (in accordance with Section 146 of the *Heritage Act 1977*). Further assessment by a maritime archaeologist and development of an appropriate management strategy may also be required at this point.		✓	
Noise				
G1	The works' contractor would be required to validate the SPL of its piling, rock revetment and dredging operations.		✓	
G2	Specifically for the piling and rock revetment there would be a requirement for the works' contractor to achieve the following limits. • Calculated 15-minute sound power levels $L_{w,eq,15min}$ ≤ 113 dB(A) at source. • Measured 15-minute sound pressure levels $L_{p,eq,15min}$ ≤ 85 dB(A) measured at 10 m from the source in-situ or in a similar location where the works are to be carried out. The above measurements would need to be carried out by a qualified acoustics consultant, (i.e. a member of the Australian Acoustical Society (AAS) or the Association of Australian Acoustical Consultants (AAAC)), and they must be undertaken in accordance with relevant Australian Standards for acoustic measurement of equipment in the field		✓	
G3	If the piling is shown to exceed the above limits, additional mitigation would be required for these activities. For the piling this may include physical measures (such as the use of wooden damping blocks or screening), whilst periodic breaks in undertaking the piling could reasonably reduce the noise to below the Noise Criteria Management Level along Prince Charles Parade.		✓	

Item	Mitigation and Management Measures	Implementation of mitigation measures		
		Design	Implementation	Operation
G4	Specific noise management measures for the rock revetment works would be included as part of a Construction Environmental Management Plan (CEMP) for the proposed works. The plan would: • be prepared in consultation with NSW EPA by a suitably qualified and experienced acoustic consultant; • identify the nature, location and duration of the rock revetment works (including scheduled commencement of construction); • identify the location of the potentially affected receptors; • include a noise monitoring program that can be used to demonstrate the exceedances are limited to 3 dB(A); and • detail what management and/or contingency actions would be taken if noise emissions were found to be approaching or exceeding 3 dB(A). Caltex would specifically consult with the residents of Prince Charles Parade and other local community groups ahead of starting the rock revetment works. The consultation would be managed through the measures set out below.	✓	✓	
G5	When works were to take place outside of standard working hours defined by the ICNG, there would be a requirement to undertake monthly-attended monitoring to verify noise levels along Prince Charles Parade where exceedances were predicted. Any persistent exceedances would require Caltex to include additional noise management controls in line with the ICNG.		✓	
G6	Noise complaints would be handled through Caltex's 24-hour advertised hotline. A response would be made to complaints within 48 hours. Where required NSW EPA would be consulted.		✓	
G7	The community would be regularly updated on the proposed work schedule. Specific consultation would be undertaken to inform residents and users of Silver Beach of the piling, dredging and rock placement works and to set out the proposals for daytime working at the weekend.	✓	✓	
G8	The works contractors would be required to implement appropriate training to ensure staff awareness relating to the appropriate use and shielding of equipment.		✓	

Item	Mitigation and Management Measures	Implementation of mitigation measures		
		Design	Implementation	Operation
G9	The following measures would be included in the *Fauna Management Plan* (see **Chapter 11, Ecology**). • During the proposed works, contact would be made with the whale migratory team within NSW OEH during June and October to confirm any reported whale sightings. • During the proposed works observations would be made up to a distance of 420 m from the active working area (whilst dredging, piling or rock placement works were taking place). The observations would be made using the Whale and Dolphin Sighting Log and be trained in the identification of sighting cetaceans, pinnipeds or dugongs. The checks would also include any noted instances of shoaling fish in this area. • Slow start up measures would be used for all submarine noise generating activities to ensure any noise-sensitive marine fauna would move away from the source of the noise if required. Works would not commence if cetaceans, pinnipeds or dugongs were sighted within 150 m of the dredging, piling or rock placement works. • If, during the dredging, piling or rock placement works, cetaceans, pinnipeds or dugongs were to come within 420 m, the works' contractor would be put on standby to stop any associated underwater noise-generating works from taking place. • If, during the dredging, piling or rock placement works, cetaceans, pinniped or dugongs were to come within 150 m, the works' contractor would stop any associated underwater noise-generating works until the sensitive marine fauna had moved out of this area. Activities would not recommence until 30 minutes following the mammal leaving this 'exclusion' zone.		✓	
Hazards and Risk Assessment				
H1	A review of working procedures developed by the works' contractor for the berths would be undertaken ahead of the proposed dredging. These procedures would be agreed with Sydney Ports Corporation. The results of this may involve installing additional hardware (such as protective buoys) as well as the introduction of procedural safeguards.		✓	
H2	A procedure would be developed for the safe operations of the dredger and hopper barges. This work would be undertaken to determine the need to develop a works-specific operation safety plan for extreme weather conditions. This would be undertaken in conjunction with the above stakeholders and would form part of the *Port Operating Procedure* (POP).		✓	
H3	The DSDMP would contain controls and measures to ensure no overflow dredging would occur within parts of the turning circle and the whole of the fixed berths. It would also include measures to ensure the sediments would be lifted and loaded so as to prevent any excessive disturbance and agitation, whilst preventing excessive spillage.	✓	✓	

Item	Mitigation and Management Measures	Implementation of mitigation measures		
		Design	Implementation	Operation
H4	Biodegradable oil would be used within the pile rig. Pre start checks would be undertaken prior to commencing piling. Regular servicing and maintenance would be scheduled as part of the works.		✓	
H5	Materials would be available to provide spill containment if required in accordance with Caltex's *Emergency Response Plan* (STD 4.02.01.01) and *Oil-spill Callout and Response Work Procedure* (PROC 120.05.001).		✓	
H6	Any off ship incidents would be managed as per current established operating procedures in place for the existing port and berthing facility.		✓	
Waste and Resource Management				
I1	The proposed works would be integrated into existing resource efficiency, waste management and handling, emergency response and preparedness plans for the port and berthing facility.	✓	✓	
I2	A *Waste and Resource Management Plan* (WRMP) would be compiled as part of the CEMP prior to the works commencing.	✓	✓	
I3	The WRMP would: • identify requirements consistent with the waste and resource hierarchy; • ensure resourcing efficiency is delivered through the design and responsible construction practices; • provide consistent clear direction on waste and resource handling, storage, stockpiling, use and reuse management measures (consistent with current management practices relating to Caltex's CEMP procedures); • identify disposal and management routes consistent with current management practices as adapted for the proposed works; • set out clear requirements for meeting legislative and regulatory requirements; • define requirements to support Caltex's sustainable procurement objectives through effective, design, construction and procurement; and • set out processes for disposal, including onsite transfer, management and the necessary associated approvals.	✓	✓	
I4	The WRMP would incorporate the requirements of the waste and resource hierarchy and cleaner production initiatives.	✓	✓	
I5	The WRMP would include a process for auditing, monitoring and reporting, which would include regular inspections of site activities and the waste management area(s). The WRMP would be subject to regular auditing and a system would be used to record and report the types, volumes and management measures for all waste and resource arising from/used for the works.	✓	✓	

Item	Mitigation and Management Measures	Implementation of mitigation measures		
		Design	Implementation	Operation
I6	Works-generated waste would be segregated at source and stored in accordance with current site practices. This would extend to ship-generated waste. Site management practices would potentially need adapting to consider additional storage requirements. Regardless, all waste would be stored in suitable containers and designated waste management areas. Waste would be stored (and segregated) to accord with the *Waste Classification Guidelines* 2009.		✓	
I7	Ballast water would be controlled in accordance with the management provision included in the International Convention for the Control and Management of Ships' Ballast Water and Sediments (of which Australia is a signatory), the IMO Guidelines for the Control and Management of Ships' Ballast Water (2004) and the Australian Ballast Water Management Requirements (Version 5) (DAFF, 2011).		✓	
I8	Bilge water discharge would not be permitted.		✓	
I9	Any refuelling taking place at the Wharf would be undertaken in accordance with existing procedures and permits.		✓	
I10	All operations would conform to the Marpol Convention to prevent marine pollution in addition to the requirements of Section 120 of the POEO Act.		✓	
I11	The discharge of any solid waste overboard would not be permitted.		✓	
I12	Caltex's existing procedures for the disposal of sewage, greywater, controlled waste, general waste and recyclable materials would be adopted for the proposed works (and modified if required). This would include using licensed contractors to remove and transport waste from the site.		✓	
I13	The works would feed into Caltex's annual reporting of waste.		✓	
I14	Design efficiency would be employed to limit the need for excess resource.	✓		
I15	A procurement strategy would be included to manage the works.		✓	
Amenity, Land Use. Recreation and Navigation				
J1	Caltex would continue to communicate to the public throughout the works via existing channels. Communications would include project updates, the program of works and any atypical disruption or changes not anticipated in this EIS.	✓	✓	
J2	A *Port Operating Procedure* (POP) and *Marine Works Management Plan* (MWMP) would be implemented in consultation with SPC and NSW RMS to accommodate the works, ship movements and safety requirements.	✓	✓	✓
J3	Caltex would use the current methods of communication with the Harbour Master to manage the additional ship movements within the Botany Bay Shipping Channel during the proposed works. Shipping schedules would be forwarded and agreed in advance.		✓	

Item	Mitigation and Management Measures	Implementation of mitigation measures		
		Design	Implementation	Operation
J4	Temporary exclusion zones would be created around the main working areas (principally including the dredging vessel), the hoppers (when placing sediments over the exposed pipeline and anchor point), and when working on the mooring lines outside of the sub berth.		✓	
J5	A Traffic Management Plan (TMP) would be developed and implemented for the concrete pouring works. The TMP would comply with all relevant regulations and bylaws and in particular address safe access and egress to Prince Charles Parade when arriving and leaving the wharf and/or laydown area.		✓	
J6	Ongoing consultation with sailing, diving and recreational user groups identified in this EIS would help inform Caltex (and the works' contractors) of any activities and events that are likely to be occurring within the area during the works. These would be accommodated by either timing the works to avoid an event or more likely relocating the event if there is was a substantiated claim of an impact.	✓	✓	

19.3 Environmental Management

19.3.1 Overview

The proposed works would require the preparation of:

- a CEMP to support the infrastructure works (the upgrade to the fixed berths and sub berth) and elements of the dredging works; and
- a DSDMP to support the dredging works.

The DSDMP would detail the mitigation and management measures required to control the impacts of dredging in Botany Bay along with the impacts of loading, transport and disposal permitted under the Commonwealth *Environmental Protection (Sea Dumping) Act 1981* (see **Chapter 9, Spoil and Contamination**).

19.3.2 The CEMP

The CEMP would confirm the procedures that would be implemented to manage environmental impacts associated with the proposed infrastructure works and elements of the dredging works. The CEMP would provide a reference document that would ensure that the mitigation and management measures specified as part of the approval of the proposed works would be implemented and monitored.

The CEMP would identify all environmental aspects associated with the relevant construction works and would include the mitigation and management measures identified in this EIS.

The use of a CEMP would provide the basis for:

- all works complying with all relevant environmental statutes, regulations and standards;
- environmental factors being taken into account for each activity; and
- regular audits being performed to confirm compliance with environmental policies and standards.

Caltex would appoint an EMR to regularly audit the works activities to confirm that all mitigation and management measures were being effectively applied and that the proposed works were being carried out in accordance with the CEMP and all environmental approval and statutory requirements.

The CEMP would identify the roles and responsibilities of all personnel with respect to the management of environmental hazards and impacts associated with the proposed works, in support of minimising the risk of environmental harm. The CEMP would be subject to refinement and sign-off by the EMR prior to commencement of the relevant construction works. It would also be subject to ongoing updates as the works progress to reflect developments in environmental compliance requirements and standards.

The CEMP would include the following:

- a description of the proposed relevant construction works;
- an outline of the proposed program of works;
- statutory requirements and required licences and approvals;
- standards and/or performance measures for the relevant environmental issues associated with the proposed works;
- a description of what actions and measures would be implemented to mitigate the potential impacts associated with the proposed works and ensure that these works would comply with the relevant standards and/or performance measures;
- a description of the procedures to ensure all employees were trained in regards to their responsibilities under the CEMP;
- a description of the procedures that would be implemented to register, report and respond to any complaints during the infrastructure work;
- a description of the procedures that would be implemented to manage any environmental incidents and associated reporting requirements;
- identification of key personnel who would be involved in the relevant construction works and their contact details;
- monitoring procedures and a description of the process to be followed if any non-compliance is detected; and
- detailed plans on:
  - spill control;
  - fauna management;
  - underwater noise management;
  - traffic management during the concrete pouring;
  - port operating procedure and marine works management; and
  - waste and resource management.

These items are consistent with the commitments presented in **Table 19-1**.

19.3.3 The DSDMP

The DSDMP would provide a framework for the management and execution of environmental controls associated with the proposed dredging and disposal. The DSDMP would use a performance-based approach structured to deliver management of potential environmental impacts at levels consistent with the mitigation and management measures provided in this EIS (relating to dredging) and within the conditions of consent for the project and the SDP in relation to loading, transport and disposal.

The DSDMP would include the objectives, actions and associated key performance indicators for management of potential environmental impacts associated with the dredging program. The DSDMP would also present the proposed monitoring and inspection programs required to confirm compliance.

The EMR for the dredging works would audit the environmental performance of the dredging activities to ensure that all mitigation and management measures were being applied effectively, and that the proposed works were being carried out in accordance with the DSDMP, associated approvals and permit conditions.

The DSDMP would also be subject to refinement and sign-off by the EMR prior to commencement of the dredging works. It would also be subject to ongoing review as the works progressed to reflect developments in environmental compliance requirements and standards.

- An outline the proposed dredging and spoil disposal program.
- A description of the overarching strategy that forms the design basis for the DSDMP.
- A description of the procedures that would be implemented to minimise and manage potential on water and sediment quality, noise, ecology and heritage impacts.
- A description of the environmental monitoring and inspection programs that would be implemented.
- A description of the outline the contingency measures that would be implemented in the event that a specific threshold limit (as set out in this EIS) is exceeded.
- A description of the measures that would be implemented to manage environmental issues relating to marine quarantine, the use and handling of hydrocarbons, waste management, noise management, and shipping operations.
- An outline how the environmental management strategies would be implemented, including the definition of clear and accountable roles and responsibilities, coordination and communication, auditing and reporting requirements.

Various sub-plans would be included within the DSDMP:

- a spill control plan;
- a sediment and water quality monitoring program;
- flora management;
- fauna management;
- underwater noise management;
- a port operating procedure and marine works management plan; and
- a waste and resource management plan

19.4 General provisions for Inclusion in Management Plans

The following general provisions would be included in the CEMP, DSDMP and associated sub-plans to ensure that impacts are effectively managed.

- Mapping/works plans would be provided to clearly show the locations where dredging, overflow operations and other works activities would take place and where they would be restricted.
- There would be a requirement for the works' contractor to use a GPS when undertaking the works to ensure accuracy and limit impacts to the approved works area. In addition the works area would be marked out with buoys.
- The works' contractor would be required to demonstrate that all ships and equipment hold current certifications of maintenance and seaworthiness.
- The contractor would be made aware of the continuous turbidity monitoring requirement, locations for monitoring and the monitoring limits. The contractor would also be made aware of the potential requirement to further limit spill rates or overflow dredging operations in additional areas as the works progress. The basis of management would be to include provisions to ensure the works' contractor immediately cease overflow dredging operations should an exceedance be detected, to then work with the EMR to identify how the spill rates or overflow dredging operations would progress moving forward.
- There would be a requirement for the dredger to make use of a closed bucket to minimise sediment spill when lifting the backhoe through the water column and when undertaking slewing.
- There would be a requirement for the hopper doors to be kept in good condition to minimise loss of sediment during transportation.
- There would be a requirement for all shipping to maintain 4 knots at all times when undertaking the proposed works.
- Provisions on the use, and restriction of, lighting would be included to prevent light spill. The measures would restrict the use of lighting to that required for safely operating away from the Wharf.
- There would be a requirement for dredging activities to be conducted using equipment that is registered, and which complies with the conditions of relevant approvals.
- Caltex's current operational management procedures would be included in the management plans for the works' contractor to adopt. This would ensure there would be no discharges to the marine environment, backed by specifications on managing solid and liquid wastes.
- The works' contractor would be required to monitor dredged materials to ensure there was no visible drying occurring whilst loading or in transit to the disposal ground so as to prevent ASS risks. This would be backed by a requirement to dampen the sediments if required.
- Specifications on the location, type and frequency of turbidity and physico-chemical monitoring along with reporting and auditing provisions would be included as part of the Sediment and Water Quality Management Plan (SWQMP). The SWQMP would also include provisions to:
  - manage any exceedances, which would include temporarily stopping overflow operations; and
  - implement further restrictions where required.

- A subsection of the SWQMP would be the Spill Control Plan (SCP). This would set out the management and containment provisions should there be an accidental or emergency release, backed by the necessary reporting mechanisms, auditing provisions and the need for regular maintenance on the part of the contractor. It would also specify the requirement for managing spills, and the location, use and correct disposal of oil spill response equipment and spill kits.
- A secifications for the works' contractor to monitor the works as they progress to ensure any identified heritage items would be reported under the provisions and requirements set out under the *Heritage Act 1977* would be included.
- A clear works schedule would be included. It would set out activities that would be limited or prohibited outside of the standard working hours. It would also specify the noise monitoring requirements to be undertaken during the proposed piling and rock revetment works along with the controls to be put in place should noise limits be exceeded. It would also include the reporting and auditing requirements that the contractor would be required to adopt.
- For the piling works, slow start up specifications would be included.
- Construction equipment used for the proposed works would be maintained in good repair and any excessive noise would be investigated and remedied immediately. All equipment would be required to operate within recommended parameters.
- Provisions to monitor for marine fauna within 420 m of the working dredger or piling rig would be included, with the additional requirement for the contractor to cease work for 30 minutes if any such fauna come within 150 m.
- A requirement for the works' contractor to implement a process of odour screening to identify anomalous odours would be included. This would require a notification process of instances of where odour was recorded, and in exceptional circumstances, the need to undertake odour monitoring or limit the rate of dredging.
- Waste management provisions would be included under a specific WRMP. The WRMP would provide clear direction on waste and resource handling, storage, stockpiling, use and reuse management measures (consistent with current management practices relating to Caltex's operations). The WRMP would be backed by specifying the responsibilities of the works' contractor and their relationship with the EMR.
- The contractor would be bound by the requirements of the POP and MWMP, which would provide detail on managing ship movement and working arrangements to ensure navigational safety.
- A specification would be included.
- to ensure that all activities associated with dredging and reclamation would be carried out to avoid spreading *Caulerpa taxifolia* consistent with the current management plan for that species issued by the NSW DPI. This would be underpinned by the need to provide written certification to SPC that any ships coming from outside Botany Bay were free from fouling organisms and sediment.
- A requirement to comply with the requirements of all relevant authorities for the import of vessels, including the Department of Agriculture, Fisheries and Forestry (DAFF) would be included.
- There would be a requirement for dredging equipment located outside of the region to be subject to hull cleaning and/or inspection for marine pests prior to commencing works.

- There would be a requirement for the works' contractors to manage ballast wasters in accordance with DAFF requirements.
- There would be a specified requirement to use biodegradable oil in the pile rig.
- There would be a requirement to immediately cease dredging operations in the case of accidental or unintended pipe breaks overflows or spillages. Works would not be allowed to recommence until repairs were complete or relevant work methods modified.
- Specifications on the required training needed prior to and during the proposed works would be included. These would focus on:
  - waste disposal, segregation and management;
  - pollution prevention;
  - the reporting of spills;
  - the EMR specifically briefing the site management and dredge manager; and
  - providing toolbox talks on the use of oil spill equipment, marine mammal identification and heritage identification.
- Information on the requirement for the contractor to work within the expectations of the local community (as communicated ahead of the works by Caltex) would be included. This would include information on the complaints handling and management procedure governing the works backed by the protocol for implementing and managing modifications to the working practices following any valid complaints.

20 Proposed Works Evaluation and Justification

20.1 Introduction

This chapter provides an evaluation and justification for the proposed works. It does this by including:

- a process of environmental risk analysis (ERA);
- consideration of any residual impacts;
- an assessment of the proposed works against the principles of Ecologically Sustainable Development (ESD);
- a description of the benefits of the proposed works;
- consideration of the consistency of the proposed works with the objectives of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation); and
- the justification for undertaking the proposed works.

20.2 Environmental Risk Analysis

An ERA provides an analysis of the environmental impacts that have been identified and outlined as part of this EIS.

The ERA has used a number of stages of the environmental assessment (EA) process as input:

- the environmental interactions identified in the environmental scoping assessment (ESA) as discussed in **Chapter 7**, **Scope and Approach to Assessment**;
- the assessment requirements set out in the DGRs; and
- the environmental, social and economic impacts identified through preparing the technical assessments to support this EIS (see **Chapters 8-17**).

20.2.1 Method of Assessment

The ERA has been prepared using the methods described in:

- Standards Australia's document *HB 203:2006 Environmental Risk Management, Principles and Process*;
- Australian Standard *AS 4360:2004 Risk Management*; and
- *AS ISO 31000:2009 Risk Management, Principles and Guidelines*.

The analysis has categorised levels of risk based on the significance of effects (consequences) and the manageability of those effects (likelihood). The ratings used to measures consequence and likelihood are defined in **Tables 20-1** and **20-2.** The consequential risk ranking matrix is shown in **Table 20-3**.

Table 20-1 Measures of Likelihood

Rank	Likelihood	Description
A	Almost Certain	Happens often and is expected to occur.
B	Likely	Could easily happen and would probably occur.
C	Possible	Could happen and has occurred elsewhere.
D	Unlikely	Unlikely to happen but may occur.
E	Rare	Could happen, but only in extreme circumstances.

Table 20-2 Measure of Consequences

Rank	Consequence	Description
Negative Consequences		
1	Extreme	Permanent and catastrophic impacts on the environment or population; large impact area; reportable incident to external agency; large fines and prosecution; operational constraints; substantial community concern.
2	Major	Permanent and detrimental impacts on the environment or population; large impact area; reportable incident to external agency; may result in large fines and prosecution; operational constraints; high level of community concern.
3	Moderate	Substantial temporary or minor long term detrimental impacts on the environment or population; moderate impact area; reportable incident to external agency; action required by reportable agency; community interested.
4	Minor	Minor detrimental impacts on the environment or population; small impact area; reportable incident internally; no operational constraints; some local community interest.
5	Low	Nil or temporary impacts on the environment or population; small or isolated impact area; not reportable incident; no operational constraints; uncontroversial, no community interest.
Positive Consequences		
1	Extreme	Permanent and extremely beneficial impacts on the environment or population; large impact area.
2	Major	Permanent and beneficial impacts on the environment or population; large impact area.
3	Moderate	Substantial temporary or minor long term beneficial impacts on the environment or population; moderate impact area
4	Minor	Minor beneficial impacts on the environment or population; small impact area.
5	Low	Nil or temporary beneficial impacts on the environment or population; small or isolated impact area.

Table 20-3 Risk Matrix for ERA

			CONSEQUENCES				
			1 Extreme	2 Major	3 Moderate	4 Minor	5 Low
Likelihood	A	Almost Certain	VH	VH	H	H	M
	B	Likely	VH	H	H	M	M
	C	Possible	H	H	M	M	L
	D	Unlikely	H	M	M	L	L
	E	Rare	H	M	L	L	L

Risk Matrix is defined as follows: VH = Very High, H = High, M = Medium and L = Low.

Taking into account the technical assessments outlined in **Chapters 8-17** and the mitigation and management measures provided in the **Chapter 19**, **Table 20-4** provides an assessment of the residual risk ratings associated with the proposed works. This has been completed for each environmental aspect assessed within this EIS. Adverse risks have used the colours in **Table 19-3**. Positive risks have been coloured in blue. A consideration of residual impacts and effects is considered in **Section 20.3**.

Table 20-4 Residual Risk Analysis

Potential Likely Environmental Impact	Environmental Risk Analysis		Assessment Findings Mitigation and Management Measures Performance Criteria Design Standards	(Residual) Environmental Risk Analysis		Residual Risk Rating
	L	C		L	C	
Hydrodynamics and Coastal Process (Chapter 8)						
Changes to the hydrodynamics and coastal processes of Botany Bay.	D-E	1-2	Modelling has confirmed there to be no significant impacts on the hydrodynamic and coastal processes.	E	3	L
Potential for erosion and scour around the installed infrastructure.	D	3	The detailed design would be in accordance with the *AS4997: Guidelines for the Design of Maritime Structures* to ensure there would be no localised erosion or scour around the berths and Wharf. This would include scour protection to the top and toe of the sheet piled wall and the rock revetment. In turn these structures would protect the Wharf and areas to the south.	E	4	L
The effects of climate change (and in particular sea level rise) on the upgraded port and berthing facility.	B	3	Predictions in sea level rise would be managed by providing additional corrosion protection higher up each piled structure. The design assessment has confirmed there to be no requirement for additional controls to manage climate change.	E	5	L
Spoil and Contamination (Chapter 9)						
Tributyltin (TBT) within the dredged marine sediments at concentrations that exceed the *Interim Sediment Quality Guidelines* (ISQG) would be disturbed and removed from the seabed for transportation and sea dumping.	A	2	**Disposal:** The loading, transport and removal of the dredged sediments for disposal via sea dumping would take place in accordance with the requirements included in the *National Assessment Guidelines for Dredging 2009.* Initial dilution calculations have confirmed that sufficient dilution would occur at the Sydney Offshore Spoil Ground for there to be no water quality impact to the receiving environment.	D	4	L
The presence of actual acid sulfate soils (ASS) and potential ASS has been confirmed. There would be a potential impact should the actual ASS not be neutralised during disposal and/or the potential ASS become oxidised as a result of the sediments drying out during their transportation.	A	5	**Disposal**: The pH of the seawater at the disposal ground and the depth of disposal (120 m) would be sufficient to allow the neutralisation of any actual or potential ASS. The dredged sediments would be monitored during transit to ensure they would not dry out. Sediments would be sprayed if they were drying out.	E	5	L

Potential Likely Environmental Impact	Environmental Risk Analysis		Assessment Findings Mitigation and Management Measures Performance Criteria Design Standards	(Residual) Environmental Risk Analysis		Residual Risk Rating
	L	C		L	C	
Water and Sediment Quality (Chapter 10)						
The proposed works would generate suspended sediments (turbidity), which has the potential to exceed the ecological, aquaculture and recreational limits set by the *Guidelines for Fresh and Marine Water Quality*. These exceedances would occur within, and immediately adjacent to, the project site as a result of overflow dredging operations in the turning circle and approaches. Sediment deposition could affect an area beyond the project site to a depth of up to approximately 10 mm, and a wider area of a depth up to 1 mm.	A	3	Modelling has predicted that the suspended sediment threshold limits of the *Guidelines for Fresh and Marine Water Quality* would be satisfied at the point of the sediments reaching the environmental receptors and ecological values of Botany Bay (see **Chapter 9, Water and Sediment Quality**). Live turbidity monitoring would be undertaken for the duration of the proposed works to ensure compliance with the *Guidelines for Fresh and Marine Water Quality*. Should any persistent exceedances of the threshold limits within the *Water Quality Guidelines for Fresh and Marine Waters* be experienced further restrictions on the spill rate or the use of overflow dredging would be implemented.	D	3	M
The proposed works would disturb TBT contaminated sediments during their removal, and disperse residual TBT within the marine environment of Botany Bay through overflow dredging operations. The dispersion would exceed the environmental protection threshold limits of the *Guidelines for Fresh and Marine Water Quality* within the immediacy of the project site	A	4	**Outside the Project Site**: Live turbidity monitoring against the standards set by the *Guidelines for Fresh and Marine Water Quality* would serve as a surrogate to ensure predicted TBT dispersion and deposition occurring largely as a result of the overflow operations would be in accordance with modelling predictions.	D	4	L
	A	4	**Within the Project Site**: No overflow dredging would be permitted within the contaminated areas. No additional measures would be included to manage and mitigate dispersion within the project site. Overall concentrations would be lower than at present due to the removal of much of the contaminated sediment. There are no sensitive resources, receptors or values within the project site that would be impacted as a result of the proposed works.	B	4	M

Potential Likely Environmental Impact	Environmental Risk Analysis		Assessment Findings Mitigation and Management Measures Performance Criteria Design Standards	(Residual) Environmental Risk Analysis		Residual Risk Rating
	L	C		L	C	
Ecology (Chapter 11)						
Potential for marine oil spills resulting from the proposed works and their effect on protected areas, marine sub-tidal and intertidal habitats, marine flora, and marine and intertidal fauna.	E	1	Consistent with current controls at the port and berthing facility, stringent measures would be put in place to store, manage, handle and dispose of oil, hydrocarbons and other hazardous material. This would be backed by the routine maintenance of equipment, the appropriate training of staff and the inclusion of rigorous spill management and reporting protocol.	E	3	L
Removal of un-vegetated soft sediments and peat barren habitat containing negligible seagrass and macroalgae resulting in no significant loss of or overall reduction in biodiversity of the local region.	A	5	The loss would represent a negligible portion of available habitat of this type in Botany Bay. Recolonisation would rapidly occur. The impact would not have a significant impact on, or fragmentation of, critical or important benthic habitat.	A	5	M
Creation of new habitat structure through the construction of a rock revetment and the installation of new marine structures.	C	4	No mitigation proposed. Development and maturation of the habitat would naturally occur over a long period.	C	4	M
The removal of existing structures scheduled for decommissioning and their use as habitat by seabirds.	A	5	These structures do not represent critical or important habitat for these species and replacement structures, as well as a large number of shoreline and marine structures in the area, would provide alternative habitat for seabirds.	E	5	L
Generation of suspended sediments that would create sediment plumes and sediment deposition. The deposition would be to a depth of up to 10 mm over the northern limit of the seagrass beds, affecting the periphery of the *H.ovalis* beds and up to a depth of 5 mm affecting the periphery of the and *P.Australis* beds. Deposition would occur for a short period of time until the sediments redispersed through natural dynamics.	A	4	The effects would be limited given the limited depth of deposition, the extent over which the deposition would occur and the chemistry of the deposited sediments. Turbidity monitoring would be implemented during the works to validate the modelling. If required further limits and use and restriction of overflow dredging would be put in place if there was a persistent monitored exceedance of environmental protection limits set for suspended sediments, tributyltin, pH and dissolved oxygen as defined by the *Guidelines for Fresh and Marine Water Quality*.	D	4	L

Potential Likely Environmental Impact	Environmental Risk Analysis		Assessment Findings Mitigation and Management Measures Performance Criteria Design Standards	(Residual) Environmental Risk Analysis		Residual Risk Rating
	L	C		L	C	
Water pollution caused by the potential solution of TBT into the marine waters of the project site at concentrations exceeding the threshold limits for environmental protection included in the *Guidelines for Fresh and Marine Water Quality*. Limited impact due to natural dispersion and dilution beyond the immediate dredging working area.	A	5	The majority of the TBT would be removed from the project site through dredging. Post settlement, the concentrations of sediment-bound TBT would be less than at present. As the environmental value of the project site is low any residual impact would be negligible. Continued dilution and dispersion would limit the extent and duration of impact.	A	5	M
The potential for ships striking marine (mega) fauna.	C	3	As part of the marine fauna plan observations would take place to ensure marine (mega) fauna were not within 150 m of the dredging operations. If observed the works would temporarily stop until the animal(s) had left the exclusion zone. In addition a 4-knot speed limit would be imposed on the works to prevent collision risk.	E	3	L
The potential disorientation of seabirds through the need to light the dredger at night and a limited need to light any works away from the Wharf at the start and end of the day.	D	4	Any additional lighting would be minimised to that required for safe operations and to meet navigational safety requirements. Also, the equipment would be required to implement measures to prevent light spill outside of areas that would not be required to be lit.	E	5	L

Potential Likely Environmental Impact	Environmental Risk Analysis		Assessment Findings Mitigation and Management Measures Performance Criteria Design Standards	(Residual) Environmental Risk Analysis		Residual Risk Rating
	L	C		L	C	
Potential introduction of marine pest species *C.taxifolia* and *Alexandrium sp*.	C	3	Measures would be put in place to control the presence of *Caulerpa taxifolia*i over the course of the dredging program that accord with the NSW *Control Plan for the Noxious Marine Alga Caulerpa taxifoliai*. This standard has been written to meet the requirements of the *Marine Pollution Act* and the *Noxious Weeds Act.* In addition routine inspections of the at the port and berthing facility would be undertaken by the Department of Agriculture, Fisheries and Forestry (DAFF). Also, any dredging equipment from outside the region would be subject to hull cleaning and/or inspection for marine pests prior to commencing works in Botany Bay.	D	4	L
Heritage (Chapter 12)						
The works would result in the loss of elements of the fabric that make up a locally important heritage listed item in the form of the Wharf.	A	3	A photographic recording of the existing fabric and operation of the Kurnell Wharf would be prepared prior to the upgrade works, including in particular the existing infrastructure at fixed berth #1. This record would become part of the history of the place and would be maintained for the appreciation of present and future generations. This approach is consistent with the requirements of the *Heritage Act 1977.*	A	5	M
Undocumented relics could be unearthed as part of the dredging process, relating to the north west portion of the turning circle. Unanticipated discovery of marine heritage within the project site.	C	3	A management control would be put in place to ensure the works' contractor would monitor for heritage items during the dredging. If any relics were to be discovered in the dredging areas, the proposed works would immediately cease and the relics would be reported to NSW Heritage Office (in accordance with Section 146 of the *Heritage Act 1997*). Further assessment by a maritime archaeologist and development of an appropriate management strategy may also be required.	C	3	M

Potential Likely Environmental Impact	Environmental Risk Analysis		Assessment Findings Mitigation and Management Measures Performance Criteria Design Standards	(Residual) Environmental Risk Analysis		Residual Risk Rating
	L	C		L	C	
Noise (Chapter 13)						
It is predicted that there would be up to a 4 dB(A) exceedance of the noise criteria management levels along Prince Charles Parade as defined under the *Interim Construction Noise Guideline* (ICNG) due to the piling lasting 15 weeks.	A	4	Initially, there would be a requirement for the works' contractor to confirm the sound power level (SPL) of the piling equipment and its consistency with the SPLs used in the model. Mitigation controls would be put in place by the works' contractor to achieve the noise management criteria levels, which would either include respites in the piling or the use of active controls such as wooden dampening blocks.	D	4	L
It is predicted that there would be a 3 dB(A) exceedance of the noise criteria management levels along Prince Charles Parade as defined under the *Interim Construction Noise Guideline* (ICNG) due to the rock revetment works lasting 3-3.5 weeks.	A	3	Caltex would work with the community to provide early warning of the likely impact of the rock revetment works. A noise complaints and handling procedure would be put in place and monthly noise monitoring would take place. Any persistent exceedances would require Caltex to include additional noise management controls in line with the ICNG. These measures are in accordance with the provisions of the ICNG.	E	4	L
Temporary behavioural changes to marine mammals as a result of the underwater noise generated through piling and the dredging works.	B	3	There would be a requirement to implement slow start up measures for all submarine noise generating activities to ensure any noise-sensitive marine fauna would acclimatise to the working conditions and move away from the area of activity. Measures would be put in place to manage underwater noise impacts. This would include ceasing piling and dredging works should any marine mammals come within 150 m of the active working area.	D	4	L

Potential Likely Environmental Impact	Environmental Risk Analysis		Assessment Findings Mitigation and Management Measures Performance Criteria Design Standards	(Residual) Environmental Risk Analysis		Residual Risk Rating
	L	C		L	C	
Hazards and Risks Assessment (Chapter 15)						
*NB: The PHA identified additional hazards that would be generated through the works therefore they do not have an initial risk ranking consistent with the assessment in **Chapter 15, Hazard and Risk Assessment.***						
Hazardous interactions between: • ships involved in the proposed dredging and upgrade works; • ongoing port and berthing activities; • moored ships and the sub berth equipment (including manifolds), wharf equipment (including risers) and the hydraulic loading arms; • commercial and recreational ships and either moored ships or ships that are in transit to and from the port and berthing facility; and • the potential for personnel injury or the loss of personnel overboard.	-	-	A review of working procedures developed by the works' contractor for the berths would be undertaken ahead of the proposed dredging activities taking place. These procedures would be agreed with Sydney Ports Corporation (SPC). The results of this may involve installing additional hardware (such as protective buoys) as well as the introduction of procedural safeguards.	D	2	M
Extreme weather resulting in damage to ships involved in the proposed dredging and upgrade works with the potential for personnel injury or the loss of personnel overboard.	-	-	A procedure would be developed for the safe operations of the dredger and hopper barges. This work would be undertaken to determine the need to develop a works-specific operation safety plan for extreme weather conditions. This would be undertaken in conjunction with the above stakeholders. This would form part of the *Port Operating Procedure* (POP).	D	2	M
Loss of containment event (diesels, oils, lubricants and hydraulic fluids) from ships as a result of the proposed works.			Biodegradable oil would be used within the pile rig. Pre start checks would be undertaken prior to commencing piling. Regular servicing and maintenance would be scheduled as part of the works. Materials would be available to provide spill containment if required in accordance with Caltex's *Emergency Response Plan* (STD 4.02.01.01) and its *Oil-Spill Callout and Response Work Procedure* (PROC 120.05.001). Any off ship incidents would be managed as per current established operating procedures in place for the existing port and berthing facility.	C	4	M

Potential Likely Environmental Impact	Environmental Risk Analysis		Assessment Findings Mitigation and Management Measures Performance Criteria Design Standards	(Residual) Environmental Risk Analysis		Residual Risk Rating
	L	C		L	C	
Workplace injuries.	-	-	Existing controls would extend to cover the proposed works to limit the potential for workplace injuries.	D	2	M
Electrical hazards during the proposed upgrade of the electrical system leading to injury and/or fire.	-	-	Existing controls would be extended to cover the proposed works to limit the potential for workplace injuries.	D	2	M
Failure to remove flammable liquid at fixed berth # 1 during the facility upgrade leading to a loss with the potential to pollute the marine environment and/or cause personnel injury. Failure to isolate the operational supply lines when connecting to the proposed upgraded manifold on the Kurnell Wharf leading to a loss of flammable liquids. Loss of displaced water flushed through the existing fuel lines and pipework that would be removed through the proposed upgrade of fixed berth #1 resulting in the pollution of the marine environment.	-	-	Caltex has an existing permit to work procedure, including lockout/tag-out requirements. Positive isolation would be in place for all fuel sources, and for the flushing of any pipelines, prior to any removal of pipes being allowed.	E	2	M
Wastes and Resource Management (Chapter 16)						
The proposed works have the potential to produce waste due to the need to refurbish elements of the existing infrastructure. Additional construction waste would also be produced.	A	5	The proposed works would be managed through a *Waste and Resource Management Plan* (WRMP) that would extend current waste and resource management practices at the Kurnell port and berthing facility to cover the proposed works.	D	5	L
The works would require the use of natural resources to construct and upgrade the project infrastructure.	A	5		D	5	L
Amenity, Land Use, Recreation and Navigation (Chapter 17)						
There would be approximately 11,000 m^2 of the Bay given over to support the expansion of fixed berths #1. This area can currently be accessed by the public and does not fall within the Marine Security Zone.	A	4	The loss represents less than 1% of the total area available for recreational use within Botany Bay. Its recreational value is limited given its location immediately adjacent to the existing fixed berth #1.	A	5	M
The proposed works could have a limited impact on the recreational resource of Botany Bay due to the need for a temporary exclusion zone around the marine works in areas extending beyond the Marine Security Zone.	D	3	The inclusion of a temporary exclusion zone around the proposed works would be in place for safety reasons to limit and prevent accidents. This would be in accordance with the *Marine Safety Act*. In addition, ongoing consultation with sailing, diving and recreational user groups identified in this EIS would continue throughout the proposed works.	D	5	L

Potential Likely Environmental Impact	Environmental Risk Analysis		Assessment Findings Mitigation and Management Measures Performance Criteria Design Standards	(Residual) Environmental Risk Analysis		Residual Risk Rating
	L	C		L	C	
There would be need to accommodate an additional 400 ship movements in the Botany Bay Shipping Channel as materials are shipped to the project site and waste is shipped to the offshore disposal ground.	A	4	A *Port Operating Procedure* (POP) and a *Marine Works Management Plan* (MWMP) would be implemented to ensure navigation safety throughout the proposed works. This would include ongoing consultation with SPC and NSW RMS. This would be in accordance with the *Marine Safety Act*.	D	4	L
There would be need to accommodate 100 concrete truck movements over a 6-8 week period, the movements occurring on 9 days during this period.	A	4	A *Traffic Management Plan (TMP)* would be implemented for this specific operation. It would include temporary traffic management controls to facilitate the movement of trucks on and off the Wharf backed by provisions to park up within the laydown area should there be a delay on getting on to the Wharf.	D	4	L
There would be reduction in shipping to and from the port and berthing facility following its upgrade.	A	2	The Kurnell port and berthing facility would continue to operate under the current procedures to ensure navigational safety.	A	2	VH

20.2.2 Summary of Risk Analysis

The ERA has illustrated that the proposed mitigation and management measures would reduce the risk in many instances leaving residual risk ratings that are low. It has also confirmed that no additional impacts are likely to occur as a result of the proposed works beyond those identified, assessed and considered in **Chapters 8-17**. The ERA has also confirmed that the conclusions of the technical assessments remain valid.

There are a number of instances however where there is a **medium** residual risk rating (i.e. there is a reasonable likelihood of a residual impact occurring). These are considered below.

20.3 Residual Impacts

Table 20-5 considers the impact of those residual risks that are rated **medium** adverse. Where the residual impacts do not affect any sensitive resources, receptors or values considered in this EIS they are considered not significant.

Table 20-5 Residual Impacts

Risk	Residual Impact	Significance
Increased turbidity within the project site.	There are no sensitive resources, receptors or values within the area where the increased turbidity and dispersion of TBT would exceed the guidance limits set for ecological and recreational value protection.	Not significant
Dispersion of TBT within the project site.		Not significant
Removal of un-vegetated soft sediments, peat barren and marine structures.	The removal of these habitats represents a negligible proportion of available alternatives in Botany Bay. Neither habitat is critical nor important, nor do they support any notable, critical, important or threatened biota. The loss would not have an adverse impact on the lifecycle of any threatened species, and would not increase the risk associated with key threatening processes. Recolonisation would occur quickly following the proposed works, with new structures providing a suitable alternative.	Not significant
Water pollution immediately around the location of the dredger within the turning circle and approaches.	As a result of disturbing contaminated sediments, there is a potential that the TBT would likely dissolve in to the surrounding water at a concentration that would exceed the water quality limits set by the *Guidelines for Fresh and Marine Water Quality.* This would only affect the area immediately surrounding the dredger. After a short distance (within the confines of the project site) the water quality would meet the above limits. Furthermore, even at these concentrations it would not result in any toxicity impacts. The other impact would be the dispersion of residual sediment-bound TBT once the sediments had been disturbed and loaded for disposal. Whilst the prevention of overflow dredging within parts of the turning circle would limit this dispersion and deposition, the final settled sediment-bound concentrations of TBT close to the project site would likely still exceed the sediment quality limits included in the above Guidelines. Importantly however, the deposition over the areas containing identified sensitive receptors/values would not exceed these guidelines providing the necessary mitigation and management controls were put in place. As such the residual impacts are considered not significant.	Not significant

Risk	Residual Impact	Significance
Loss of fabric of the existing wharf as a heritage item.	The removal and upgraded of certain assets associated with the existing Wharf is required as part of the proposed works, principally for safety reasons. However, whilst there would be a loss in heritage value, the upgrade would extend the operational life of a heritage-listed item. The method of preservation by (photographic) record would ensure the impact is sufficiently mitigated in accordance with the *Heritage Act*. As such, there is no anticipated significant residual impact.	Not significant
Potential to disturb potential shipwrecks, articles associated with shipwrecks, or other items of underwater cultural heritage.	There is a residual medium potential for marine artefacts to be found within the turning circles and approaches. This potential remains due the limited dredging and disturbance has taken place in the western part of the turning circle and approaches. Measures have been included in accordance with the *Heritage Act* to ensure this impact is mitigated should any heritage item/relic be discovered during the works.	Not significant
Exceedance of noise management criteria along Prince Charles Parade during the piling and rock revetment works.	The impact would be short-term and temporary. The predicted exceedance would likely cause 'some community reaction'; however it would be well below the highly noise affected levels and would be unlikely to cause sleep disturbance or significant adverse health effects.	Not significant
A number works' hazards	The hazard management controls included as mitigation measures would ensure compliance with the *Protection of the Environment Operations Act*, the *Marine Safety Act*, the *Work Health and Safety Act* and the *Marine Pollution Act.* Whilst there would be residual risks, they would be managed in every instance to a standard that is consistent with the currently operating port and berthing facility, which has obtained the necessary approvals, permits and licences to operate as a major hazard facility in the marine environment.	Not significant
A number of operational hazards.		Not significant
Loss of a small area east of the fixed berth #1.	The loss would not be offset or compensated as the area is not a part of Botany Bay that is used extensively for recreational purposes or provides an important resource to any of the sensitive receptors and values identified and assessed in this EIS. This residual impact is therefore considered acceptable to achieve the outcome of the proposed works and is not significant.	Not significant

20.4 Ecologically Sustainable Development

This section provides a review of the proposed works against the principles of ESD as defined under the EP&A Regulation. The principles are as follows:

- '*the precautionary principle - namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;*
- *inter-generational equity - namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations;*

- *conservation of biological diversity and ecological integrity—namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration; and*
- *improved valuation, pricing and incentive mechanisms—namely, that environmental factors should be included in the valuation of assets and services.*'

Each is discussed in turn below.

20.4.1 Precautionary Principle

The precautionary principle deals with certainty in environmental and technical decision-making. It advocates that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

An EIS is a public process that examines the potential effects of the proposed works. Therefore, it is precautionary by its very nature. The requirement to assess the impacts of the proposed works is a form of regulation designed to identify and address uncertainty about any effects on, or changes to, the existing environment and the resources contained therein.

Caltex has commissioned specialists to undertake detailed assessments on a range of environmental aspects identified during the consultation and risk assessment phases. These assessments provide sufficient scientific understanding of the proposed works and the surrounding environment to enable a decision that is consistent with this principle.

Proposed Works Objectives

A fundamental principle of the development, design and assessment of the proposed works has been to adopt the precautionary principle where there is design or impact uncertainty. In instances, alternative scenarios (such as the proposed dredging method) have been considered and discounted due to their unknown, uncertain or unpredictable impact.

It has also been an objective of the proposed works to ensure compliance with relevant performance criteria and design standards (as discussed above in **Table 20-4**). Achieving these standards has required decisions that have focussed on design choices that avoid impacts and therefore implement precaution.

Backing this is a process of staged environmental risk analysis and management, which commenced during the initial stages of the design to review the proposal. This was followed by a review of the risks as part of this EIS, including an assessment of key issues that have formed specific technical assessments. As a result the EIS process has reduced the environmental impact of the proposed works and has not identified any threats of serious or irreversible environmental damage.

Design Safeguards

The initial design concept was to extend the functional life of an existing asset. Under this basis, a number of design safeguards have been incorporated in to the concept design in response to the precautionary principle.

These include:

- selecting a method of dredging that prevents the unnecessary disturbance to the seabed in an area that contains known (and recorded) concentrations of TBT;
- consideration of all possible alternatives to disposal ahead of taking the precautionary measure of opting for offshore disposal (and therefore reducing a legacy impact by removing the TBT from the Bay and disposing of it an area where it has been assessed as being safe to do so (see **Chapter 9, Spoil and Contamination**));
- limiting the use of overflow dredging operations in key areas of the project site to minimise sediment dispersion and water pollution; and
- adopting Caltex's current port and berthing facility environmental, hazard and safety procedures to cover the proposed works, as a set of procedures that have that have been subject to approval, and accepted by, by a number of Government agencies, whilst satisfying relevant legislation and regulations such as the requirement of the *Protection of the Environment Operations Act 1997.*

Works and Operational Principles

Should approval be granted for the proposed works, the safeguards, and mitigation and management measures included in this EIS would form the basis of a Construction Environmental Management Plan (CEMP) to manage the infrastructure works and elements of dredging works. An additional specific Dredging and Spoil Disposal Management Plan (DSDMP) would be prepared to manage the loading, transport and disposal components of the dredging. Noise, sediment, water quality and ecological monitoring programs would also be implemented as required. These monitoring plans would be used to validate the assessments within this EIS and to help ensure the necessary environmental protection.

Other precautionary measures include:

- monitoring to confirm the physico-chemistry and turbidity resulting from the proposed dredging;
- additional measures to monitor during the proposed dredging works for heritage relics due to the absence of certainty of presence/absence in the turning circle and approaches;
- the assumed presence of marine flora and fauna in the absence of certainty, with supporting mitigation as required;
- mitigation to control the underwater noise from the rock revetment works given the uncertainty of its impacts;
- inclusion of a sufficient buffer around the proposed works to manage the impacts of piling on underwater noise given the uncertainty over which impacts have an effect on marine fauna; and
- provision for scour protection to the Wharf due to the expansion of fixed berth #1.

20.4.2 Inter-Generational Equity

Inter-generational equity requires that the present generation pass onto the next generation an environment that does not limit the ability of those future generations to attain a quality of life at least equal to that of the current generation.

Through the design of the proposed works and the implementation of measures to mitigate and manage any short-term or long-term environmental impacts, Caltex is confident that inter-generational social equality impacts have been addressed. Examples of intergenerational equity included in the proposed works are described below.

Project Objectives

The objectives of the proposed works are to ensure that the Kurnell port and berthing facility remains operable for the next 50-years. The basis of design has been to ensure that over this period the environmental management of future operations is consistent with the current facility in its need to meet various environmental obligations, targets and standards. Backing this has been the consideration of relevant operational changes following the proposed works, including any associated long-term implications such as the consumption of non-renewable resources, ongoing waste management, emissions, changes to the visual amenity etc.

Design Safeguards

The proposed works would maintain inter-generational equity by ensuring components of the existing bio-physical, social and economic environment available now would also be maintained in a similar condition for future generations. Relevant design considerations include the following:

- a design that accommodates predicted sea level rise changes;
- a design that does not result in any additional hydrodynamic change to the environment;
- a design that compiles with the latest safety design standards therefore minimising operational hazards;
- a design that ensures no navigational or safety risk to the marine environment; and
- the upgrade of a facility to standards that are compliant with its operation as a major hazards facility, whilst satisfying the requirement of WorkCover NSW and Caltex's Environmental Protection Licence (EPL).

Works and Operational Principles

Caltex would continue to maintain inter-generational equity through the safeguards identified in this EIS, including but not limited to the following:

- continuing to operate and work with the community of Kurnell before, during and after the works;
- maintaining community relations into the future therefore substantiating Caltex's claim of corporate social responsibility; and
- sustaining access to petroleum products for future generations, which despite not being a renewable energy resource, is still economically important and will be until such a time when other more viable alternatives and products become available.

20.4.3 Conservation of Biological Diversity and Ecological Integrity

This EIS includes an assessment of the ecological impacts of the proposed works against the requirements of legislation, planning policy and guidance. The ecological impact assessment concluded that the proposed works are unlikely to cause any significant ecological impacts providing that certain mitigation and management measures are adopted.

Project Objectives

The proposed works directly impact a modified area of Botany Bay where the associated ecological values are limited and not significant. The sea dumping of the dredged sediment would take place in a location that has been set aside for sea dumping providing a number of criteria can be satisfied under the terms of a sea dumping permit application made under the provision of the *Commonwealth Environmental Protection (Sea Dumping) Act 1981*. These two objectives have ensured every opportunity has been taken to conserve biological diversity and ecological integrity. Appropriate mitigation has been identified and included in the EIS to ensure the impacts on biodiversity have been managed to a level where there would be no anticipated significant residual effect.

Design Safeguards

As part of the planning for the proposed works, the following design features have been incorporated to minimise the impact of the proposed activities on the biodiversity and ecological integrity of the locality:

- the decision to extend the life of an operational asset, and therefore limiting the impacts to an area of Botany Bay already subject to disturbance. This would avoid the loss of sensitive ecological values associated with other areas should another wholly alternative method of supply (such as a new berthing facility or pipeline) have been promoted;
- removing an amount of the TBT that exists within the project site thereby removing a legacy impact whilst ensuring its responsible disposal (and dilution) offshore; and
- the limitation of overflow dredging operations close to sensitive areas of the Bay.

Works and Operational Principles

In addition to these design safeguards, ecological management plans would be incorporated into the final CEMP and DSDMP to protect specific ecological values associated with Botany Bay (see **Chapter 19, Mitigation and Management Measures**).

20.4.4 Improved Valuation and Pricing of Environmental Resources

This ESD principle is premised on an assumption that all resources should be appropriately valued and that the value of environmental resources should be considered alongside any economic or cost benefit analysis for the life of the proposed works.

Project Objectives

The proposed works would provide value to the local and State economy whilst at the same time not generating any significant residual impact on the environment (see **Section 20.3**). The foundation of this is the objective of ensuring there is a maintained fuel supply to the NSW and the ACT economies over the coming years until such a point where commercially viable non-fossil fuel alternatives are available.

Economic assessment undertaken by Caltex has concluded that the maintenance of the port and berthing facility at Kurnell as part of the infrastructure required to assist in achieving this objective is economically favourable over the considered alternatives (see **Chapter 2, Needs and Alternatives**). Furthermore, whilst it is recognised that the works would take place in an environmentally sensitive area, it is anticipated that on balance the impact of maintenance and upgrade works is less than that of constructing new infrastructure providing the appropriate mitigation and management measures are put in place during the works (see **Chapter 19, Mitigation and Management Measures**).

Design Safeguards and Works and Operational Principles

As discussed above, the design of the proposed works includes a number of measures to ensure that impacts to the biophysical environment are avoided or mitigated. These measures help ensure that the existing environment would continue to provide the same resource and value now and into the future. A number of these measures would also be implemented through the CEMP and DSDMP for the proposed works.

Conclusion

The value placed by Caltex on environmental resources is evident from the extent of site-specific investigations, planning and environmental safeguards and measures that have been undertaken and which would be implemented to prevent an unacceptable significant residual effect to the existing environment. The proposed works also advocate safe working, ensure compliance with safety requirements, and promote the continued reliable supply of petroleum products principally to the NSW and the ACT economies.

20.4.5 Compatibility with the Principles of ESD

The approach taken in planning the proposed works has been multi-disciplinary, involving consultation with various stakeholders including Government agencies and the community (see **Chapter 6, Consultation**). The principles of ESD have been included in every step of developing appropriate design, mitigation and management controls. At the heart of this has been aligning the principles of ESD with the adopted mitigation hierarchy. This has ensured that the avoidance of impacts has been achieved wherever possible, followed by reduction (where avoidance cannot be achieved) and finally compensation or offset (where reduction cannot be achieved or would not achieve practicable or acceptable levels of mitigation).

20.5 Objects of the Environmental Planning & Assessment Act 1979

As required by the DGRs issued for the proposed works, consideration has been given to the consistency of the proposed works with the objects of the EP&A Act as outlined below in **Table 20-6**.

Table 20-6 The Objectives of the EP&A Act

Objective	Consideration
The proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.	The proposed works would facilitate the proper management of resources by allowing for 'a continuation of use' at the Kurnell port and berthing facility. The works would maintain and augment capacity whilst ensuring the smallest environmental impact possible. As such, the proposed works would allow the supply of petroleum products to continue to NSW and the ACT thereby providing an assured supply for the next 50-years (or until such time that demand for such products declines).
The promotion and coordination of the orderly and economic use and development of land.	The project site is located on unincorporated land in Botany Bay with the exception of a small area that is located within land covered by the *State Environmental Planning Policy (SEPP) for the Kurnell Peninsula*. The legislative requirements for undertaking the proposed works in these areas are outlined in **Chapter 5, Legislation and Planning Policy Context.** These demonstrate permissibility for such development in this location and therefore the proposed works are in line with orderly and economic use and development of land (principally driven through promoting a continued use). The proposed works would not significantly affect the future orderly use or development of land, as they do not compromise any existing planning policy within any of the surrounding Local Government Areas (LGAs).
The provision of land for public purposes.	The proposed works would have a minor and temporary impact on public usage of Botany Bay for recreational purposes. These impacts would be managed in line with the mitigation measures laid out in **Chapter 17, Amenity, Land Use, Recreation and Navigation.**
The provision and coordination of community services and facilities	The proposed works would not impact on the provision of existing community services and facilities.
The protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.	The proposed works would neither directly nor indirectly have any significant impact on any threatened species, populations and ecological communities, and/or their habitats. Although threatened biota are known to be present in Botany Bay and the surrounding area, the mitigation measures and design features of the proposed works would ensure that there would be no significant impact on these ecological values.
Adopting the principles of ESD.	An assessment of the proposed works against the principles of ESD has been undertaken in **Section 20.4**. The proposed works align with and do not compromise these principles.
The provision and maintenance of affordable housing.	The proposed works would not impact on the provision or maintenance of affordable housing.
To promote the sharing of the responsibility for environmental planning between the different levels of government in the State.	The proposed works are to be assessed as State Significant Development under Part 4 of the EP&A Act and the *SEPP on State and Regional Development 2011*. Input into the Director-General's Requirements was obtained from the relevant NSW Government departments, agencies and stakeholders including local government authorities, thereby achieving this objective.
To provide increased opportunity for public involvement and participation in environmental planning and assessment	An established mechanism is in place for maintaining an open dialogue between Caltex and the residents of Kurnell. Regular community liaison meetings are held to ensure that the local residents are kept informed regarding important matters relating to the Caltex's current and future planned operations. Caltex has also undertaken additional consultation activities to inform, and receive feedback from, the public and Government agencies in planning the proposed works. This consultation effort has been outlined in **Chapter 6, Consultation**. In addition, DP&I will place the EIS on public exhibition for a minimum of 30 days. In accordance with the requirements of the EP&A Act, stakeholders and the public are invited to make submissions. This process provides further opportunity for public involvement and participation in the environmental planning and assessment process for these proposed works.

Table 20-7 Assessment of Compliance with SEPP

Compliance with State Environmental Planning Policy	Compliance
SEPP on State and Regional Development 2011	The capital value exceeds the $30 million limit set for port and wharf facility development included under Section 18, Schedule 1 of the *SEPP on State and Regional Development 2011* and as such the works classify as State Significant Development (SSD).
SEPP Kurnell Peninsula 1989	The Waterway Zone is defined under Part 2(9) of this SEPP. A small portion of the proposed works would take place within this zone. The Waterway Zone is categorised as a prescribed zone under Division 13 of SEPP Infrastructure 2007 which identifies the proposed dredging works and launch jetty as a permissible form of development requiring development consent under clauses 69(1) and 69(3) of SEPP Infrastructure 2007.
SEPP Nº 33: Hazardous and Offensive Development 1992	A preliminary hazard analysis (PHA) has been prepared to support this EIS. The PHA was used to determine the hazards to people, property and the environment resulting from the proposed works. It concluded by setting out a number of recommendations and measures, which if maintained by Caltex throughout, would not exceed the acceptable level of risk adopted in *Hazardous Industry Planning Advisory Paper (HIPAP) Nº 4 – Criteria for Land Use Safety Planning*.
SEPP Nº 55: Remediation of Land 1998	This SEPP requires that a consent authority considers the suitability of land for a proposed development. Ultimately, a consent authority needs to be satisfied that a site is suitable for its proposed use or can and will be made suitable, based on what they know of the site. The proposed works are taking place 'on land' that is not notified as being contaminated under the Contaminated Land Management Act 1997. However, the project site does contain contaminated sediments. Associated with these sediments would be a residual concentration of tributyltin (TBT), which has been calculated to exceed the sediment quality limits set by the *Guidelines for Fresh and Marine Water Quality* 2000 where the sediment deposition exceeds approximately 15-20 mm. This would therefore not impact any of the identified receptors considered within this EIS. The works would also be subject to the preparation and approval of a remediation action plan (RAP).
SEPP Nº 62: Sustainable Aquaculture 2000	This SEPP applies to '*natural water-based aquaculture'* and '*oyster aquaculture*'. Schedule 2 of this SEPP requires the identification of sites of natural water-based aquaculture. However at the time of preparing this EIS no such sites have been identified or included under the SEPP.
SEPP Infrastructure 2007	Development consent for the proposed works would be sought for the development to the existing port facilities and for the dredging component under clauses 69(1) and 69(3) this SEPP.

20.6 Project Justification

The proposed works would allow Caltex to satisfy its business objectives by continuing to meet the current and projected future demand for petroleum products in NSW and the ACT. The objectives would be met by upgrading an existing asset and extending its operational life by 50-years. This approach is in preference to installing completely new supply infrastructure, which would require a greater demand on natural resources, and would likely result in a number of additional permanent impacts over and above those associated with the proposed works.

The proposed works also bring improved shipping economics, the result of which would be a reconfiguration of the berthing arrangements and an effective drop in the number of ships accessing the Kurnell port and berthing facility following the works. This would be achieved by returning the effective depth of the seabed across the project site to its previous operational state, expanding the fixed berths, and upgrading the port and berthing facility infrastructure.

Whilst there are a number of residual environmental risks associated with the proposed works none of these would result in a significant adverse residual environmental impact or any significant cumulative effect (see **Chapter 18, Cumulative Effects**). As such, the residual effect on the existing environment and the environmental, social and economic resources, receptors and values that form it would not be compromised.

Key impacts relate to the deposition of sediment, the impacts of noise and the loss of the fabric that forms part of what is a locally listed heritage item. There are a number of unknown effects, which include the moderate potential for discovering maritime heritage (principally in the turning circles and approaches) and the need to validate the modelling through further monitoring. However these effects are considered acceptable in terms of the conservative approach that has gone into informing the technical assessments and the adoption of the precautionary principle in setting and defining mitigation and management measures.

20.7 Conclusion

This EIS document provides a comprehensive assessment of the proposed works and includes investigations regarding all relevant technical, social, planning and environmental issues.

Potential adverse impacts along with any residual impact and effects arising from the proposed works have been identified in a variety of ways, which have included consultation, a review of planning and design standards, and consideration of relevant performance criteria (threshold limits) and design criteria, all of which have been used to define and assess significance.

Arising from this EIS has been the identification of strategies to ensure that Caltex can adequately avoid, minimise and mitigate identified impacts. Those strategies have been consolidated in to a single table of mitigation and management measures (see **Chapter 19, Mitigation and Management Measures**). If development consent was granted these would be consolidated in to the CEMP, DSDMP or included as specific measures to be implemented during the design or implementation of the proposed works. There are a few mitigation and management measures that would be implemented to support the ongoing operations however in the majority there would be little change from how the facility is currently operated and managed.

The proposed works have also been designed (as far as reasonably practical) to address the issues of concern to the community, stakeholders, statutory agencies and Government. This EIS has identified that the proposed works can proceed because they would result in no material significant residual effect on the existing environment.

With the submission of this EIS for exhibition, assessment and determination Caltex feels it has provided just reason for the works to proceed. This is on the basis of providing appropriate design controls and mitigation and management measures sufficient to meet the expectations of the community, Government agencies and other interested stakeholders, whilst making provision for uncertainty through the adoption of precaution in every instance and without exception.

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