Chapter 14

Marine and Coastal Environment

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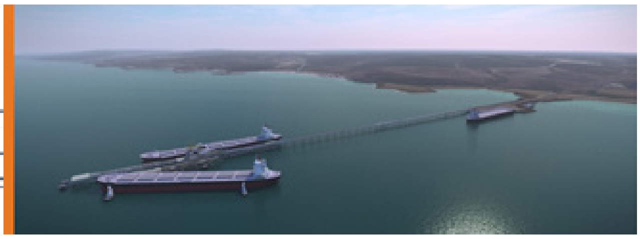


14 Marine and Coastal Environment

This chapter provides an overview of the existing marine and coastal environment of Spencer Gulf, in particular, in the vicinity of the proposed port development at Cape Hardy. An assessment of the likely impacts and risks to the marine and coastal environment resulting from the construction and operation of the proposed port has been undertaken, with management and/or mitigation measures proposed to reduce these impacts where appropriate.

This chapter is restricted to the marine and coastal environment only. Consideration of ecological values in the terrestrial environment at the proposed port site development is discussed separately in Chapter 13 Terrestrial Flora and Fauna.

14.1 Applicable Legislation and Standards

Flora and fauna that are threatened and marine and/or migratory species (legislatively granted by Conservation Status) within South Australia are protected both at the Commonwealth and at the State level. Additionally, all native vegetation (such as seagrass) is protected. Protection of marine values is also provided for through the establishment of marine parks and protected aquaculture and commercial fishing resources. Waste management procedures for the control of pollution from ships and ports are also regulated to prevent a reduction in water quality and the introduction of pest species.

The relevant operative legislative documents within South Australia are:

- *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*(EPBC Act)
- *Harbours and Navigation Act 1993 (SA)*
- *Native Vegetation Act 1991 (SA)*
- *National Parks and Wildlife Act 1972 (SA)* (NPWA)
- *Fisheries Management Act 2007 (SA)*
- *Marine Parks Act 2007 (SA)*
- *Aquaculture Act 2001 (SA)*
- *Coast Protection Act 1972 (SA)*
- *Protection of Marine Waters (Prevention of Pollution from Ships) Act 1987*
- *Natural Resource Management Act 2004 (SA)*
- *Environment Protection Act 1993 (SA)*

A detailed overview of the requirements and obligations of the relevant legislation is provided within the Marine and Coastal Environment Impact Assessment Technical Report (Appendix Q), the Marine Environmental Noise Assessment (Appendix S) and Chapter 5, Statutory Framework. Specifically, the following standards provide a range of assessable criteria relevant to the marine and coastal environment:

- Environment Protection (Water Quality) Policy 2003
- ANZECC Guidelines for Fresh and Marine Water Quality 2000
- Aquaculture (Zones – Port Neill) Policy 2008
- National Assessment Guidelines for Dredging 2009
- Australian Ballast Water Management Requirements 2011
- Underwater Piling Noise Guidelines (DPTI 2012)

The Environment Protection (Water Quality) Policy aims to achieve the sustainable management of waters in South Australia, utilising the ANZECC Guidelines for Fresh and Marine Water Quality (2000) as water quality trigger values, to establish discharge limits for particular activities.

The Aquaculture (Zones – Port Neill) Policy identifies the location of the Port Neill Aquaculture Zone and Port Neill Aquaculture Exclusion Zone. It also designates the classes of aquaculture permitted within the Zone, and outlines the criteria to be taken into account when applying for an aquaculture licence.

The National Assessment Guidelines for Dredging set out the framework for the environmental impact assessment and permitting of ocean disposal of dredged material. Although dredging is not proposed at the proposed port, the National Assessment Guidelines for Dredging were used as a basis for assessing impacts relating to sedimentation that were not covered by other guidelines or policy.

The Australian Ballast Water Management Requirements outline mandatory procedures to reduce the risk of introducing harmful aquatic organisms to Australian waters through ballast water from international vessels. The Australian Ballast Water Management Requirements prohibit the discharge of ballast water within Australian waters that is considered to be of high risk. High risk ballast water is all salt water from ports or coastal waters outside of Australian waters.

The Underwater Piling Noise Guidelines (DPTI 2012) provide a framework to minimise the risk of significant impacts to marine mammals. Impacts are minimised through implementation of mandatory management measures.

14.2 Assessment Method

The port site is located at Cape Hardy, approximately 7 km south of Port Neill, and was selected based on a multi-criteria assessment of port options on the Eyre Peninsula which considered environmental, social and engineering constraints. The rationale for the selection of the port site is discussed in further detail in Chapter 3, Project Alternatives.

For the purpose of this chapter, a marine study area was identified as the area of marine and coastal environment being potentially impacted by the construction and operation of the proposed port. The marine study area is depicted in Figure 14-1 extending roughly 6 km along the coastline and 3 km from shore, the study area covered 29 km^2.

Plate 14-1 Encrusting Marine Fauna

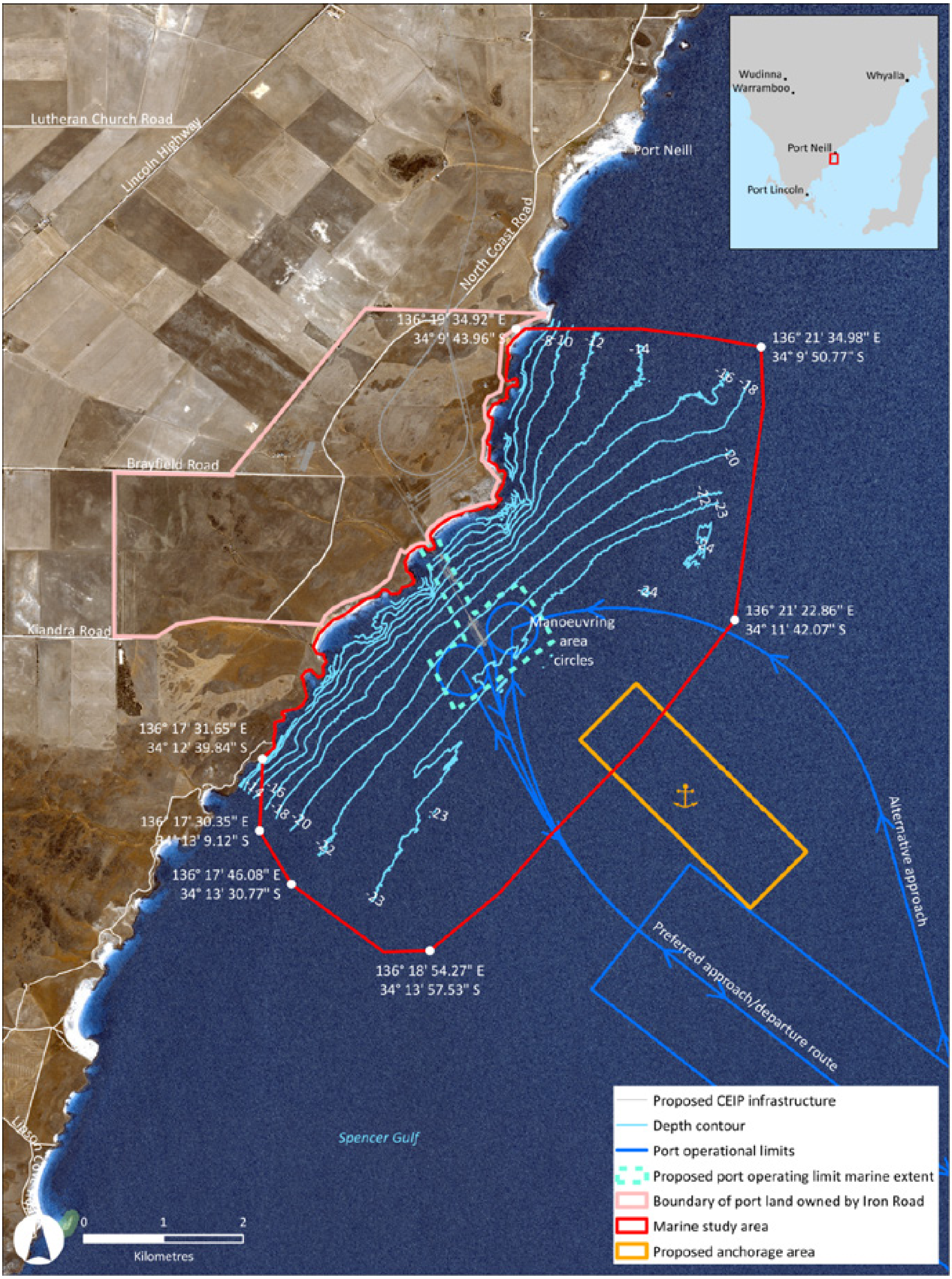


Figure 14-1 Marine and Coastal Environment Study Area

A comprehensive suite of environmental characteristics were assessed to provide an overview of the existing marine environment at the proposed port development site and to provide a basis for the subsequent environmental impact assessment. The methods used to identify environmental values and conduct the impact assessment, ranged from desktop literature review, to in-field survey or sampling and detailed modelling based upon existing or collected data. The environmental parameters and methods of investigation applied to each of the environmental characteristics are summarised in Table 14-1. A detailed overview of the methods employed in assessing existing values and impacts to the marine and coastal environment is provided in Appendix Q, R and S.

Table 14-1 Data Sources

Environmental Parameter	Data Sources and Study Method
Bathymetry	· Marine navigation charts from the Australian Hydrographic Office · Personal communications with Captain Walter Ferraro (DPTI) · High-resolution bathymetric survey undertaken at the port site (Hydro Survey 2012)
Hydrodynamic Environment	· Available data and literature from relevant local authorities, including the BOM, CSIRO and SARDI · Port Spencer marine baseline quantitative surveys (Golder Associates 2012) · Site-specific surveys, including Acoustic Doppler Current Profiling (ADCP) and temperature, salinity, tide and wave climate logging · Hydrodynamic and wave modelling (presented in Appendix R)
Seabed Conditions	· Towed video survey of seabed and mapping of seabed features · Seabed sediment sampling to ascertain particle size distribution, and chemical analysis and detection of contaminants · Cape Hardy geophysical surveys including side scan sonar, sub-bottom profiling, continuous marine seismic refraction and geotechnical borehole calibrations (MES 2012)
Water Quality	· Publically available published literature, including data from the EPA · Port Spencer marine baseline quantitative surveys (Golder Associates 2012) · Water sampling of surface and bottom waters and analysis for baseline
Marine and Benthic Habitats and Flora	· Publically available published literature · National and State benthic habitat map (Nature Maps) · EPBC Protected Matters Database · Biological Database of South Australia · Atlas of Living Australia online database · Towed video benthic habitat survey
Benthic Fauna, Fish Species and Marine Megafauna	· Publically available published literature · EPBC Act Protected Matters Database · National and State benthic habitat map · Atlas of Living Australia online database · Towed video benthic habitat survey · Incidental sightings during benthic habitat surveys
Marine Noise and Vibration	· Underwater noise modelling report (presented in Appendix S) · Marine fauna species noise threshold based on existing published literature
Fisheries and Aquaculture	· Aquaculture Zones – Port Neill Policy 2008 · Land not within a Council Area (Coastal Waters) Development Plan · PIRSA Aquaculture Public Register · Publically available published literature – SARDI fisheries reports · Incidental sightings during benthic habitat surveys

Environmental Parameter	Data Sources and Study Method
Invasive Marine Species (IMS)	· Global Invasive Species Database · Australian Government Department of Agriculture resources (including interactive map of known IMS) · Publically available published literature · EPBC Protected Matters Database · Biological Database of South Australia · Atlas of Living Australia online database · Opportunistically during review of video tow survey (none identified)

14.3 Existing Environment

This section provides an overview of the existing environment and values at Cape Hardy (Plate 14-2 and Plate 14-3) within the marine study area and in the broader Spencer Gulf. Environmental values are discussed in terms of the environmental characteristics previously identified in Table 14-1.

Plate 14-2 Cape Hardy

Plate 14-3 Cape Hardy from Spencer Gulf

14.3.1 Bathymetry

The Spencer Gulf is a semi-enclosed body of water bordered by the Yorke Peninsula to the east and the Eyre Peninsula to the west. The Gulf extends for approximately 300 km from Port Augusta in the north to the entrance. It has a maximum width of 130 km, narrowing to less than 1 km in the upper Gulf. The Spencer Gulf is a relatively shallow body of water, with a typical depth of 40 m in the lower Gulf and 15 m to 20 m in the northern reaches (Bullock 1975). Two main channels with an average depth of approximately 40 m are located within the southern and central regions of the Gulf (DEH 2003).

The key findings of the detailed hydrographic survey (Hydro Survey 2012) at the Cape Hardy site include:

- Sub-tidal bathymetry at Cape Hardy generally has low relief and is free of significant navigational hazards.
- Rocky projections within the study area are restricted to the in-shore areas close to headlands and intertidal zones.
- The 20 m depth contour is generally at 750 to 1200 m from shore (at lowest astronomical tide (LAT)).
- The site was generally suitable for the establishment of a port facility as it is accessible to deep water and free of significant navigational hazards.

A detailed hydrographic map of the marine study area, local benchmarks and sounding charts are available in Appendix R.

14.3.2 Hydrodynamic Environment

Spencer Gulf is an inverse estuary, meaning that evaporation exceeds the minimal freshwater input. The enclosed nature of the Spencer Gulf results in a trend of increasing temperature and salinity towards the upper reaches, particularly in summer months.

The hydrodynamic modelling of the study area predicts that the highest current flows and bed shear (nearshore sediment deposition and / or erosion) are generally experienced at the Cape Hardy point proper with a second, slightly weaker area of high current and bed shear located at a southern headland (refer to Appendix R).

Current Flow Regime

Spencer Gulf has an unusual tidal regime with large tidal ranges, 0.0 m to 4.0 m (BOM 2015) and neap tides roughly every fortnight (Harvey et al. 1995). Spring tides have a greater tidal range and occur fortnightly on a full or new moon. These tides range over 4.0 m compared to the mean tide range of approximately 1.5 m (DEH 2003). During neap tides, the tidal range is 0 m and all tidal movements cease for a period of two to three days (Lennon et al. 1987).

In the gulf, funnelling tidal movement may also affect tidal amplitude (Harvey and Caton 2010); therefore the spring tide range at Port Lincoln is 2.0 m, while at Port Augusta it is 3.9 m. As the port site lies further up the gulf it would be subject to some increased tidal amplitude especially during major storms which could raise tides 1.0 m to 1.5 m above predicted heights (Harvey and Caton 2010).

Overall, the upper Spencer Gulf is a relatively sheltered ecosystem subject to low wave energy. Wave energy ranges from moderate at the lower Gulf to very low in the upper Gulf (Harvey and Caton 2010).

Thermohaline currents (flow of ocean water caused by changes in temperature, or the addition of fresh water or salt) are the result of density variations caused by evaporation over the Spencer Gulf region and subsequent temperature and salinity differences. Upper portions of the gulf become highly saline during summer as a result of evaporation. The highly saline water flows out of the gulf along the seafloor to be replaced by less saline (less dense) water flowing along the surface creating a net transport of saline water out of the gulf (Alendal et al. 1994; Middleton et al. 2013).

Currents at the port site were recorded by an ADCP over three deployment periods between January and September 2012. Currents travel parallel to the shoreline following the bathymetry contours with the exception of currents around Cape Hardy which circulate in a bay. The current speed ranges at the port site are depicted in Table 14-2.

Table 14-2 Current Speeds

Current Type	Speed Range (m/s)
Spring Flood	0.30 – 0.35
Spring Ebb	>0.35
Neap Flood	0.25 – 0.30
Neap Ebb	0.25 – 0.30

Wave Regime

Wave data was recorded by the ADCP unit in the deployment period between January and August 2012. Wave data was recorded over the duration of the deployment period and recorded significant wave height, peak period, and peak direction.

Significant wave heights of up to 2.6 m were recorded over the field programme; however waves were typically less than 1.5 m. One event with significant wave heights in excess of 2 m was recorded during the ADCP unit deployment. Peak wave direction was predominantly between southerly and easterly. Peak wave periods were dominated by wind swell with typical intervals between waves of approximately 5 seconds. Occasionally longer period waves dominate the wave record with peak periods typically between 9 and 15 seconds. The significant wave height of long period swells rarely exceed 0.5 m.

The wave regime is indicative of the overall wave regime in the Spencer Gulf. The Spencer Gulf is a relatively sheltered ecosystem with low, to moderate wave energy primarily driven by tidal currents.

Temperature

Water temperatures were recorded at 12 locations in the marine study area at eight depth intervals over 16 m from the seabed or six depth intervals over 2 m from the surface. Strong diurnal variation in the water temperature was recorded throughout the deployment due to the strong influence of solar heating and night time cooling. This effect is more apparent at the surface than at depth and gives rise to a diurnal thermal stratification. The ADCP was deployed over a nine month period, capturing all seasons, the general trend in water temperatures is downward following summer, from around 23°C to 21°C near the surface, and to 22.5°C to 20.5°C at depth.

Salinity

Given the high rates of evaporation and lack of freshwater inputs within the Spencer Gulf, salinity is known to increase within the upper regions. Lateral salinity gradients are reported, with salinity typically greater in the eastern portion of the Gulf (Ansell 1997). Within the marine study area, salinity was recorded at five locations at various depths in the water column. For the sample period January to September, salinity levels at the sample sites for surface to bottom waters were typically between 36 to 38 psu. Higher salinities and variation were recorded at the surface during summer, presumably due to evaporation. Lower in the water column (i.e. at depth) salinities were comparable at each of the recorded locations and were approximately 1 psu lower than at the surface.

14.3.3 Seabed Conditions

A geophysical survey was conducted in 2012 to document seabed conditions and the distribution of loose sediments within the marine study area. Rocky reef occurs in discrete patches of shallow water close to the shoreline, with the rocky projections restricted to the in-shore areas close to headlands.

In terms of particle size distribution (PSD), the southern extent of the marine study area had a greater proportion of fine particle size sediments than in the north. Particle size increased closer to shore compared to sites sampled further from shore, which generally had a greater portion of fine sediments. In shallow waters, the substrate is dominated by sand, both vegetated and bare, which becomes silty with greater distance from the shoreline. Towards the northern extent of the marine study area, sand substrate dominated with no silt being observed. The PSD is consistent with benthic habitat observations of the seabed geomorphology as depicted in Figure 14-2.

Northern portions of the study area were often covered with dense seagrass, which was of sufficient density to obscure visual classification of the benthos in several places, with mats dense enough to prevent penetration of remote sediment grabs.

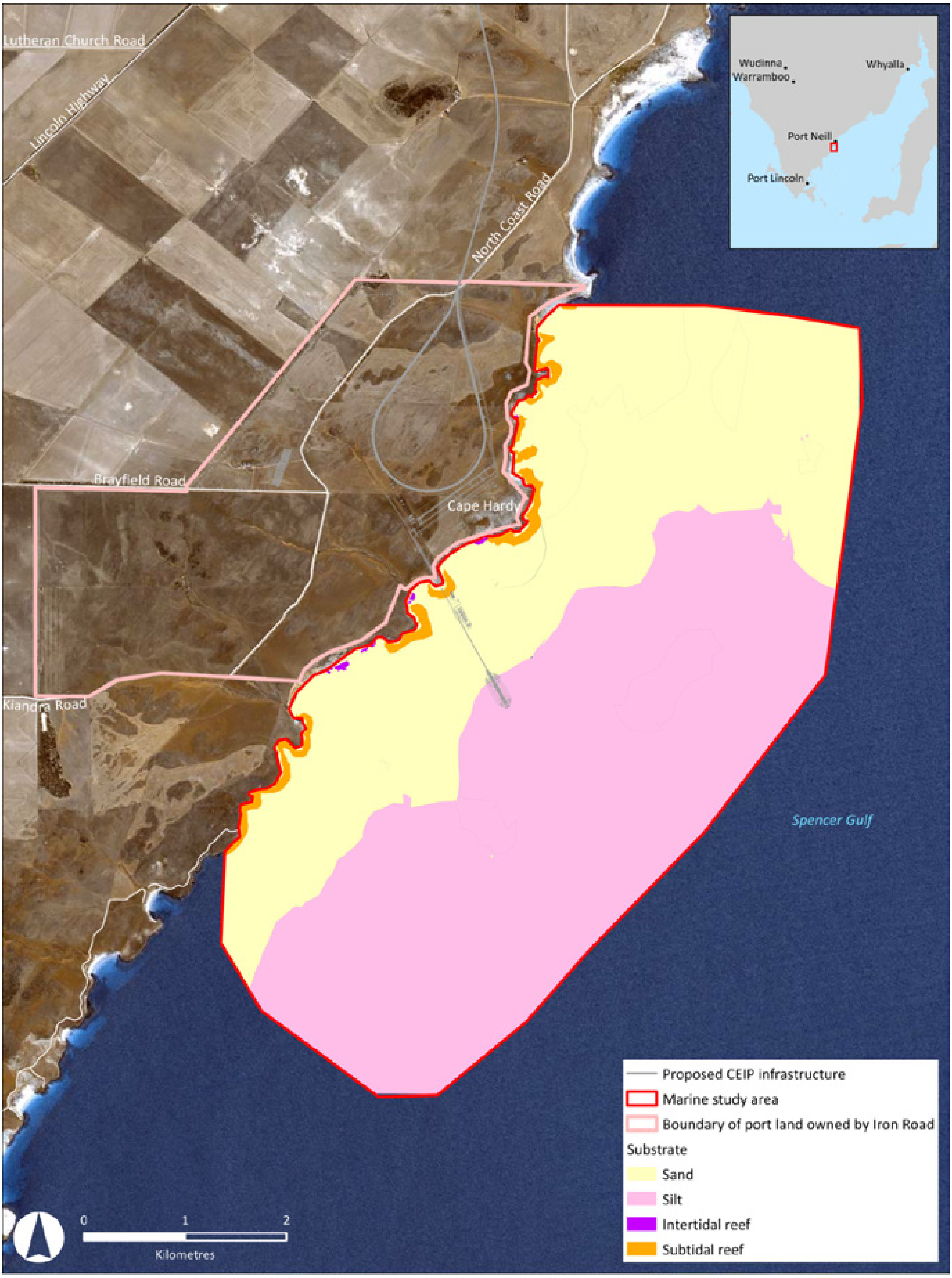


Figure 14-2 Seabed Substrate Type, Determined from Video Transects and Sediment Grabs

14.3.4 Water Quality

Water quality samples were collected across the marine study area to document water quality conditions at the port site and provide a baseline level of information. A number of the sampled values were below the limit of detection (LOD) of the laboratory and in those cases conservative values equivalent to the LOD were presented rather than zero. The full results of the water quality analysis are provided in Appendix Q.

The key findings of the water quality sampling indicate that:

- The levels of metals in surface and bottom water samples taken within the marine study area were compared to the Environment Protection (Water Quality) Policy criteria for marine waters. Levels of metals were generally well below the criteria outlined in the guidelines, with the exception of copper which was at a level of 0.01 mg/L (approximately equal to the criteria).
- Two sample sites had concentrations above the Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines for arsenic, considered to be naturally occurring. Across the marine study area the concentrations of metals were observed to increase in a linear fashion progressing north-eastwards.
- A comparison of concentrations of metals at the marine study area with those of other locations in Spencer Gulf indicated that the concentrations of dissolved metals at the marine study area are below or at similar levels to other operating ports within Spencer Gulf.
- Concentrations of nutrients in surface and bottom waters at the marine study area are low, often at or below the LOD. There was little difference in concentrations between surface and bottom waters, suggesting that the water column was well mixed and homogeneous in nutrient composition.
- The concentration of chlorophyll-a was low within the marine study area, with average concentrations ranging from 1 to 3 mg/m^3. The low levels of chlorophyll-a is characteristic of waters in Spencer Gulf (van Ruth and Doubell 2013).
- All other reported water quality values were either at or below the relevant criteria outlined by the Environment Protection (Water Quality) Policy criteria for marine waters, or were below the LOD.

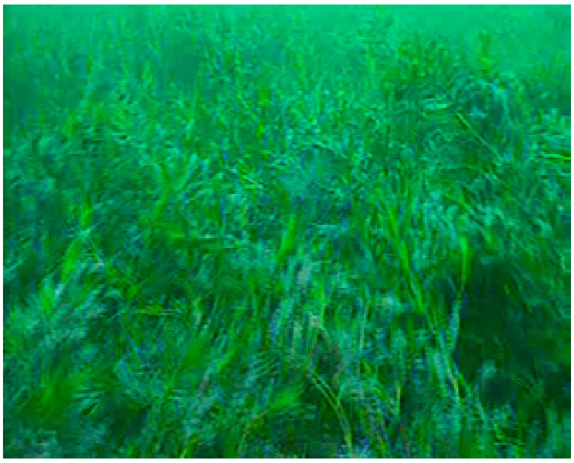
Approximately 40% of the world's oceans can be described as representing a 'high-nutrient low-chlorophyll' (HNLC) system, where the key limiting variable to primary productivity is bio-available iron (Bowie et al. 2001). The waters of the Spencer Gulf are known to be naturally low in nutrients (van Ruth and Doubell 2013), and readily responsive to nutrient inputs (Russell et al. 2005). Gulf environments adjacent to human population have suffered substantial eutrophic effects and seagrass losses as a result of nutrient-rich runoff (Hecky and Kilham 1988; Walker and McComb 1992).

The water quality sampling at the marine study area detected levels of dissolved iron well above those present in true iron-limited HNLC systems. South Australia's gulfs do not fit the definition of a HNLC system as waters are naturally low in nutrients (SKM 2011).

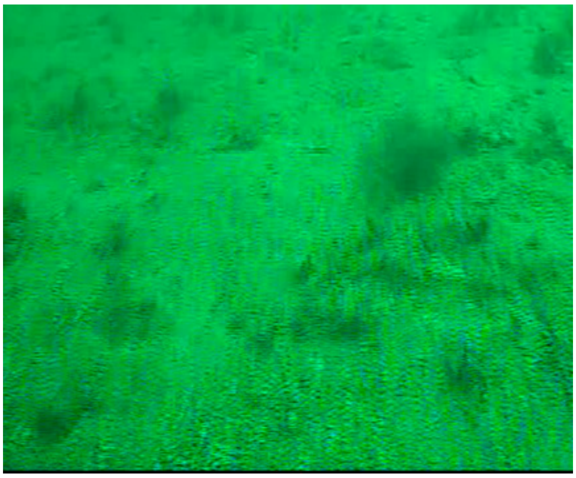
14.3.5 Benthic Habitats and Flora

The marine study area includes areas covered by dense seagrass as depicted in Plate 14-4 and Figure 14-3. Seagrass meadows are considered a habitat of high conservation value as they are associated with a host of secondary benefits, including key roles in carbon and nutrient cycling (Duarte and Cebrian 1996), sediment stabilisation (DeBoar 2007), supporting higher biodiversity (Edgar et al. 1994) and providing nursery habitats for many commercially fished and other species (Beck et al. 2001; Jackson et al. 2001; Heck et al. 2003).

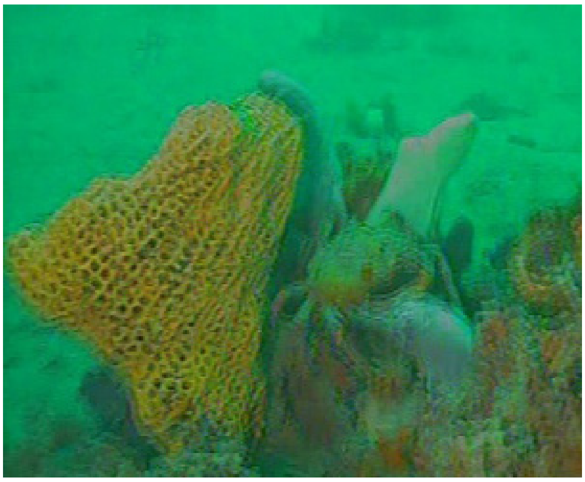
Shallow Benthos Seagrass (Posidonia sp.)



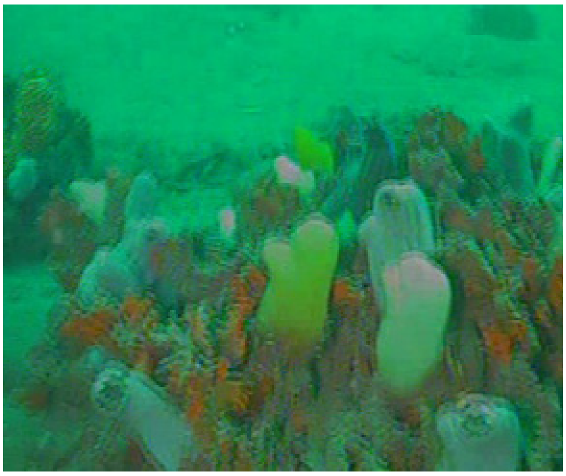
Shallow Benthos Dense seagrass (A. antarctica)



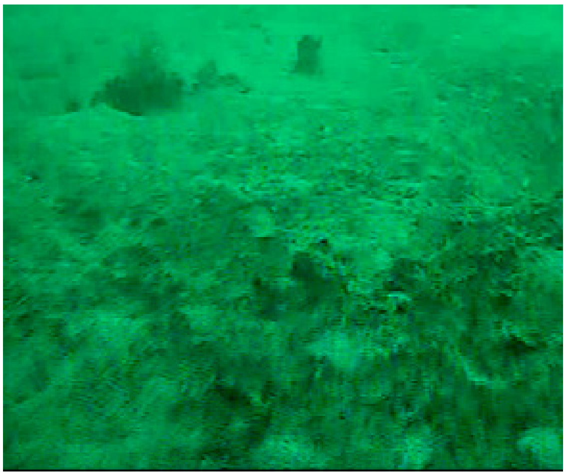
Mid-benthos Bare substrate with very sparse mixed small algae (<1% Cover)



Deep Benthos Sponge groups, ascidians and other mixed invertebrates



Deep Benthos Sparse sponge groups, ascidians and other mixed invertebrates



Deep Benthos Cyanobacterial mat

Plate 14-4 Typical Benthic Habitats and Flora (screen-shots from video-tow)

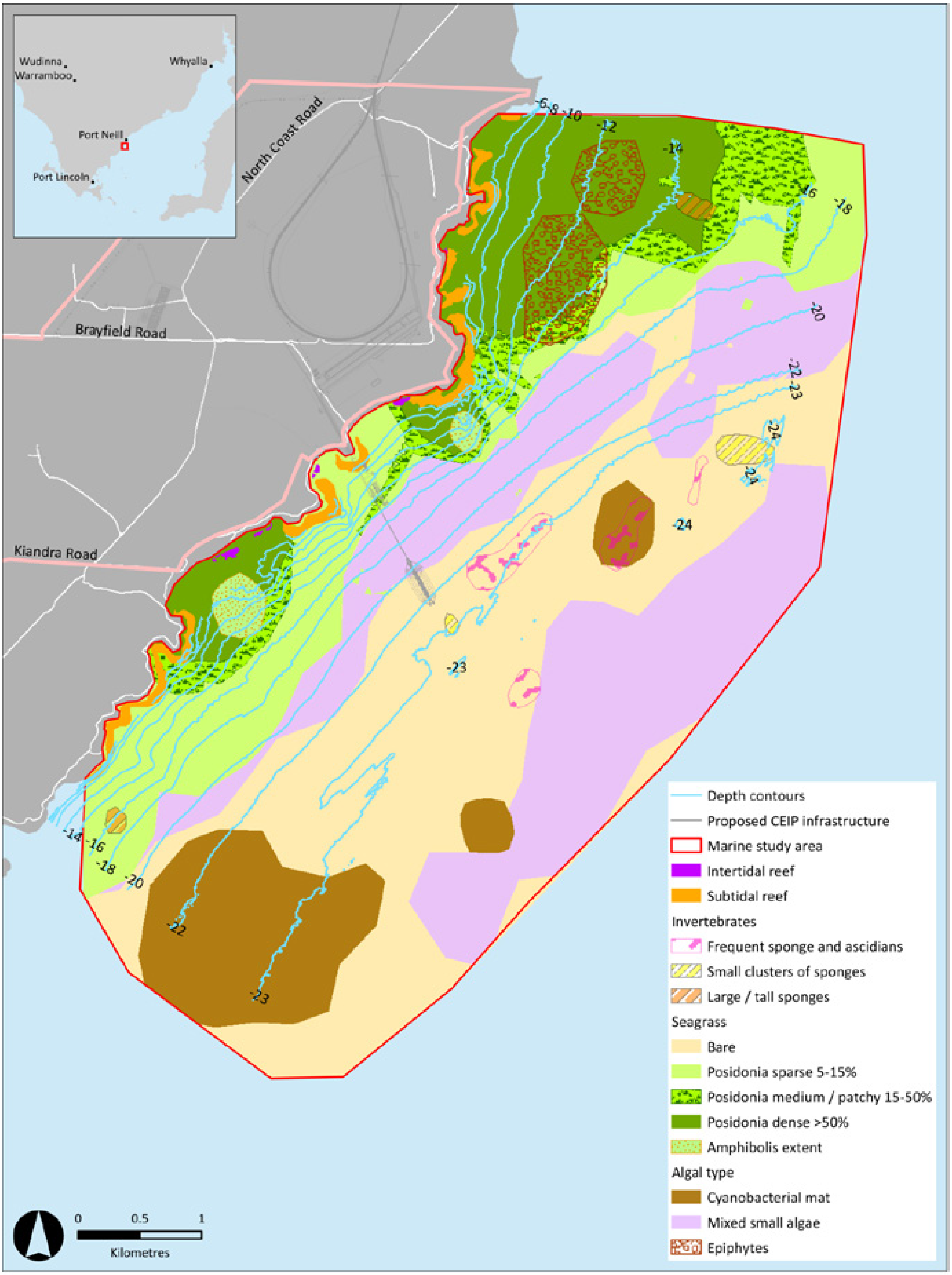


Figure 14-3 Benthic Habitat Map for Cape Hardy Area

It has been established that 12 of the 59 species of seagrass found worldwide are present in South Australia's gulf waters, where some of the most extensive seagrass meadows in Australia are represented. Spencer Gulf has approximately 5,520 km^2 of seagrass coverage, representing around 60% of total seagrass coverage in South Australian waters. The marine study area falls within the Spencer Gulf bioregion, which supports an estimated seagrass coverage of 1,377 km^2 (Edyvane 1999). It is considered that the Spencer Gulf as a whole could comprise up to 10% of all seagrass habitat in Australia (Edyvane 1999).

It should be noted that in November 2013 the Posidonia seagrass meadows were nominated for protection as an "endangered" ecological community under the EPBC Act, despite several review periods a formal decision on this nomination has not yet been published by the Department of the Environment (DoE, 2015). Therefore for the purposes of this assessment we have only considered the level of protection under the Native Vegetation Act 1991.

Previous studies indicate that the Spencer Gulf seagrass meadows within the intertidal zone are dominated by *Zostera* sp. and *Heterozostera* sp. A species shift to *Posidonia* spp. occurs below the low tide mark with *P. australis* dominating in shallower waters, and *P. sinuosa* and *P. angustifolia* becoming more dominant with increasing depth (Seddon, 2000). Other species such as *Amphibolis antarctica*, *A. griffithii*, and *Heterozostera nigricaulis* occupy edges, blowouts, and smaller areas (Edyvanne 1999). The local distribution and abundances of these species are affected by numerous factors, including wave energy, tidal velocity, sediment stability, and light availability (Shepherd and Robertson 1989). A conceptual cross section of the habitat within the marine study area is presented in Figure 14-4.

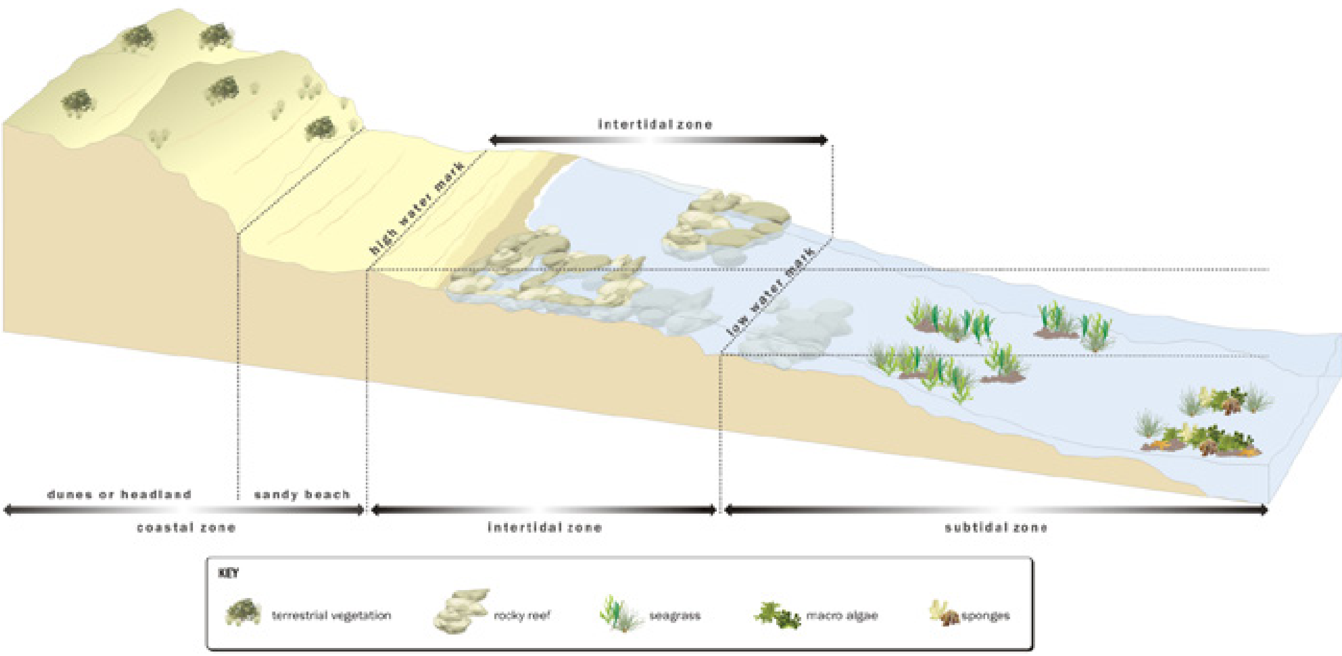


Figure 14-4 Conceptual Cross Section of Marine Habitat

Historical data concerning the benthic habitat at the marine study area was limited to benthic surveys carried out to support two aquaculture leases previously granted within the marine study area (both leases were surrendered in 2013). These benthic surveys showed sparse biota with no seagrass populations or benthic communities. The biota observed on the lease sites comprised very small clumps of Chlorophyta and Phaeophyta (i.e. green and brown) algae (PIRSA 2008).

A benthic habitat survey of the marine study area was conducted in November 2011 via video towed transects. Analysis of the towed video footage generated a high-level benthic habitat map and is depicted in Figure 14-3. It shows that benthic flora appeared to follow depth and substrate contours with a higher density of flora coverage at shallower depths and toward the north of the study area. The primary habitat types recorded in the marine study area are:

- The Shallow Benthos (< 16 m depth): comprises seagrass meadow predominantly *Posidonia* spp., with some *A. antarctica* patches restricted to shallower waters (< 12 m depth).
- The Mid Benthos (< 18 m depth): comprises mainly bare fine sand and silty sediment with very sparse mixed small algae, *Posidonia sp.* and occasional scattered invertebrates.
- The Deep Benthos (> 20 m depth): comprises bare silt dominated by clumps of mixed invertebrates (sponges, ascidians, molluscs and both motile and immotile shellfish). Very sparse, mixed small algae were also present, along with some evidence of cyanobacterial matting. It was observed that no dense seagrass beds were observed beyond 19 m of depth and macroalgae became uncommon after 21 m depth.
- Rocky Reefs: occurs in discrete patches of shallow water close to the shoreline.

14.3.6 Benthic Fauna

The physical isolation of the Spencer Gulf along with a lack of oceanic upwelling and low volumes of freshwater inputs has led to increased salinities and resource scarcity within the gulf (van Ruth and Doubell 2013). These physical conditions have contributed to high levels of endemism within the upper gulf; however the lower gulf has more in common with the region of all of southern Australia (Poore 1995).

Previous studies of the benthic invertebrate and infauna assemblages within the Spencer Gulf have focused on the northern and upper Gulf regions (Shepherd 1983; Ainslie et al. 1989; Hutchings et al. 1993; Ward and Hutchings 1996). There have been no systematic surveys carried out across the entire gulf (Gillanders et al., 2013). Hutchings et al. (1993) investigated the infaunal community of marine sediments and seagrass beds in the upper Spencer Gulf (near Port Pirie) and showed polychaetes to be the dominant invertebrate taxa, comprising up to 76% of the infauna species in *Posidonia* seagrass beds and 48% of the infauna in *Zostera* beds. Other infauna taxa found within Spencer Gulf include crustaceans, molluscs, ascidians and echinoderms.

The distribution of polychaete, mollusc and crustacean infauna in the upper Spencer Gulf has been connected to concentrations of trace metals in sediments (As, Cu, Mn, Pb and Zn) with areas dominated by polychaetes correlated with areas of higher trace metals (Ward and Hutchings 1996). These studies were generally carried out in areas of high anthropogenic disturbance. Areas with a high level of disturbance can also change sediment composition i.e. distribution of grainsize can lead to differences in taxa between sites with delicate bivalves such as *Tellina sp.* preferring undisturbed coarse sand, whereas opportunistic taxa such as polychaetes colonise areas of high disturbance in either silt or gravel.

Taxonomic identification and counting of sediment samples from 15 sample sites within the marine study area was undertaken to determine infaunal diversity. The results of the benthic infaunal analysis are presented in Appendix Q. The results indicate that the shallowest transect had the greatest infaunal diversity with the highest number of organisms per sample and greatest number of taxa. This shallowest transect was aligned with dense areas of seagrass habitat.

Moving from north to south through the marine study area, the trends of infauna diversity align with seagrass coverage with the highest infauna diversity in the northern section of the marine study area and the lowest diversity of infauna recorded at the southern extent of the marine study area.

The results of the infauna sampling indicate that the overall habitat health of the study area is good with diverse taxa identified within nearshore and seagrass areas. Areas of decreasing diversity aligned with areas of no seagrass coverage, anoxic sediments and elevated levels of some metals.

Analysis of the towed video footage identified a number of epifaunal invertebrate species that were present within the marine study area. None of the identified species are protected under the EPBC Act or NPW Act and therefore do not carry any particular conservation status.

The distribution of many marine organisms is governed by the tide, where the maximum ranges or physiological tolerances to desiccation and exposure or submergence and salinity dictate where an organism can survive. For this reason, findings from investigations were separated into marine habitats based on their geographic location within the natural tidal range, i.e. areas above the high tide mark were deemed coastal habitats and classed as the coastal zone, areas below the high tide mark but above the low tide mark are classed as intertidal zone, while areas below the low tide mark are classed as the subtidal zone (see Figure 14-4).

14.3.7 Marine Megafauna

Database and literature reviews identified protected megafauna species that have the potential to occur in waters around the Spencer Gulf region and are presented in Table 14-3. Species are classed as common, uncommon, rare or vagrant based on the frequency which they are seen in the region (Caton et al. 2011).

Table 14-3 Protected Marine Megafauna Potentially Occurring in the Spencer Gulf Region

Common Name	Scientific Name	EPBC Listing	NPW Listing	Frequency[1]
Cetaceans				
Southern Minke Whale	Balaenoptera bonaerensis	Cetacean, Migratory	-	U
Bryde's Whale	Balaenoptera edeni	Cetacean, Migratory	Rare	R
Blue Whale	Balaenoptera musculus	Endangered	Endangered	U
Pygmy Right Whale	Caperea marginata	Cetacean, Migratory	Rare	U
Common Dolphin	Delphinus delphis	Cetacean	-	C
Southern Right Whale	Eubalaena australis	Endangered	Vulnerable	C
Southern Bottlenose Whale	Hyperoodon planifrons	Cetacean, Migratory	Rare	R
Humpback Whale	Megaptera novaeangliae	Vulnerable	Vulnerable	C
Bottlenose Dolphin	Tursiops aduncus	Cetacean	-	C
Pinnipeds				
New Zealand Fur Seal	Arctocephalus forsteri	Marine	-	C
Australian Fur Seal	Arctocephalus pusillus	Marine	Rare	V
Subantarctic Fur Seal	Arctocephalus tropicalis	Vulnerable	Endangered	V
Australian Sea Lion	Neophoca cinerea	Vulnerable	Vulnerable	C
Reptiles				
Leatherback Turtle	Dermochelys coriacea	Endangered	Vulnerable	R
Loggerhead Turtle	Caretta caretta	Endangered	Endangered	R
Green Turtle	Chelonia mydas	Vulnerable	Vulnerable	R

[1] As reported in Caton et al. (2011) Eyre Peninsula Coastal Action Plan (EPCAP) 2011: C = Common, U = Uncommon, R= Rare, V = Vagrant. All marine mammals (and The Great White Shark) are protected at all times under the Fisheries Management Act 2007.

A brief overview of each of the species identified as common to the region is provided below. Information relating to Blue Whales in the region is also provided due to the potential for ship strike during operation and construction outside of the study area. Additional information about each of the listed species identified as having a reasonable potential to be impacted is provided in Jacobs (2014) presented in Appendix Q.

Large whale species (Blue, Humpback and Southern Right) are migratory in nature and are therefore seasonal visitors to South Australian waters (Plate 14-5). Whale sightings recorded in the Spencer Gulf since 1997 are presented in Appendix T. It should be noted that as the gulf does not represent any known feeding or calving grounds, verified records (assessed for duplication) submitted within the Spencer Gulf are uncommon (Kemper 2005).

Plate 14-5 Humpback Whale

Southern Right Whale

The Southern Right Whale is migratory in nature and therefore is only present in the area on a seasonal basis. Southern Right Whales move from summer feeding grounds in the Southern Ocean to the warmer Australian waters in winter months to calve and breed. Southern right whales are known to be present all along the South Australian coast from May to November during their breeding season. As depicted in Figure 14-5 (DSEWPaC 2012a), the Spencer Gulf does not represent an aggregation area for the species.

It is recognised that the entire South Australian coastline is considered potential habitat for the Southern Right Whale (DSEWPaC 2012). Observations of Southern Right Whales within the Spencer Gulf suggest that the species is only an occasional visitor to the region when compared to the frequency of sightings around the Fleurieu Peninsula. Whale sightings within the Spencer Gulf are presented in Appendix T.

Threats to Southern Right Whales in Australian Waters as described in the Conservation Management Plan for the Southern Right Whale (DSEWPaC 2012a), include entanglement, vessel disturbance, whaling, climate change, noise interference, habitat modification and overharvesting of prey.

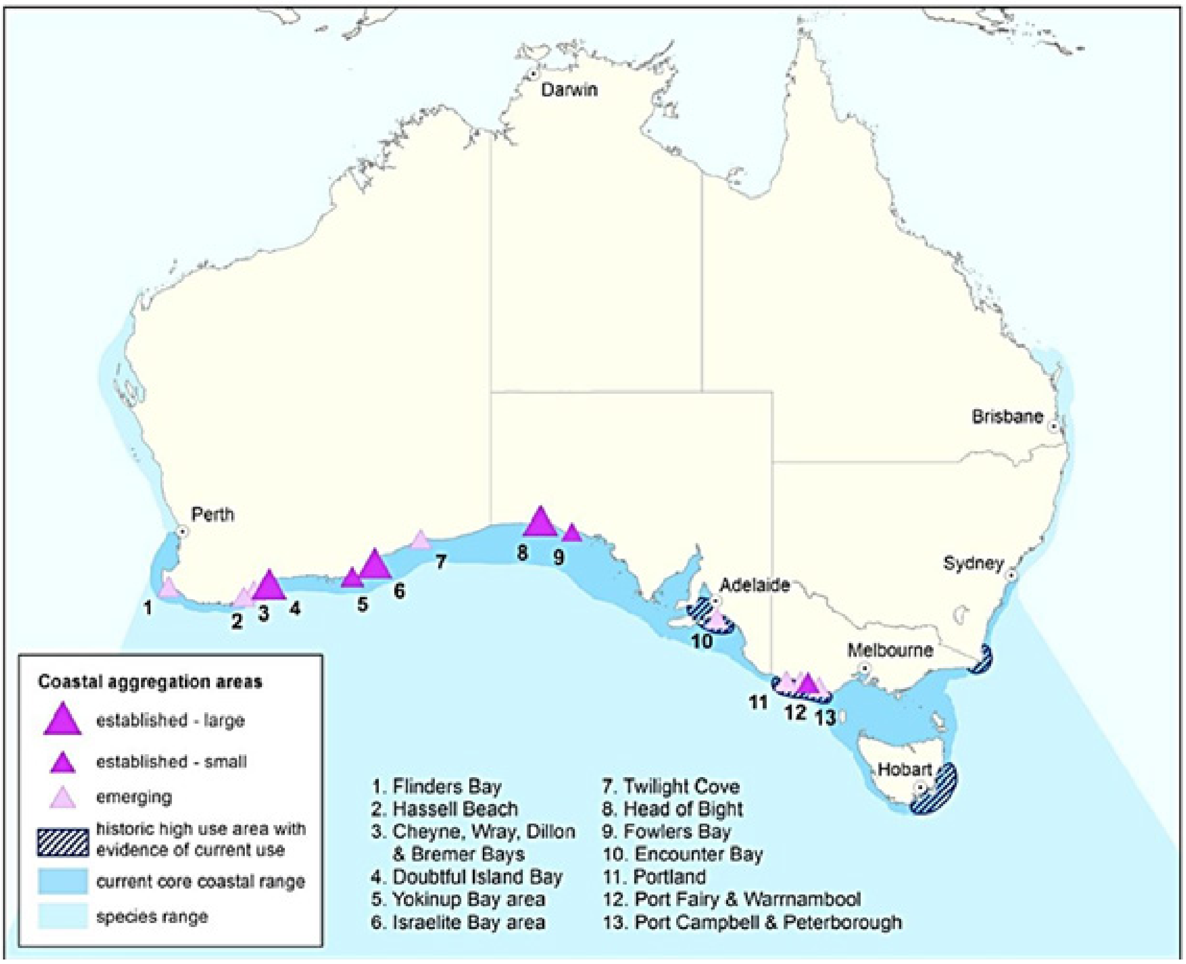


Figure 14-5 Aggregation Areas for Southern Right Whales

Humpback Whale

The Humpback Whale is migratory in nature and therefore is only present in the area on a seasonal basis. Humpback Whales have a large distribution area and generally migrate through Australian waters in autumn through the Southern Ocean, then up the east and west coasts of Australia to aggregation areas on the north coast. Breeding and calving occurs in these aggregation areas during winter and spring before returning to southern waters for the summer months.

Although the main Humpback Whale migration routes exist along the eastern and western Australian coasts, they are occasionally observed in South Australia waters including the Spencer Gulf. In South Australian waters there have been sightings of Humpback Whales in all season, as the species is less predictable in migratory patterns that the Southern Right Whale. As with Southern Right Whales, the Humpback Whale is an occasional visitor to the Spencer Gulf compared to the number of sightings elsewhere in South Australian waters. Whale sightings within the Spencer Gulf are presented in Appendix T.

Known threats to Humpback Whales in Australian waters include entanglement, whaling, noise interference, habitat modification, ship strike and changing water quality (Department of the Environment and Heritage 2005).

Common Dolphin

Common Dolphins (Plate 14-6) are known to occur in the Spencer Gulf region on a year round basis. In general Common Dolphins tend to be distributed evenly across the wider gulf area in open water. They have been recorded in the waters of all Australian States and Territories and are found in shallow and deep offshore waters. Up to six subpopulations of the species have been documented in southern Australia including one that extends from the western Eyre Peninsula through South Australia's gulfs, and into Wilsons Promontory in Victoria (Bilgmann et al. 2014).

A study focused on the Gulf St Vincent established that Common Dolphins appear to have a preference for depths greater than 14 m (Filby et al. 2010). A single common dolphin was observed at the Cape Hardy site during field investigations.

The main threats to the Common Dolphin include indirect catches by commercial fisheries, entanglement in debris, intentional killing and pollution. High levels of cadmium and histological abnormalities have also been found in Common Dolphins in South Australian waters (Department of the Environment, 2013).

Plate 14-6 Common Dolphin Photographed in Marine Study Area

Bottlenose Dolphin

Bottlenose Dolphins are known to occur in the Spencer Gulf region on a year round basis. In general Bottlenose Dolphins have a near-shore coastal distribution and are distributed continuously around the Australian mainland.

The main threats to the Bottlenose Dolphin include indirect catches by commercial fisheries, entanglement in debris, tourism, habitat destruction and degradation, and overfishing (Department of the Environment 2013a). High levels of cadmium, lead, mercury, selenium and zinc have also been found in Common Dolphins in South Australian waters, probably reflecting their coastal habitat and benthic prey preferences (Lavery et al. 2008, Butterfield and Gaylard 2005, Department of the Environment, 2013).

New Zealand Fur Seal

The New Zealand Fur Seal breeds in South Australian waters, with most known pupping sites on the west coast of the Eyre Peninsula (Shaughnessy et al. 2005). They are known to occur throughout the southern Australian coastline and New Zealand. Known pupping sites in the Spencer Gulf region include Neptune Islands (Goldsworthy and Page 2009), 110 km from marine study area and Sir Joseph Banks Conservation Park, 45 km to the south of the marine study area (PIRSA 2008). The Spencer Gulf is a known foraging area for New Zealand Fur Seals, with a high level of use year round (Goldsworthy and Page 2009).

Oil pollution is considered to be of potential concern to New Zealand Fur Seals, whilst pressures such as habitat modification, human presence, collisions with vessels and entanglement were considered to be of 'less or no concern' (DSEWPaC 2012).

Australian Sea Lion

The Australia Sea Lion is endemic to Southern Australia and is only known to occur in South Australian and Western Australian waters (DSEWPaC 2013a; SPRAT 2013). The entire Spencer Gulf, including the study area, is a known foraging range for Australian Sea Lions (Goldsworthy et al., 2007). The species range is vast and includes approximately 30% of the 178,000 km^2 of potential habitat from Western Australia to Kangaroo Island, with individuals known to travel up to 70 km while foraging. Aerial surveys (Shaughnessy et al. 2005) identified several pupping sites around the western and southern coast of the Eyre Peninsula.

A number of pupping sites exist in the southern Spencer Gulf including English Island, Lewis Island and Dangerous Reef (PIRSA 2008). The closest site to the study area is Sir Joseph Banks Conservation Park, including Langton Island (Shaughnessy et al. 2011), approximately 45 km to the south. Investigations revealed no records or signs of sea lions using the study area as a haul out beach. While the species is capable of utilising South Australian waters, they tend to aggregate in offshore areas and breeding colonies which is the focus of their foraging effort.

Plate 14-7 Sea Lions

14.3.8 Fish Species

The Spencer Gulf supports a high diversity of fish species due to its range of marine ecosystems, which provide suitable habitats for both endemic and migratory fish species. In the Cape Hardy area, the predominant habitats are nearshore rocky reef, bare sediments and seagrass beds, which provide habitat and feeding areas for fish, including commonly observed species of pipefish, toadfish and leatherjackets (Bryars 2003).During the towed video surveys, several fish were observed including a leafy seadragon (Plate 14-8), which is protected under both the Fisheries Management Act and the EPBC Act.

Plate 14-8 Leafy Seadragon

The desktop study identified 77 fish species as potentially occurring in the study area, with 29 fish species protected under either the Fisheries Management Act, EPBC Act, or both. It should be noted that species listed as 'marine' under the EPBC Act are protected in Commonwealth waters only. Several fish species were also opportunistically sighted during the video tow survey. With the exception of the leafy seadragon, none of the fish species observed in the area are protected under legislation. As survey transects were not designed to detail the presence, absence, abundance, density or species composition of fish in the area, this is simply a record of incidental observations.

EPBC-protected species with the potential to occur in the study area were predominantly pipefish or seahorse species, with the other species of note likely to occur in this region being the Great White Shark (*Carcharodon carcharias*), Shortfin Mako (*Isurus oxyrinchus*) and Porbeagle (*Lamna nasus*). The Great White Shark is protected under the EPBC Act and is listed as 'Vulnerable' and the Porbeagle as 'Migratory'. Great White Sharks are also protected under the Fisheries Management Act. The Great White Shark is known to feed in the Eyre Peninsula region, especially in the vicinity of seal pupping colonies. It is also thought that Great White Sharks may breed in the Spencer Gulf and inshore coastal waters may be important nursery grounds (DEWHA 2007).

14.3.9 Invasive Marine Species

No IMS were identified during field investigations at the marine study area. In recent years a number of marine pest species have been identified in Australian waters, including the European Fanworm *Sabella spallanzanii*, the Northern Pacific Seastar *Asterias amurensis*, the Eastern Atlantic Clam *Corbula gibba*, the ascidian *Ciona intestinalis* and the tropical seaweed *Caulerpa taxifolia*. Pest species can be toxic to other organisms and have the capacity to overgrow, prey upon and out-compete endemic marine fauna and flora. For example, the Northern Pacific Seastar is known to prey upon sessile and sedentary organisms. Introduced species in the marine environment are often well established in the new habitat before they are discovered and identified. IMS considered to represent the greatest risk to the marine environment at the proposed port site are:

- *Alexandrium minutum* (toxic dinoflagellate, estuarine dinoflagellate)
- *Carcinus maenas* (European or green shoe crab)
- *Caulerpa taxifolia* (aquarium caulerpa, killer alga)
- *Codium fragile ssp. tomentosoides* (dead man's fingers, green sea-fingers, oyster thief, sea staghorn)
- *Charybdis japonica* (Asian paddle crab, lady crab, Asian swimming crab, Japanese swimming crab, Japanese rock crab, shore swimming crab)
- *Musculista senhousia* (Asian date mussel, bag mussel, Senhouse's mussel, Asian mussel, Japanese mussel, green mussel, east Asian bag mussel, date mussel, cuckoo mussel)
- Polysiphonia brodiei (red macroalga)
- *Sabella spallanzanii* (European fan worm, sabellid fan worm, Mediterranean fan worm, giant fan worm, tremuligione amaro)
- Watersipora spp. (lace coral)

Plate 14-9 Asian Date Mussels (source: Reefwatch, 2015)

Marine investigations at the proposed Port Spencer project site located approximately 12 km south of the marine study area identified the presence of the Asian date mussel, *Musculista senhousia*, in seagrass samples. The Asian date mussel is native to the Pacific Ocean, and although previously recorded elsewhere in South Australian waters, the record from Port Spencer was the first recording within the Spencer Gulf (Golder Associates 2012). An overview of each of the aforementioned IMS is provided in Appendix Q.

14.3.10 Marine Noise and Vibration

The study area has moderate water depth and wave energy. As such, wind and wave noise will be higher compared with deep water environments. Ambient underwater noise measurements were not undertaken to inform the impact assessment as no introduced noise sources (e.g. existing port or industrial activities) are present within the study area. The noise impact assessment (Appendix S) considered absolute noise levels; i.e. they are independent of existing background noise levels. In the absence of ambient noise measurements, the following section discusses the known sensitivity of marine fauna to noise emissions.

There is limited information regarding the effects of noise on fish. The studies that have been conducted to date only consider a tiny fraction of the species in existence and in environments which typically do not represent wild fish in their natural habitats (Popper and Hastings 2009). Sensitivity to noise amongst fish species differs as a result of the considerable variation between anatomical and physiological hearing structures (Popper and Fay 1993). It is known that pulsed noise (such as piling) can cause behavioural changes or fish kills dependent on the magnitude of the noise source and anatomical variations from species to species (e.g. swim bladder or non-swim bladder fish) (McCauley and Kent 2008).

Fish are able to detect sounds, with the majority of species regarded as “hearing generalists” that have a narrow hearing bandwidth. A small number of fish species are classified as “hearing specialists” and have a greater hearing bandwidth and sensitivity due to a coupling between gas filled organs (such as the swim bladder) and inner ear (Hastings and Popper 2005). The hearing range for the different types of fish is provided in Table 14-4. Fish sensitivity to noise also depends on the mass of the fish. It has been found that tissue damage from noise will increase as the mass of the fish decreases (Carlson et al. 2007).

A number of peer-reviewed studies have assessed the impact of noise on marine mammals (Cetaceans and Pinnipeds). The most contemporary information is provided in the recommendations for marine mammals of the United States National Oceanic and Atmospheric Administration (NOAA) Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals (NOAA 2013). The level of noise resulting in injury varies dramatically between species and is presented in Table 14-4.

Information regarding the known effects of underwater noise on turtles is limited. Independent studies by Ridgway and Bartol (cited in Bartol 2008) confirm that turtles can hear and that the hearing range of turtles is approximately between 200 Hz and 1,000 Hz. There are no recommended noise criteria for turtles; however based on behavioural response studies by O'Hara and Wilcox (cited in Bartol 2008) and Moein (cited in Bartol 2008), and the hearing range of turtles, the low frequency Cetacean noise criteria is considered appropriate.

There is very limited information known about the effects of underwater noise on penguins. Studies indicate that the hearing range of penguins is best between 2,000 Hz and 5,000 Hz in air and is likely to reduce to frequencies below 4,000 Hz in water (Dooling and Therrien 2012). Based on the hearing range, and the lack of specific objective criteria, the low-frequency Cetaceans noise criteria have also been applied to penguins.

There is very limited information known about the effects of underwater noise on Cephalopods (cuttlefish). Studies indicate that Cephalopods can perceive low-frequencies. It is not known if Cephalopods can "hear" or if they are sensitive to particle velocity (Mooney et al. 2012). Notwithstanding, it has been shown that they can perceive sounds with frequencies of up to 1.5 kHz, but as they do not have any gas-filled bladders there is no possibility for sound amplification and therefore have a hearing capacity comparable to fish without swim bladders (Hu et al. 2009). Based on the above, the noise criteria for fish have been conservatively applied to Cephalopods.

The level of noise resulting in auditory injury varies between species and the types of noise. A summary of noise criteria for marine fauna is provided in Table 14-4, with the threshold level being reached if either the peak level or SELcum is exceeded (NOAA 2013).

Table 14-4 Species Hearing Range and Noise Level Resulting in Auditory Injury

Species	Hearing Range	Impulsive Noise Threshold	Non-impulsive Noise Threshold (includes continuous noise)
Low-frequency Cetaceans (Baleen whales)	Between 7 Hz and 30 kHz	Peak level: 230 dB_{peak} SEL_{cum}: 187 dB	Peak level: 230 dB_{peak} SEL_{cum}: 198 dB
Mid-frequency Cetaceans (Dolphins)	Between 150 Hz and 160 kHz	Peak level: 230 dB_{peak} SEL_{cum}: 187 dB	Peak level: 230 dB_{peak} SEL_{cum}: 198 dB
High-frequency Cetaceans (Porpoise)	Between 200 Hz and 180 kHz	Peak level: 201 dB_{peak} SEL_{cum}: 161 dB	Peak level: 201 dB_{peak} SEL_{cum}: 180 dB
Phocid Pinnipeds (Earless Seals)	Between 75 Hz and 100 kHz	Peak level: 235 dB_{peak} SEL_{cum}: 192 dB	Peak level: 235 dB_{peak} SEL_{cum}: 197 dB
Otariid Pinnipeds (eared sea lions and fur seals)	Between 100 Hz and 40 kHz	Peak level: 235 dB_{peak} SEL_{cum}: 215 dB	Peak level: 235 dB_{peak} SEL_{cum}: 220 dB
Fish (hearing generalist)	Between 50 Hz and 500-1500 Hz	Peak level: 206 dB_{peak} SEL_{cum}: 187 dB	Peak level: 206 dB_{peak} SEL_{cum}: 187 dB
Fish (hearing specialist)	Between 50 Hz and 3-100 kHz	Peak level: 206 dB_{peak} SEL_{cum}: 187 dB	Peak level: 206 dB_{peak} SEL_{cum}: 187 dB
Turtles	Between 200 Hz and 1000 Hz	Peak level: 230 dB_{peak} SEL_{cum}: 187 dB	Peak level: 230 dB_{peak} SEL_{cum}: 198 dB
Penguins	Between 2000 Hz and 4000 Hz (in water)	Peak level: 230 dB_{peak} SEL_{cum}: 187 dB	Peak level: 230 dB_{peak} SEL_{cum}: 198 dB
Cephalopods (cuttlefish)	Unknown	Peak level: 206 dB_{peak} SEL_{cum}: 187 dB	Peak level: 206 dB_{peak} SEL_{cum}: 187 dB

14.3.11 Fisheries and Aquaculture

Fishing and aquaculture have a significant commercial role in the Spencer Gulf region. Port Lincoln is the major centre of fisheries and aquaculture production in South Australia, with Arno Bay representing an alternate focal point for the aquaculture industry.

The proposed port site lies within the Port Neill Aquaculture Exclusion Zone as delineated by the Land Not Within a Council Area (Coastal Waters) Development Plan.

Currently, the closest active aquaculture lease is 30 km south of the study area near Cape Euler where there is a land-based lease for abalone, calamari, greenback flounder, blue and pen mussels, native and pacific oysters, scallops, sea urchin, cockles, razorfish, pot-bellied seahorse and leafy seadragon. There is also an offshore lease in the Tumby Offshore Aquaculture Zone, with offshore sea cages for three abalone species. There are several leases 33 km north of the study area in the Arno Aquaculture Zone, with the majority of the licenses for finfish sea cages of bluefin tuna (Plate 14-10), yellowtail kingfish, mulloway, snapper and black bream. There are also land-based operations with license for King George whiting, kingfish, calamari, abalone and pacific oyster at Arno Bay.

Plate 14-10 Tuna Aquaculture

The Spencer Gulf is an important fishing area in South Australia, supporting a number of commercial fisheries and commercial yield for species, including (Bryars 2003; Knight and Tsolos 2012):

- Western king prawns
- Blue crab
- Abalone
- Rock lobster
- Sardines
- Snapper
- Whiting
- Garfish
- Tommy Ruff
- Snook

A detailed overview of commercial fisheries operating within the Spencer Gulf is provided in Appendix Q. Figure 14-6 depicts aquaculture activity in the region of the proposed port development.

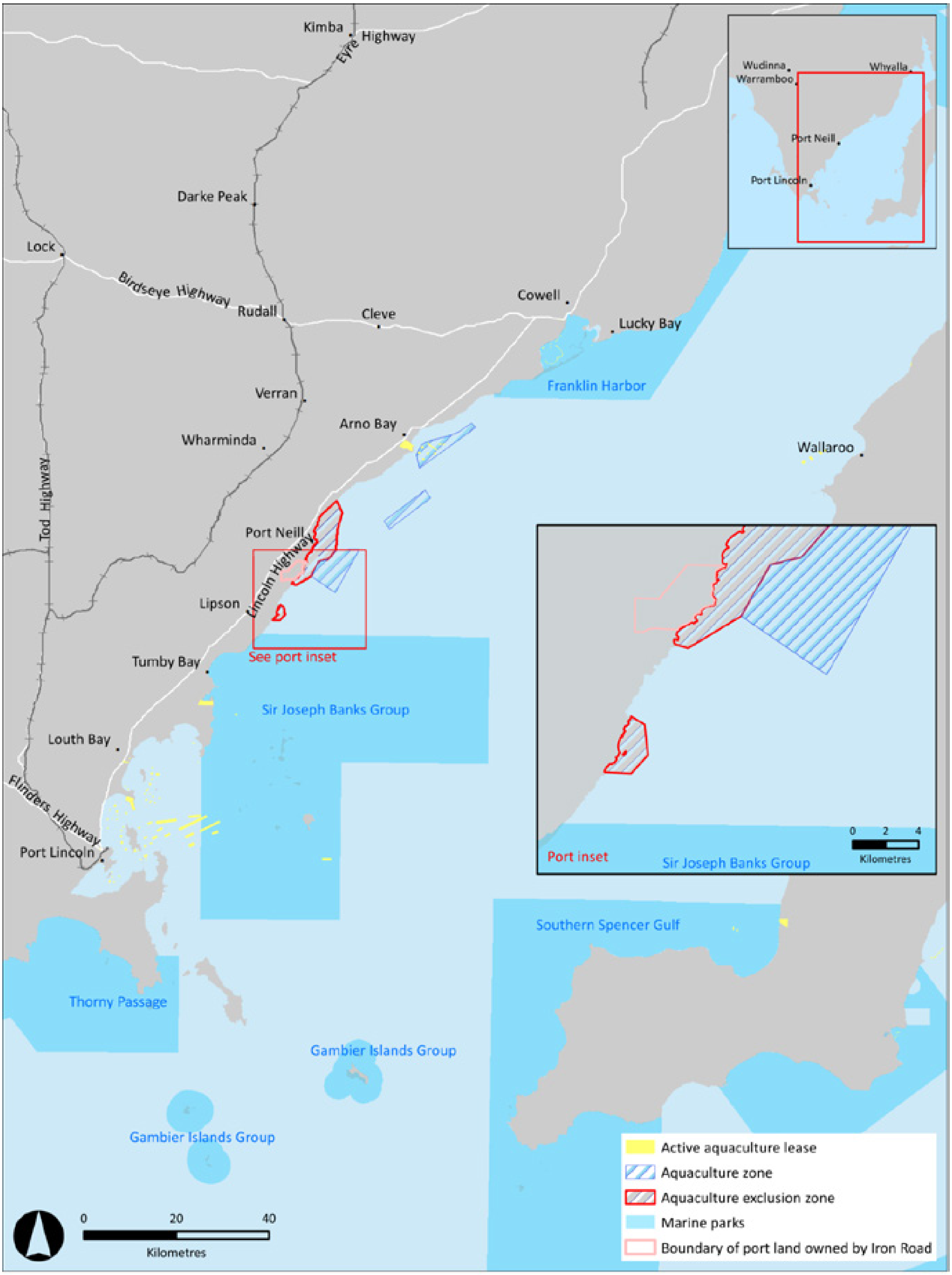


Figure 14-6 Aquaculture in Marine Study Area

14.3.12 Summary of Key Environmental Values

The proposed port site has a generally low relief and is free of significant navigational hazards. Hydrodynamic studies indicate that the site is relatively sheltered, with the highest current flows and bed shear experienced at the point of Cape Hardy.

The southern extent of the study area has a greater proportion of fine particle-size sediments than the north. In shallow waters, the substrate is dominated by sand, both vegetated and bare, which becomes silty with greater distance from the shoreline.

Twelve of the 59 species of seagrass found worldwide are present in South Australia's gulf waters, exhibiting some of the most extensive seagrass meadows in Australia. Within the study area, benthic flora appeared to follow depth and substrate contours with a higher density of flora coverage at shallower depths and in the northern parts of the study area.

The results of the benthic infaunal analysis indicate that shallow areas had the greatest infaunal diversity and abundance, with the highest number of organisms per sample and the greatest number of taxa present. The trends of infauna diversity align with seagrass coverage with the highest infauna diversity in the northern nearshore section of the marine study area and the lowest diversity of infauna recorded at the southern extent of the marine study area.

Nineteen protected megafauna species were identified as having the potential to occur in waters around the Eyre Peninsula region. Of these 19 species, six were considered to be common visitors to the region. Whale species are migratory in nature and therefore are seasonal visitors to South Australian waters. There are no resident whale populations in Spencer Gulf. Neither the marine study area, nor the Spencer Gulf represent any known feeding or calving grounds for whales.

Desktop investigations identified that 77 fish species potentially occur within the study area, of which, 29 species are protected under the Fisheries Management Act, EPBC Act, or both. The identified protected species were predominantly pipefish or seahorse species with the other species of note likely to occur in this region being the great white, shortfin mako and porbeagle sharks.

No IMS were identified during field investigations at the marine study area. Marine investigations at the proposed Port Spencer project site located approximately 12 km south of the marine study area identified the presence of the Asian Mussel in seagrass samples.

No introduced noise sources (e.g. existing port or industrial activities) are present within the study area. The study area has moderate water depth and wave energy. As such, ambient noise will be largely limited to wind and wave noise, increasing in noise level as water depth decreases. Sensitivity to noise amongst fish and marine species differs greatly as a result of the considerable variation between anatomical and physiological hearing structures. Fish and high-frequency cetaceans (such as porpoises) are considered most sensitive to noise.

Fishing and aquaculture have a significant commercial role in the Spencer Gulf region with Port Lincoln and Arno Bay representing focal points for the industry. The closest aquaculture leases to the proposed port site are approximately 33 km north (Arno Bay), and 30 km south (Cape Euler). The Port Neill Aquaculture Zone is approximately 2 km from the closest point of the proposed jetty, and is located within the marine study area. A number of commercial fisheries also operate within the Spencer Gulf; however the study area represents only a small proportion of habitats used by these industries.

14.4 Design Measures to Protect Environmental Values

A key consideration in the port site selection process was identifying a site with minimum requirement for physical and biological alterations to the existing marine environment. The selected site at Cape Hardy is readily accessible to deep water and does not require dredging (or subsequent disposal of dredge spoil) to make the site accessible for large vessels. Similarly, no blasting which could alter the benthic substrate is proposed to be undertaken within the marine environment. As such, there will be no major changes to the existing bathymetry that may alter local currents. Avoiding the need for dredging and blasting will also:

- Minimise sedimentation and turbidity during construction which in turn minimises potential impacts to water quality and marine flora/fauna.
- Minimise sedimentation that could smother seagrasses and other habitat areas.
- Minimise noise and vibration emissions (particularly associated with blasting) within the marine environment that could impact marine fauna.

The proposed port site selection avoids known critical habitat, key breeding colonies, foraging grounds and haul out areas for coastal fauna, fish species, benthic fauna and marine megafauna. Similarly, the port site is not within any known migration paths for whales. The site selection also provides an adequate separation distance to sensitive industry locations, including aquaculture areas and commercial fishing grounds.

The design and alignment of the jetty was refined in conjunction with the marine investigations (Appendix Q) and hydrodynamic modelling (Appendix R) to minimise changes to sediment deposition across the study area and avoid areas of dense seagrass which in turn avoids habitat impacts. The use of a predominantly pylon structure for the jetty significantly reduces potential effects on hydrodynamics as opposed to a rock armour or earthen structure.

The proposed marine infrastructure has been deliberately aligned to avoid coastal and intertidal zones, and to minimise its footprint within subtidal and seagrass areas that may represent habitat for marine fauna. Similarly, the alignment avoids areas of dense flora coverage (>50% seagrass coverage), with areas of dense seagrass in the north of study area being outside the construction footprint. Avoiding the northern parts of the study area also resulted in the avoidance of identified areas with high metal concentration, thereby minimising the likelihood of releasing metals from sediments.

The rock armour for the MOF and tug harbour will be built out from the small headland using roughly 1 m^3 boulders and reclaimed clean fill from the landside construction area. By not relying on large sea-based equipment for construction, there is no requirement for dredging and therefore impacts from mobilisation of sediments associated with these large vessels are removed. Similarly, avoiding the use of large sea-based construction equipment will reduce the number of vessels needing to access the near shore area, minimising vessel scour, propwash and anchoring impacts. Vessel scour, propwash and anchoring can resuspend sediments and cause turbidity which would result in diminished water quality, coastal erosion and damage to habitats.

The jetty itself will be constructed in stages using a jack-up barge for impact piling to minimise disturbance to the seabed. The staged construction will also minimise long-term alterations to site hydrodynamics and bathymetry to localised areas, with construction equipment in place for short durations only.

The covered conveyer system, telescopic shiploader and veneering of stockpiles aims to minimise magnetite concentrate loss by spills or dust generation, which will minimise any concentrate material reaching the marine environment. A full overview of dust management measures at the proposed port is provided in Chapter 10 Air Quality.

No wastewater discharge into the marine environment is proposed with full containment of all wastewater and sewage on site. Runoff patterns at the proposed port site will be altered by the construction of non-permeable infrastructure, including roadways, hardstands and buildings. The runoff from this infrastructure will be captured with guttering and directed into evaporation/infiltration ponds with capacity to capture up to a 90th percentile of run-off events with any over flow from greater events discharged into vegetated swales away from the marine environment.

The capture and treatment of stormwater at the site is to eliminate the negative effects to water quality from an increase in fresh water runoff, and/or the release of potential contaminants or sediments within stormwater. This will also prevent high sediment loads, pollutants or high velocity flows from entering the marine environment, creating erosion, or impacting coastal, intertidal and subtidal areas, fauna and fish species.

A sea-level rise allowance of 0.5 m has been incorporated into the design of the proposed port to account for sea level rise over the design life.

Hollow piles will be utilised for construction of the jetty. The driving of hollow piles into the seabed results in significantly less sedimentation in comparison to solid piles.

14.5 Impact Assessment

This section provides an assessment of the impacts on the marine environment associated with the construction and operation of the proposed port development. As the proposed port site has ready access to deep water and is free of significant navigational hazards, neither blasting nor dredging is required to support construction of the proposed port. As such, no impacts will occur as a result of blasting or dredging.

The procedures anticipated to represent the greatest potential impact during the construction and operation of the port include:

- Habitat clearance to support new infrastructure (construction)
- Noise and turbidity associated with piling activities (construction)
- Noise and turbidity associated with shipping movements (construction and operation)
- Disturbance to marine fauna from light spill (construction and operation)
- Interaction of construction activities, vessel movement and marine infrastructure with fisheries and aquaculture industries (construction and operation)
- Release of magnetite concentrate into the marine environment as a result of transfer and loading practices (operation)
- The permanent siting of physical structures altering the hydrodynamic environment at the site (operation)
- The permanent siting of physical structures altering natural light availability (operation)

Impacts to individual marine fauna species are not separately discussed in this chapter. The marine technical report (Appendix Q) assesses the likelihood of occurrence and level of impact to 58 coastal species (marine birds and coastal reptiles), 19 megafauna species (seals, sea lions, whales, dolphins and reptiles) and 77 fish species (sharks, finfish, syngnathids and pipefishes) that were identified as potentially occurring within the marine study area. Impacts to marine fauna are broadly discussed in the following section in relation to specific impact events (e.g. habitat clearance, noise emissions and light spill).

14.5.1 Habitat Clearance

The extent of habitat proposed to be cleared during construction is limited to an area within the project footprint, and the area immediately surrounding the offshore infrastructure. Habitat clearance was conservatively estimated based on the footprint of the proposed port development (including temporary construction areas) with an additional 5 m buffer. The extent of habitat clearance within the marine study area is presented in Table 14-5.

Table 14-5 Habitat Clearance within Marine Study Area

Substrate Type	Direct Clearance[1] (ha)		Potential Disturbance[2] (ha)		Total
	MOF & Tug Harbour	Jetty	Port Area	Anchorage Area	
Rocky Reef / Macroalgal	0.51	2.1	2.98	241.2	246.79
Seagrass	2.49	0.16	14.7	0	17.35
Total Vegetated Area[3]	3	2.26	17.68	241.2	264.14
Sandy Beaches	0	0	0.15[4]	0	0.15
Bare Sediment	0	6.49	131.6	58.9	196.99
Total Area	**3**	**8.75**	**149.43**	**300.1**	**461.17**

[1] Assumes total clearance of habitat beneath the proposed infrastructure to provide a conservative estimate. In some cases (e.g. beneath the jetty) only partial clearance will occur.
[2] Clearance is not anticipated; however habitat may be affected by temporary activities such as anchoring, vessel scour during construction etc.
[3] Excluding bare sediment and sandy beaches.
[4] Comprising a 1% change to sediment distribution at beaches adjacent to the marine study area.

As detailed in Table 14-5, 2.65 ha of seagrass is conservatively estimated to be cleared, with an additional 14.7 ha susceptible to periodic disturbance. As such, 17.35 ha of seagrass will experience some form of disturbance during construction and operation of the proposed port facility. The area to be disturbed is classified as sparse (<5% density) and represents less than 0.02 % of total known seagrass area within the Spencer Gulf.

An estimated 48 ha of intertidal and subtidal rocky reef is present within the marine study area based on review of the geophysical survey and aerial imagery. Approximately 5.4% of the rocky reef and macroalgal habitat within the marine study area is proposed to be cleared (2.61 ha) as a result of the construction and operation of the proposed port facility. As previously detailed in Table 14-5, additional areas of rocky reef may also be subject to periodic disturbance. It is anticipated that the majority of rock reef habitat would largely remain intact and not result in significant habitat fragmentation. In addition, the rocky surface of the MOF and the pylons of the jetty will provide habitat for a number of species that would naturally associate with reef areas.

When considered in a regional context, the proposed habitat clearance required for construction of the offshore infrastructure does not represent a significant effect to the viability of marine flora communities. A significant proportion of the Spencer Gulf outside of the study area is declared a marine park under the *Marine Parks Act 2007* (as previously indicated in Chapter 8), providing a high level of protection to habitats within the region. The habitats represented within the marine study area are typical of communities found throughout the Spencer Gulf. As previously outlined in Section 14.3.5, the marine study area has not been identified as supporting critical habitat for benthic fauna, marine megafauna or fish species.

It is expected that recovery of cleared vegetation will occur post-construction, with suitable nearshore seagrass such as Amphibolis spp. re-colonising suitable areas over time. Macroalgae and some locally occurring seagrass species have generation times rapid enough to recolonise within three years following the cessation of construction activities. Despite this, a long-term loss of habitat and a long-term change to existing seabed conditions within the marine study area is required to support construction of the proposed port, representing a **medium** impact.

Ship movements during both construction and operation will also disturb the seabed and habitats as a result of the installation of navaids, anchoring, propwash and vessel scour. Impacts from ship movements will be managed through the implementation of procedures, such as limiting ship speeds within the port site and utilising tugs to manoeuvre large vessels into place. As such, any activities disturbing seabed conditions or habitat will be localised, periodic and only effecting environments within the marine study area, and are therefore considered to represent a **low** impact.

Sandy beaches represent coastal habitat for a number of important species such as the hooded plover and beach slider. No direct disturbance to sandy beaches is proposed as part of the construction or operation of the proposed port facility. Alterations to hydrodynamic movements will result in small changes (<1%) to sediment movement which may result in minor disturbance to sandy beach habitat, considered to represent a **negligible** impact (refer to Section 14.5.3 for more information on impacts to the hydrodynamic environment).

14.5.2 Noise and Vibration

The primary sources of noise as a result of construction activities at the port site are piling noise and engine noise from marine vessel movements. During operation, the main noise sources are engine noise from vessel movements and operation noise associated with materials handling. These activities will result in an increase of underwater noise at the port site that has the potential to result in physical and/or behavioural effects on marine fauna. For many marine fauna, the acoustic sense is critical for basic life functions, such as feeding, communication and navigation. For example, noise is used for interspecies communication to detect danger, such as predators, and to identify feeding opportunities. Sound waves underwater can also be used to enable fauna to navigate and forage in low light conditions. Therefore, disruption to these functions has the potential to result in significant impacts to some species.

Impacts to marine fauna from noise vary depending on the level of exposure and the anatomical and physiological structures present within the animals, but can include:

- Masking of existing sound sources
- Avoidance of noise source(s)
- Temporary or permanent damage to the acoustic sensory system

Habitation of marine animals to areas of high vessel traffic and noise has been shown to occur readily around the globe. Several resident populations of marine mammals, birds and fish species are observed at existing large ports in Australia, for example the Port Adelaide Port River dolphins and bird rookeries (SA) (ADS, 2014); Port Phillip Bay dolphin and seabird populations (VIC) (DRI, 2015); Swan River bottlenose dolphins (WA) (Chabanne et al. 2012). However, these populations show modified behaviours to the increased noise and typically many marine fauna avoid noise sources that are newly introduced to the marine environment, which can result in disruption to existing movement patterns (e.g. migration and breeding), separation of adults and calves and increased levels of stress.

Marine fauna can be injured or killed by exposure to high intensity sounds at close range. The physiology of the species, sensitivity to sound and nature of the sound profile determine the level of impact. Typically, marine fauna will return to an area of noise disturbance following cessation of the noise source. Whales have not been seen to change migratory habits or stop visiting key areas after being disturbed by noisy exploration or construction (DEWHA 2008).

Noise and vibration associated with the proposed development could cause impacts to the marine environment from:

- Construction activities (e.g. piling and drilling)
- Vessel movement
- Operation activities (e.g. shiploader and conveyor)

The Construction phase of the proposed port will result in the highest level of noise emissions that may impact marine fauna, due to the extent of piling works required. Sonus (2014) (presented in Appendix S) identified that a minimum separation distance of 470 m from piling is required to avoid physical harm to marine fauna, including Baleen whales, penguins, turtles, dolphins (and toothed whales), eared sea lions and seals, fish and cephalopods/cuttlefish (based on DPTI / NOAA criteria) as indicated in Table 14-6.

Table 14-6 Summary Table of Separation Distance (m) Required to Achieve NOAA/DPTI Noise Criteria

Noise Source	Low-Frequency Sensitive Baleen Whale, Penguins, Turtles			Mid-Frequency Sensitive Dolphins (and Toothed Whales)			Eared Sea Lions and Seals			Fish and Cephalopods	
	SEL_{cum} [1] (NOAA 2013)	SEL_{ss} [2] (DPTI 2012)	Peak Level [3]	SEL_{cum} (NOAA 2013)	SEL_{ss} (DPTI 2012)	Peak Level	SEL_{cum} (NOAA 2013)	SEL_{ss} (DPTI 2012)	Peak Level	SEL_{cum} (NOAA 2013)	Peak Level
Impact Piling	240	470	0	<10	30	0	<10	470	0	450	30
Drilling	0	-	-	0	-	-	0	-	-	10	-
Vessels	10	-	-	0	-	-	0	-	-	80	-

[1] Cumulative sound exposure level
[2] Single strike sound exposure level
[3] Maximum noise level

Through the implementation of soft start procedures, safety observation zones to monitor movement of marine fauna, and shut down procedures where marine mammals are identified within 500 m of piling activities (refer Section 14.6), it is not anticipated that any marine biota will be significantly affected by underwater noise emissions. Marine fauna affected by underwater sound are typically mobile and will likely vacate the study area during soft start procedures. As such, widespread physical trauma to marine biota is not anticipated.

Construction of the port will occur over an approximate 18 month period. Underwater noise emissions during this time will result in behavioural changes to marine fauna, with avoidance of the study area likely as a result of noise emissions. Following construction, marine fauna are expected to return to the marine study area. As such, construction noise will result in a short-term alteration to existing behavioural patterns of marine fauna within the study area, considered to be a **low** impact.

During operation, there will be noise from the ore conveyor, shiploader and equipment located on the jetty and wharf. As these noise sources do not have any direct connection to the water, there will be limited noise propagation into the water from these sources. Some structure-borne vibration energy will travel through the jetty/wharf into the water column. Sonus (2014) predicts the structure borne propagation would only comprise low levels of sound that would be quickly attenuated to levels below the ambient underwater noise level due to the bathymetry of the site and will not impact marine fauna (refer Appendix S).

Propeller cavitation and flow noise around the hull are the primary causes of vessel noise and will occur throughout construction and operation of the proposed port. At low ship speeds, machinery noise dominates and is primarily low-frequency; however, main gearboxes and gas turbines may produce higher-frequency sound. The predicted underwater noise at the port resulting from vessel movements will be dominated by the low frequencies, as vessel speeds will be restricted in the port with cargo ships being manoeuvred into position by tugs. As such, noise from vessel movement is considered to result in **negligible** impact to the behaviour and physical wellbeing of marine fauna with predicted noise levels indicating an insignificant increase in background noise levels within the study area.

Outside of the study area, increasing vessel numbers in the gulf associated with the port operations will increase the ambient noise levels in the marine environment, as low-frequency sound can travel great distances in the open water environment. The proposed port will result in approximately one additional ship movement per day through the Spencer Gulf (an overall increase in large cargo vessel traffic of approximately 7%). Sonus (2014) predicts that separation distances of 80 m for fish and 10 m for whales from low-frequency vessel noise such as propellers will be required to achieve the noise criteria (Appendix S). In deeper water low-frequency sound propagates further than high frequency sound enabling most fish and larger marine fauna to avoid any physical damage caused by noise impacts by moving away from high-intensity, low-frequency sounds before physical damage occurs. As such, given that marine fauna would need to be within 80 m of the propeller to incur physical damage, impacts are not anticipated and are considered to be **negligible**.

The effect to ambient noise levels within the gulf as a result of additional ship movements in addition to construction and operation activities will result in long-term alterations to the behaviour patterns of marine fauna (i.e. avoidance of the noise source), considered to represent a **medium** impact as ambient noise levels will be increased during noise generating construction and operation activities, and periodic vessel movements.

14.5.3 Bathymetry and Hydrodynamics

The construction of the MOF and tug harbour will permanently alter the bathymetry within the study area as they will be physical structures in the environment. This is considered to represent a **medium** impact on the bathymetry as the effects will be long term but confined to the footprint of the infrastructure.

Since no dredging or associated spoil disposal is proposed as part of the construction process, no impacts to hydrodynamics or bathymetry are expected as a result of these activities. Piling construction is only a temporary disturbance resulting in localised, but short-term changes to the hydrodynamics of the study area. As such, piling activities are expected to result in a **low** impact to the hydrodynamics of the site.

During construction and once constructed, the MOF and tug harbour will result in some minor but permanent alterations to the hydrodynamic processes at the site. As the site is moderately exposed and regularly experiences moderate wave energy that is predominantly wind driven directly onto the shore, the presence of marine structures at the Cape Hardy site, particularly the tug harbour and MOF, is expected to result in only localised and minor changes to the hydrodynamics, as detailed by the hydrodynamics modelling (presented in Appendix R). The modelled hydrodynamic changes during easterly wave conditions are presented in Figure 14-7 and Figure 14-8. Changes would include low-level reduction in the rates of sediment transport and bed shear which will generally follow the existing natural dynamics within the Cape Hardy area, resulting in increased sedimentation around the MOF of less than 1%. Therefore, significant changes in broader coastal processes such as erosion or sediment dynamics are not expected. Although the predicted alterations to the hydrodynamic environment as a result of the proposed development are minor, the long-term nature of the change means this is considered to represent a **medium** impact; long term but localised to the marine study area.

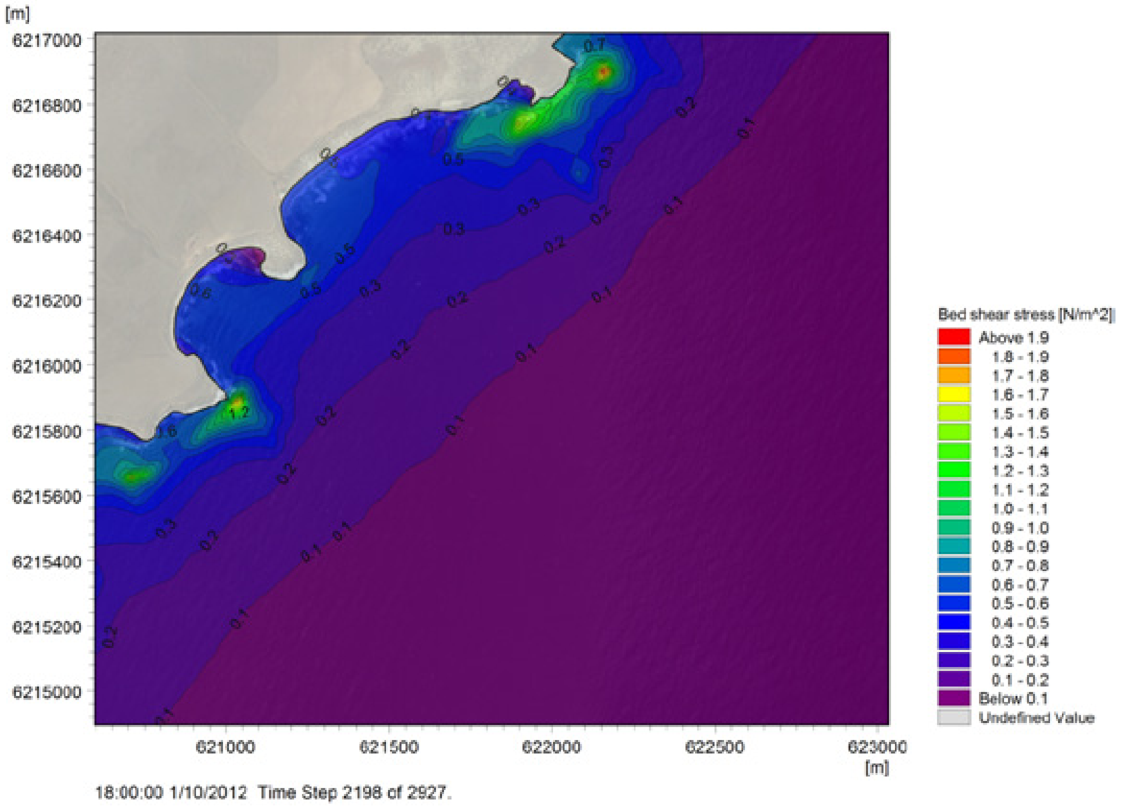


Figure 14-7 Baseline Bed-Shear Stress for Easterly Wave Conditions

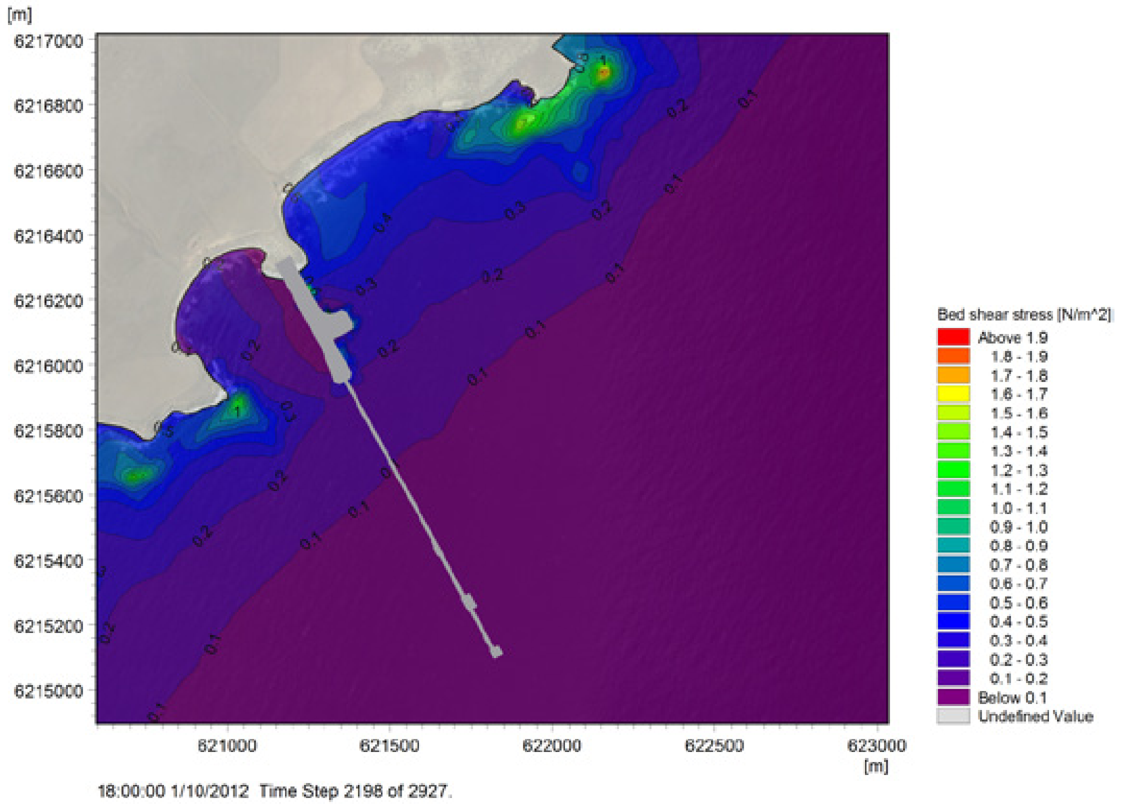


Figure 14-8 Infrastructure Scenario Bed-Shear Stress for Easterly Wave Conditions

The hydrodynamic modelling undertaken at the site to assess the potential impacts from development of the marine infrastructure at the proposed port predicts negligible changes to existing natural sediment dynamics, and therefore on the bathymetry within the study area. As no erosion of the coastline or silting of the tug harbour is expected based on the hydrodynamic model, impacts to bathymetry are considered **negligible**.

Altered hydrodynamic conditions can also affect habitat values as a result of sediment build up or erosion. Hydrodynamic modelling predicts limited changes to the oceanographic conditions at the port site as a result of the proposed infrastructure. The existing site hydrodynamics confine the majority of longshore sediment drift to the two embayments either side of the proposed jetty and MOF structure.

The changes to the hydrodynamic conditions at the site are generally associated with the construction of the MOF and pylon structure. Alterations to the maximum currents and bed shear across the site are not significant. The predicted increase in sedimentation rate around the MOF is less than 1%; and it is anticipated that the existing seagrass beds in the area will be able to adsorb this additional sediment. As such, alterations to the hydrodynamic conditions at the port site are not considered to significantly affect habitat, density or diversity of benthic fauna or intertidal habitats within the port site, representing a **negligible** impact.

14.5.4 Turbidity and Sedimentation

Piling activities, propeller wash and disturbance to the seabed from vessels will increase turbidity and suspended soils within the marine study area. Disruption of sediments during construction is of concern to sensitive habitats, sediment profiles and water quality at the site. Baseline sediment sampling showed a generally silty marine environment in the deeper water areas. Effects of sediment suspension include:

- Reducing the light penetration of the water column, potentially causing shading effects detrimental to the health of flora.
- Localised effects on water composition due to the particularly fine sediment in some areas of the marine study area; suspended soils may be abrasive and cause clogging (e.g. of gills).
- Silt deposition smothering flora and fauna.

Hydrodynamic modelling indicates that water movements, tides and wave action will disperse sedimentation such that biota within the marine study area will not be exposed to prolonged periods of elevated turbidity. Increased sedimentation associated with propeller wash is considered to be minimal due to the shallow draught of vessels. It is therefore considered that impacts associated with turbidity and sedimentation will be brief in duration and limited to the local area.

Where sedimentation does occur, mobile fauna and fish species are anticipated to move from the area of disturbance, resulting in temporary displacement. Non-mobile fauna are more likely to be impacted by increased turbidity as a result of smothering by silt deposition. However, non-mobile fauna such as mussels and oysters would close during periods of increased turbidity to prevent clogging. Impacts on other filters such as sponges are not expected as large groups of sponges have only been found outside of the marine infrastructure footprint. Therefore, effects on marine species during operation as a result of increased turbidity will be short term and localised and are considered to represent a **low** impact.

Construction activities that disturb the seabed will result in silt and sediment suspension into the water column. Increased turbidity can affect water quality and benthic communities as a result of decreased light penetration and silting. The existing wave climate at the port site regularly transports and resuspends sediment along the coast (Appendix R). As such, localised turbidity during construction is considered to represent a **low** impact, with short-term localised effects during construction activity, but no longer-term effects.

Ship scour can also result in the erosion of the seabed and increased turbidity. Tug vessels will be utilised for all large vessel movements in depths less than 23 m within the port site (including large vessel approaches and turning basins) to minimise propwash and subsequent sedimentation. Despite the utilisation of tugs, the repeated manoeuvring of vessels will result in some ship scour; destabilising sediments and resulting in short-term turbidity. The increased turbidity will result in decreased light penetration and water quality to intertidal and subtidal flora following large ship movements. Approximately one cargo ship movement per day is anticipated during operation of the proposed port. As such, localised impacts to intertidal and subtidal flora within the port site as a result of sediment suspension will occur on a daily basis for the life of the port facility, and as such, this is considered to represent a **medium** impact (long term but localised to the project area).

The addition of the tug harbour and MOF will also affect the redistribution of sediments in the water that become suspended following storm events. Altered redistribution patterns may result in elevated turbidity in the near shore environment following storm events for a greater duration than currently observed. This elevated turbidity is considered to represent a **low** impact as it will only occur following storm events (which naturally generate turbidity), and will be isolated to the marine study area.

14.5.5 Light Spill

Marine flora and fauna respond differently to light dependent on the species and stage of life. Responses can include avoiding lighted areas to avoid predation, alterations to foraging strategies and impacts upon predator/prey interactions. The majority of construction activities will occur during daytime hours; therefore the need for artificial lighting during construction is minimal. However, artificial lighting will be required for safe navigation and security purposes, in addition to select occasions where night-time construction activities are required. During operation, artificial lighting will be required for safe navigation, security purposes and for lighting areas to support the 24 hour operation of the port.

Lighting at the port site has been designed to support the safe and efficient operation of the port site. Light spill into the marine environment will be avoided through the use of directional lighting as much as practicable. Whilst the introduction of artificial light sources may result in localised changes to the behaviour of fish and predator species, the study area is not critical habitat for any fish species, and no change to fish distribution or abundance is anticipated. As such, the overall impact is considered to be **negligible**.

14.5.6 Fisheries and Aquaculture

Construction and operation of the proposed port will restrict commercial fisheries from operating within some areas of the study area. The majority of the study area will remain available for fisheries and recreational fishing if required. The entire marine study area comprises approximately 1% of Marine Fishing Area 29 and does not contain any habitat identified as critical for commercially fished species. There are no aquaculture leases located within 30 km of the marine study area. Construction of the jetty will restrict the potential future development of the aquaculture leases at the site; however the study area has been designated as an area excluded from aquaculture development. As such, restricting commercial fisheries and aquaculture from operating within the study area will not significantly impact commercial operations and is considered to represent a **negligible** impact.

14.5.7 Release of Iron Concentrate into Marine Environment

Increased bio-available iron can stimulate phytoplankton growth in the marine environment, resulting in algal blooms. Iron is a trace element essential for the growth of micro-organisms and is arguably one of the most important micronutrients influencing primary production in the marine environment (Ussher et al. 2004). Iron is only required in trace quantities, therefore a small amount can stimulate significant growth. However, for iron to be an effective fertiliser for phytoplankton it must be in a soluble (bio-available) form.

The concentrate intended for shipment by Iron Road is magnetite-based and known to be insoluble in seawater, and therefore cannot cause measurable elevation in dissolved iron concentrations in either the water column or surrounding sediment in the event of dust or accidental release to the marine environment. For there to be an iron 'fertilisation' effect on phytoplankton or algae, the receiving waters also need to be iron-limited (i.e. very low in iron concentration) but high in other nutrients. Such environments are referred to as High-Nutrient Low-Chlorophyll (HNLC) environments (Bowie et al. 2001).

The Spencer Gulf environment does not fit the HNLC definition. Middleton et al. (2013) noted that all macronutrients within Spencer Gulf are at or below concentrations likely to limit phytoplankton growth and primary productivity within the gulf is restricted by these nutrient limitations. Spencer Gulf also has relatively high levels of metals, including iron when compared with oceanic waters (Martin et al. 1994; Thompson et al. 2008). Within the study area, average iron concentrations in the water were 0.05 mg/L at the surface and 0.081 mg/L at the seabed (refer Appendix Q). Bio-available iron is only known to induce algal blooms in high nutrient, low chlorophyll environments when iron concentrations reach 0.00055 mg/L. The iron concentrate is not bio-available (i.e. is insoluble) and existing concentrations of iron in the water are approximately 100 times the level required to trigger algal blooms (i.e. the stimulation of algae growth by iron would already be occurring if it were possible). As such there are expected to be **no impacts** to water quality from iron-induced algal blooms.

Spillage of magnetite concentrate would initially affect benthic habitats as the material is insoluble in water. Large amounts of magnetite concentrate covering the benthos would change sediment characteristics, smothering benthic organisms and potentially altering habitat structures. The range of effects would be localised to the spill point, other than dust releases which would travel according to winds and currents before settling within marine sediments. As outlined in Section 14.4, design controls have been established to minimise spillage of concentrate and dust emissions during material handling at the port site. In addition, air quality modelling for the port site (refer Chapter 10) indicates that low levels of magnetite concentrate will be deposited within the marine environment as a result of airborne particles. Dust generation will be limited through the use of a veneering agent on the stockpiles, enclosed conveyors and the use of a telescopic shiploader to release concentrate deep into the ship's hull rather than 'poured' through the air. Despite these control measures, small volumes of magnetite concentrate are still expected to enter the marine environment during the transfer process between the rail transport and the ship.

A moderate energy marine environment, such as that found at the port site, will mitigate the adverse effects of small releases of iron ore into the marine environment by flushing out releases of particulates and organic matter and introducing oxygen to the environment through wave action. As such, the release of small amounts of iron ore through dust emissions or spillage is not anticipated to adversely affect marine flora or fauna within the study area and is considered to represent a **negligible** impact.

14.5.8 Shading of Seabed

While seagrasses are susceptible to the effects of long-term heavy shading from infrastructure, most species of seagrass, and in particular *Amphibolis antarctica* and *Posidonia* spp. which are found within the study area, have some tolerance for partial shading and can survive beneath jetty structures (Duarte 1991; Dennison et al. 1993; Gordon et al. 1994; Fitzpatrick and Kirkman 1995; Masini et al. 1995; Bryars and Collins 2008; Bryars and Rowling 2009). Similarly, macroalgae are capable of tolerating low-light conditions, with major habitat-forming species such as *Ecklonia. radiata* occurring to a maximum depth of greater than 40 m (Edgar 2001).

A variety of factors determine the area of seabed shaded, including the dimensions of the jetty/wharf, the duration of vessel mooring and the solar angle. The jetty orientation runs at 331° north-northwest resulting in minimal shading by the jetty due to the approximate east-west sun path. Affected seabeds will only receive reduced light for approximately 1-2 hours per day. The sun is at its highest during summer at around 79° with the lowest angle in winter approximately 32°. Seasonal changes in the angle of the sun along with the orientation of the jetty structure means that there will be no permanent shading of the seabed beneath the jetty structure.

Shading from impact piling and temporary construction activities (i.e. jack-up barge and support vessels) is not considered likely to affect benthic habitats as the shading is temporary only and seagrass can tolerate heavy shading for extended periods of time due to their ability to draw energy from their root mass (Duarte 1991; Westphalen et al. 2004).

Shading effects at the port site are expected to be restricted to the areas adjacent to and beneath the jetty and adjacent the MOF. Seagrasses identified in the footprint area include sparse coverage of the tapeweeds *Posidonia spp.* seagrasses. As a result the jetty is aligned over an area with minimal seagrass coverage, and the orientation of the jetty results in no permanent shading. Shading impacts to subtidal habitats are considered to be **negligible**.

14.5.9 Surface Water Runoff

Run-off or pollution from the port land area has the potential to impact on water quality, either stimulating algal growth through increased nutrient loading, increasing turbidity as a result of sediment discharge, reducing salinity as a result of increased freshwater discharge during storms, or introducing contaminants via inputs of hydrocarbons or other pollutants. Nutrients from run-off can stimulate algae in the water column or epiphytes that would shade benthic flora, whilst other changes in water quality (i.e. chemical contaminants such as biocides in anti-foul paint or hydrocarbons) could have direct toxic effects on benthic flora or be introduced to the food chain. Seagrass is commonly lost when nutrient levels in the water increase. Excess nutrients can also encourage more phytoplankton or epiphytes to grow in the water, reducing the amount of light available to seagrass, particularly in the deeper regions. These nutrients cause a large number of epiphytes to grow on the seagrass leaves, blocking light or causing the leaves to become too heavy and to break off. Iron ore is not known to be toxic to seagrass or macroalgal assemblages. Design measures will be implemented to control surface and waste water runoff at the port site. Retention basins, vegetated swales and bunds will limit runoff from entering the marine environment in all but extreme weather events where turbidity would be expected to be elevated anyway.

As a result of the mitigation measures designed for containment of run-off and wastewater at the site (refer Chapter 15) impacts on water quality as a result of surface water run-off during construction and operation are expected to be **negligible**. There is a risk of surface water run-off during extreme storm events, which is discussed in Section 14.7.

14.5.10 Restricted Public Access to Coastal Reserve

The exclusion zone of the port will restrict public access to the port site throughout the lifespan of the facility. The port site is known to support recreational fishing; however it is not considered to be heavily trafficked. The social impacts of restricting public access to the coastal reserve are discussed in detail in Chapter 22, Social Environment.

14.5.11 Invasive Marine Species

Operational ports have the potential to introduce IMS. Some IMS such as mussels have the potential to build up biological reefs thereby changing the bathymetry of an area. IMS can outcompete existing native communities and smother existing benthic habitat (in the case of some algae), causing seagrass loss that could alter the bathymetry of an area by destabilising sediment and causing sediment loss. The possibility of management measures failing and IMS being introduced to the port site is not a planned event and is therefore discussed as a risk in Section 14.7.

14.5.12 Summary of Impacts

The residual impacts to the marine and coastal environment due to construction and operation of the proposed port development are summarised in Table 14-7.

Table 14-7 Summary of Impacts: Marine and Coastal Environment

Impact	Comment	Level of Impact
Clearance of habitat required to support construction of the proposed port.	Habitat clearance was conservatively estimated based on the footprint of the proposed port development (including temporary construction areas) with an additional 5 m buffer. When considered in a regional context, the proposed habitat clearance required for construction of the offshore infrastructure does not represent a significant effect to the viability of marine flora communities.	Medium
Ship movements disturbing the seabed and habitats.	Through the limiting of ship speeds within the port site, and the utilisation of tugs to manoeuvre large vessels into place, impacts to the seabed and habitats will be limited to the study area and periodic in nature.	Low
Disturbance to sandy beach habitat.	No direct disturbance to sandy beach habitat is proposed. Alterations to hydrodynamic movements will result in small changes (<1%) to sediment movement which may result in minor disturbance to sandy beach habitat.	Negligible
Impacts to marine fauna as a result of construction noise from piling and vessel movements.	Through the implementation of soft start procedures, safety observation zones to monitor movement of marine fauna, and shut down procedures where marine mammals are identified within 500 m of piling activities, it is not anticipated that any marine biota will be significantly affected by underwater noise emissions during construction.	Low
Impacts to native fauna as a result of operation noise of the port associated with vessel movement and equipment located on the jetty / wharf.	Noise sources that do not have any direct connection to the water will result in noise propagation into the water that would be rapidly attenuated to levels below the ambient underwater noise level due to the bathymetry of the site. Propeller cavitation and flow noise around the hull are the primary causes of vessel noise, with low-frequency machinery noise prevalent, with some high-frequency gearboxes and gas turbines sound. Noise emissions within the port will be restricted as cargo ships will be manoeuvred into position by tugs.	Negligible
Impacts to native fauna as a result of operation noise from increased vessel movements within the Spencer Gulf.	Increased vessel numbers in the Spencer Gulf associated with the port operations will increase the ambient noise levels in the marine environment, as low-frequency sound can travel great distances in the open water environment. The proposed port will result in approximately one additional ship movement per day through the Spencer Gulf. In deeper water, low-frequency sound propagates further than high frequency sound enabling most fish and larger marine fauna to avoid any physical damage by moving away from before physical damage occurs.	Negligible
Increased ambient noise levels in Spencer Gulf.	Additional ship movements in addition to construction and operation activities will generate noise and result in long-term alterations to the behaviour patterns of marine fauna (i.e. avoidance of the noise source).	Medium

Impact	Comment	Level of Impact
Establishment of MOF and tug harbour altering site bathymetry.	The construction of the MOF and tug harbour will permanently alter the bathymetry of the immediate area.	Medium
Piling activities altering hydrodynamics of study area during construction.	Piling construction is only a temporary disturbance resulting in localised, short-term changes to the hydrodynamics of the study area.	Low
Permanent alterations to hydrodynamics due to the MOF, tug harbour and jetty.	The presence of marine structures at the Cape Hardy site, particularly the tug harbour and MOF, will result in low-level reduction in the rates of sediment transport and bed shear which will generally follow the existing natural dynamics within the Cape Hardy area, resulting in increased sedimentation around the MOF of less than 1%.	Medium
Changes in hydrodynamics alters site bathymetry.	As no erosion of the coastline or silting of the tug harbour is expected based on the hydrodynamic model, negligible changes to existing natural sediment dynamics, and therefore site bathymetry, are anticipated.	Negligible
Altered hydrodynamics affecting habitat, density or diversity of benthic fauna or intertidal habitats.	Existing site hydrodynamics confine the majority of longshore sediment drift to within the two embayments either side of the proposed jetty and MOF structure. The changes to the hydrodynamic conditions at the site are generally associated with the construction of the MOF and pylon structure. Alterations to the maximum currents and bed shear across the site are not significant. The predicted increase in sedimentation rate around the MOF is less than 1% and it is anticipated that the existing seagrass beds in the area will be able to adsorb this additional sediment.	Negligible
Turbidity impacting marine fauna.	Where sedimentation does occur, mobile fauna and fish species are anticipated to move from the area of disturbance. Non-mobile species such as mussels and oysters will close during periods of increased turbidity to prevent clogging.	Low
Sedimentation from disturbance to the seabed.	The existing wave climate at the port site regularly transports and re-suspends sediment along the coast. As such, localised turbidity during construction is comparable to existing site conditions and no longer-term effects are anticipated.	Low
Ship scour generating turbidity.	Approximately one cargo ship movement per day is anticipated during operation of proposed port. As such, localised impacts to intertidal and subtidal flora within the port site as a result of sediment suspension will occur on a daily basis for the life of the port facility.	Medium
Tug harbour and MOF altering redistribution of sediments.	Altered redistribution of sediments may result in elevated turbidity in the near shore environment for several days following storm events. This elevated turbidity will only occur following storm events (which naturally generate turbidity).	Low
Impacts to fauna as a result of spill of artificial lighting during construction or operation.	Fauna response to artificial light can include avoiding lighted areas to avoid predication, affecting foraging strategies and predator/prey interactions. Artificial lighting will be required for safe navigation and security purposes, in addition to occasions where night time activities are required.	Negligible
Construction and operation of the proposed port restricting commercial fishery / aquaculture operations.	The majority of the study area will remain available for fisheries and recreational fishing if required. The entire study area comprises approximately 1% of Marine Fishing Area 29 and does not contain any habitat identified as critical for commercially fished species. There are no aquaculture leases located within 30 km of the marine study area.	Negligible

Impact	Comment	Level of Impact
Release of iron concentrate inducing algal blooms.	The iron concentrate intended for shipment by Iron Road is magnetite-based and known to be insoluble in seawater, and will not cause measurable elevation in dissolved iron concentrations in the water column in the event of dust or accidental release. In addition, the waters around the development site already have high iron concentrations, well above that required to stimulate algal blooms.	Nil
Release of iron concentrate smothering / affecting marine flora and / or fauna.	Effects would be localised to the spill point, other than dust releases which would travel according to winds and currents before settling within marine sediments. Dust generation will be limited through the use of a telescopic shiploader, a veneering agent on the stockpiles, and the covering of conveyors. Seagrass is known to survive extended periods with limited light availability, and the moderate energy marine environment of the study area will flush out releases of particulates to the environment through wave action.	Negligible
Shading of seagrass by offshore infrastructure.	Affected sea beds will only receive reduced light for approximately 1-2 hours per day. Seasonal changes in the angle of the sun along with the orientation of the jetty structure means that there will be no permanent shading of the seabed beneath the jetty structure.	Negligible
Surface water runoff inputting additional freshwater, sediments or contaminants to the marine environment.	Nutrients from runoff can stimulate algae in the water column or epiphytes that would shade benthic flora, whilst other changes in water quality (i.e. chemical contaminants such as biocides in anti-foul paint or hydrocarbons) could have direct toxic effects on benthic flora. The implementation of design measures for the control of surface and waste water at the port site will limit runoff from entering the marine environment.	Negligible

14.6 Control and Management Strategies

Management measures that will be adopted to assist in the avoidance or mitigation of impacts and risks to the marine and coastal environment during the construction and operation of the proposed port are outlined below.

14.6.1 Underwater Noise

The impacts of underwater noise will be reduced through the following management measures:

- Establishment of a safety zone
- Establishment of standard operational procedures in accordance with the South Australian Underwater Piling Noise Guidelines (DPTI 2012)

An overview of each of these management procedures is provided below.

Safety Zone

A safety zone surrounding piling activity will be established to monitor the movement of marine mammals in waters impacted by construction noise. The safety zone is separated into the following two areas:

- ***Observation Zone*** – piling activities will be placed on standby should a mammal be sighted within the observation zone.
- ***Shutdown Zone*** – all piling activities will cease should a mammal be sighted within the shutdown zone.

The area of a suitable safety zone can vary depending on the noise exposure threshold of marine mammals in the region. An observation zone distance of 1.5 km and a shutdown zone distance of 500 m in accordance with the South Australian Underwater Piling Noise Guidelines (DPTI 2012) will be implemented during the construction of the port. The safety zone is depicted in Figure 14-9. The shutdown zone required by the South Australian Underwater Piling Noise Guidelines is sufficient to mitigate the range of underwater noise impacts on marine mammals discussed in Section 14.5.

Operational Procedures

The standard procedures that will be implemented during piling/drilling activities are outlined below. These operational procedures will be implemented prior to the commencement of daily construction activity or following a break of more than 30 minutes.

- ***Pre-start*** – The observation zone will be monitored for the presence of marine mammals for at least 30 minutes prior to the commencement of construction. Monitoring will be focused on the safety zones from an appropriate vantage point.
- ***Soft start*** – Piling impact will be gradually increased over a 30 minute period to alert marine mammals to construction activities and provide opportunity for animals to retreat to a safe distance. Monitoring of the safety zones for the presence of marine mammals will continue during the soft start process.
- ***Normal operation*** – If no marine mammals are observed during the pre-start and soft start processes, piling will commence. Monitoring of the safety zones for the presence of marine mammals will continue during normal operation.
- ***Standby operation*** – If a marine mammal is sighted within the observation during soft start or normal operation, the piling rig will be placed on standby to observe the mammal(s) and to confirm it has not entered the shutdown zone.
- ***Shutdown*** – If a marine mammal is sighted within the shutdown zone all piling activity will stop immediately. Where no marine mammals have been sighted for more than 30 minutes, piling activities will recommence following standard procedures.

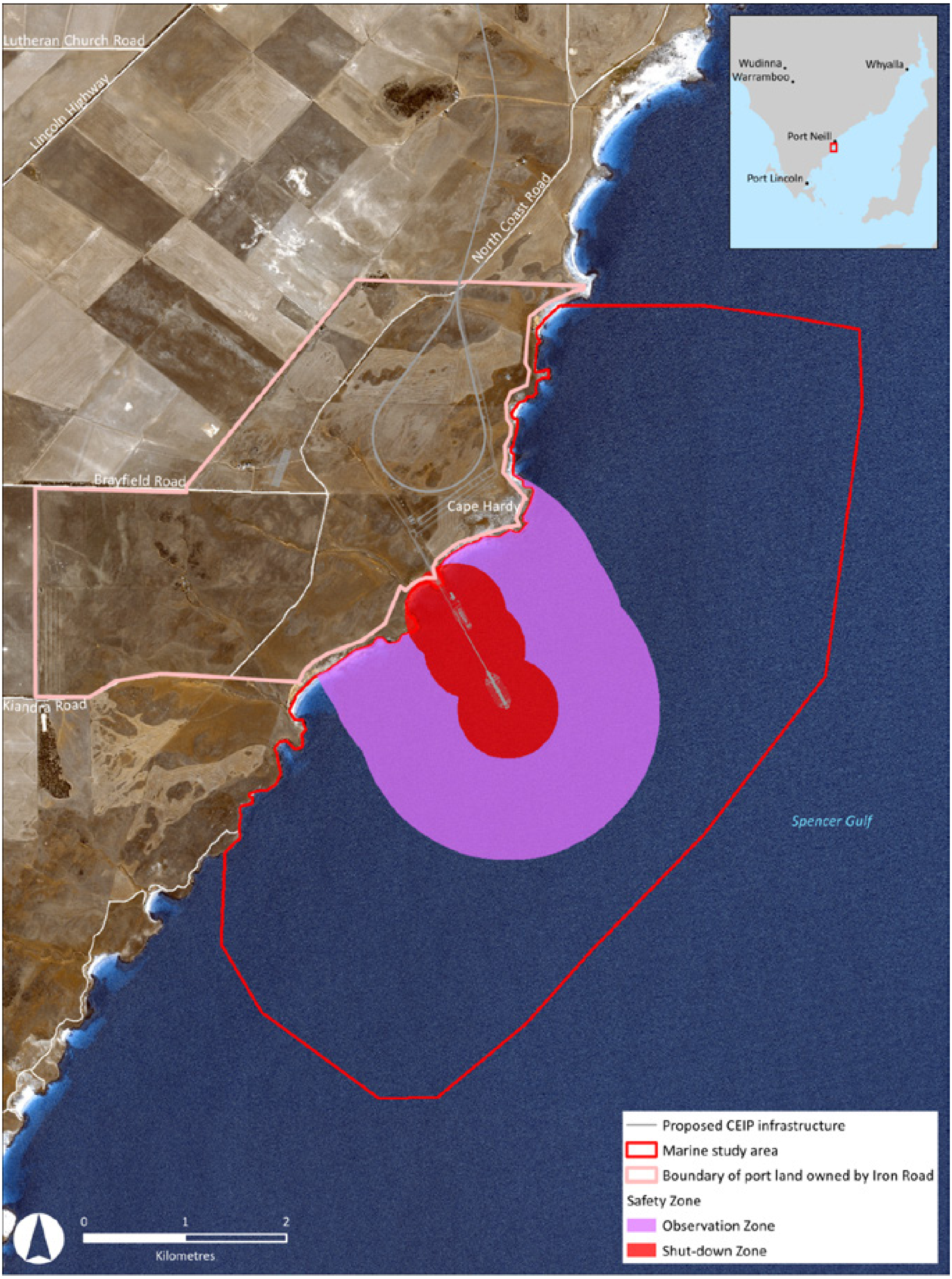


Figure 14-9 Observation and Shut-Down Zones

14.6.2 Construction and Environmental Management

This section provides an overview of construction and environmental management measures to be implemented during construction and operation of the proposed port.

Marine Fauna Management

The proposed port site is not located within critical habitat, breeding colonies, foraging grounds or migration paths for whales. Despite this, whale management procedures will be developed and incorporated into the Construction Environmental Management Plan (CEMP) and Operation Environmental Management Plan (OEMP) for the project. The whale management procedures will include:

- A description of all threats to the megafauna species expected in the area resulting from the proposed port development.
- A monitoring plan for megafauna habitat use and behaviour, using appropriate survey techniques for mapping of potential threats to the expected whale species arising from the port construction and operations.
- Identification and indication of noise sources and strategies to manage/mitigate noise impacts (e.g. piling procedures outlined in Section 14.6.1).

Waste Management

Waste management measures aligning with South Australia's Waste Strategy will be developed to identify, separate and provide adequate waste disposal for all waste streams, including kitchen wastes, soil (from foundations and clearance), hazardous items (e.g. sewage) and hydrocarbons. All waste will be sorted and stored within controlled contained areas until it can be removed from site by a suitable waste disposal company. Bunding will be used to prevent leaching of soluble waste or stormwater run-off carrying pollutants into drains or groundwater, and ultimately the marine environment.

Traffic/Vessel Management

Heavy vehicle traffic, machinery movement, excavation and construction of the MOF and tug harbour have the potential to crush habitat or disturb the flightless juvenile hooded plover, species that forage amongst the seagrass wrack, or nesting areas. To minimise adverse effects to coastal habitat, vehicle access to the beach areas will be restricted, with no storage or laydown areas for equipment on beach areas.

Vessel speed will be restricted within the port by using tugs for manoeuvring large vessels to minimise vessel scour and changes to sediment PSD or damage to identified seagrass habitat that helps to stabilise sediment. Vessel movements will also be restricted to designated areas with sufficient depth/under keel clearance to avoid vessel scour and reduce the risk of vessels running aground. Anchorage areas for large cargo vessels are located in deep water (>20 m) and away from reefs and dense seagrass.

To mitigate risks to marine parks, vessels will travel within the designated shipping channels and only anchor in designated areas. Vessels will avoid the Sir Joseph Banks Group Marine Park where possible, and remain outside habitat protection and sanctuary zones.

To mitigate the risk of vessels colliding with marine fauna, speed limits will be applied to vessels travelling within the marine study area. Should a marine mammal be spotted in open waters, vessels will either steer away from the mammal or reduce speed to reduce the risk of collision (where safe and practicable). The ability to take evasive action may be limited by safety considerations such as appropriate water depth or the presence of other vessels.

A 'Marine Mammal Notice to Mariners' system will be developed and will detail the following:

- An overview of when marine mammals are expected to be present within the study area and key shipping routes.
- Recommended reductions of speed in shipping lanes during periods of peak marine mammal movements (e.g. whale season, May to November).
- Mandatory reporting of marine mammals sightings to the appropriate authorities.
- Encouraging appropriate caution in ship movements when manoeuvring around marine mammals.
- Response procedures to be activated should an entangled marine mammal be sighted, or a collision occur.

Water Quality

Marine sediments in the study area ranged in particle size and in metal composition. Mobilisation of finer sediment would be expected to cause prolonged reductions in light penetrability, and may have a greater impact on water chemistry due to colloidal effects. To minimise the mobilisation of fine sediments, large vessels will be manoeuvred into place by tugs and vessel manoeuvring will be restricted to designated manoeuvring areas.

During the pouring of concrete into hollow piles for the construction of the jetty and wharf, removable bunding and a concrete injection system will be utilised to minimise risk of overflow and spillage into the marine environment.

Oil Spills/Leaks

Spills of contaminants from vessels are often considered a major source of water pollution at port sites (OECD, 1997). In practice, such spills are often small and difficult to track. The release of potential pollutants by marine vessels is governed by State (Protection of Marine Waters (Prevention of Pollution from Ships) Regulations 2013), Commonwealth (Protection of the Sea Act 1981 and subsequent amendments) and International Marine Organisation (IMO) guidelines and legislation. As with any operational port, all vessels accessing the wharf will be required to comply with IMO ballast water management plans and MARPOL controls for marine pollution.

Oil spills can occur in a number of ways, including leaks from construction equipment and vessel accidents. To mitigate the risk of oil spills adversely affecting the marine environment, the following measures will be implemented:

- Ship movements will remain in existing shipping channels and will be restricted from shallow waters or reefed areas.
- Shipping paths will avoid the Sir Joseph Banks Group Marine Park where possible.
- Where practical, activities with a risk of oil spill will be bunded (offshore and landside).
- Spill response materials and procedures will be established (offshore and landside).

Light Spill

Light spill to the marine environment will be minimised through:

- Limiting construction within the marine environment to day time only, reducing lighting requirements.
- Orienting lights appropriately and utilising shielding to minimise spillage, particularly on the jetty.
- Use of the minimum amount of lighting required for safety and security purposes.

Marine Pests

All vessels utilising the port will be required to comply with the national guidelines relevant to biofouling and ballast water (Australian Quarantine and Inspection Service *Australian Ballast Water Management Requirements* (DAFF 2011) and the Australian *Quarantine Act 1908*) to mitigate the risk of introducing pest species to the marine environment.

14.6.3 Summary of Control and Management Strategies

As previously outlined, in order to minimise the impact on, and potential risks to, the marine and coastal environment during construction and operation, a series of control strategies and management approaches will be incorporated into the CEMP or OEMP. Key control and management strategies are summarised in Table 14-8.

Table 14-8 Control and Management Strategies: Marine and Coastal Environment

Control and Management Strategies	EM ID
Construction	
All clearance of native vegetation to have approval from the Native Vegetation Council (as required under the *Native Vegetation Act*) prior to commencement.	VC_C1
Native vegetation clearance to be offset via implementation of an appropriate (commensurate) Significant Environmental Benefit (SEB), as approved by the Native Vegetation Council (NVC). The required SEB Offset plan will be developed in collaboration with Native Vegetation Management Unit officers (DEWNR) and regional stakeholders. The final offset will be approved by the Native Vegetation Council prior to any clearance occurring. Current proposals are being considered from the EP NRM Board and the Nature Foundation for potential offset projects which align with regional conservation objectives. Other options include payment into the Native Vegetation Fund.	VC_C2
Develop and implement piling management procedures, including: · Observation of the marine study area for marine mammals over 30 minutes prior to the commencement of piling. · Gradually increasing piling intensity over a 30 minute period. · Establishment of a 1.5 km observation zone and 0.5 km shut down zone for marine mammals during piling activities.	NV_C7 NV_C8
Develop and implement whale management procedures, incorporating: · A description of all threats to the megafauna species expected in the area. · A monitoring plan for megafauna habitat use and behaviour, using appropriate survey techniques for mapping of potential threats to marine megafauna. · Identification and indication of noise sources and strategies to manage/mitigate noise impacts.	MD_C1
Develop and implement waste management measures in accordance with South Australia's Waste Strategy to identify, separate and provide adequate waste disposal for all waste streams.	WG_C1
Restrict access to coastal areas for vehicles or temporary construction areas (e.g. laydown areas).	MD_C2
Restrict vessel movements to designated manoeuvring areas, including the avoidance of marine parks where practicable. All large vessels will be manoeuvred into place by tugs within the port site.	MD_C3
Develop and implement a Marine Mammal Notice to Mariners, incorporating: · An overview of when marine mammals are expected to be present within the study area and key shipping routes. · Mandated reductions of speed in shipping lanes during periods of peak marine mammal movements (e.g. whale season, May to November). · Mandatory reporting of marine mammals sightings to the appropriate authorities. · Encouragement for appropriate caution in ship movements around marine mammals. · Response procedures to be implemented should an entangled marine mammal be sighted, or a collision occur.	MD_C4

Control and Management Strategies	EM ID
No discharge of high-risk ballast water as defined by the *Australian Ballast Water Management Requirements* (DAFF 2011).	MD_C5
Develop and implement procedures to minimise the spillage of oil, including: · Ship movements will remain in existing shipping channels and will be restricted from entering shallow waters or reefed areas. · Where practical, activities with a risk of oil spill will be bunded (offshore and landside). · Spill response materials and procedures will be established (offshore and landside).	MD_C6
During the pouring of concrete into hollow piles for the construction of the jetty and wharf, removable bunding and a concrete injection system will be utilised to minimise risk of overflow and spillage.	MD_C7
Emergency response measures for fuel, oil or chemical spill will be consistent with the National Marine Oil Spill Contingency Management Plan 2011.	MD_C8
All vessels will comply with relevant speed restrictions and exclusion zones at all times.	MD_C9
Before undertaking piling or construction of the MOF, a marine fauna observer or trained crew member must visually monitor, using binoculars, a zone of 1000 m around the site of the activities (the monitoring zone) for cetaceans, pinnipeds, penguins (and turtles).	MD_C10
If any cetacean species are sighted in the monitoring zone, the activities must not commence until the animal is observed to leave the monitoring zone, or until 20 minutes after the last sighting within the monitoring zone.	MD_C11
Cease piling or dumping of rock wall, if any of these animals are observed within 500m of the activities being undertaken.	MD_C12
Should any injured or dead cetaceans, pinnipeds and penguins (or turtles) be discovered attributable to construction related activities, complete shut-down of all activity must immediately occur and remain in effect until a review of procedures is undertaken and alternative and/or additional management measures have been approved by regulators.	MD_C13
A record will be kept of all sightings of protected marine species. All observations of cetaceans, pinnipeds and turtles within the monitoring zone will be reported fortnightly to the appropriate authorities.	MD_C14
If a cetacean, pinniped or marine turtle is killed or injured the following reporting procedure must be followed: 1. The construction contractor must immediately report the incident to the environmental site manager. 2. The death or injury of the animal must be verbally reported within 24 hours to the appropriate state and Commonwealth authorities. 3. A written incident report detailing the species injured, location where the incident occurred or the animal was found, nature of the injuries, and circumstances surrounding the incident will be provided to the appropriate authorities within five working days. In the event of a boat strike, the report to DoE will be submitted through the Australian Marine Mammal Centre: https://data.marinemammals.gov.au/report/shipstrike.	MD_C15
Baseline, marine surveys to be undertaken in the marine study area for species present, providing robust baseline detailing presence of existing species. Follow up monitoring would be undertaken for the detection of new marine species (including pests), allowing for an early response to the introduction of IMS, if required.	MD_C16
Light spill to the marine environment minimised through: · Limiting construction within the marine environment to day time only, reducing lighting requirements. · Orienting lights appropriately and utilising shielding to minimise spillage, particularly on the jetty. · Use of the minimum amount of lighting required for safety and security purposes.	MD_C17
Piling works will only be undertaken during the day to allow for observation activities to be undertaken.	MD_C18

Control and Management Strategies	EM ID
Operation	
Develop and implement whale management procedures, incorporating: · A description of all threats to the megafauna species expected in the area. · A monitoring plan for megafauna habitat use and behaviour, using appropriate survey techniques for mapping of potential threats to marine megafauna. · Identification and indication of noise sources and strategies to manage/mitigate noise impacts.	SL_O1
Develop and implement waste management measures in accordance with South Australia's Waste Strategy to identify, separate and provide adequate waste disposal for all waste streams.	SL_O2
Restrict vessel movements to designated manoeuvring areas. All large vessels will be manoeuvred into place by tugs within the port site.	SL_O3
Locate anchorage areas for large cargo vessels in deep water (>20 m) and away from reefs and dense seagrass.	SL_O4
Develop and implement a Marine Mammal Notice to Mariners, incorporating: · An overview of when marine mammals are expected to be present within the study area and key shipping routes. · Mandated reductions of speed in shipping lanes during periods of peak marine mammal movements (e.g. whale season, May to November). · Mandatory reporting of marine mammals sightings to the appropriate authorities. · Encouragement of appropriate caution in ship movements around marine mammals. · Response procedures should an entangled marine mammal be sighted, or a collision occur.	SL_O5
No discharge of high-risk ballast water as defined by the *Australian Ballast Water Management Requirements* (DAFF 2011).	SL_O6
Develop and implement procedures to minimise the spillage of oil, including: · Ship movements will remain in existing shipping channels and will be restricted from shallow waters or reefed areas. · Where practical, activities with a risk of oil spill will be bunded (offshore and landside). · Spill response materials and procedures will be established (offshore and landside).	SL_O7
Light spill to the marine environment will be minimised through: · Orienting lights appropriately and utilising shielding to minimise spillage, particularly on the jetty. · Use of the minimum amount of lighting required for safety and security purposes.	SL_O8
Management of marine noise so that it does not exceed 150 dB(M) re 1µ Pa2.s at the nearest receptor, or use of an exclusion zone for the relevant activity if this cannot be met.	SL_09
Regular monitoring of the marine study area would be undertaken for the detection of new marine species (including pests), allowing for an early response to the introduction of invasive marine species (IMS) if required. The marine monitoring would be compared back to the baseline marine survey to determine the introduction of any marine species or IMS.	SL_O10
Emergency response measures for fuel, oil or chemical spill will be consistent with the National Marine Oil Spill Contingency Plan 2011.	SL_O11
There will be a low frequency of vessel trips (approximately average of 1 per day)	SL_O12
All vessels will comply with relevant speed restrictions and exclusion zones at all times.	SL_O13

Control and Management Strategies	EM ID
Response procedures should an entangled marine mammal be sighted, or a collision occur: · The operator must immediately report the incident to the environmental site manager. · The death or injury of the animal must be verbally reported within 24 hours to the appropriate state and Commonwealth authorities. · A written incident report detailing the species injured, location where the incident occurred or the animal was found, nature of the injuries, and circumstances surrounding the incident will be provided to the appropriate authorities within five working days. In the event of a boat strike, the report to Department of the Environment will be submitted through the Australian Marine Mammal Centre: https://data.marinemammals.gov.au/report/shipstrike.	SL_014

14.7 Residual Risk Assessment

This section identifies and assesses risks to the marine and coastal environment associated with the construction and operation of the proposed port that would not be expected as part of the normal operation of the project, but could occur as a result of faults, failures and unplanned events. Although the risks may or may not eventuate, the purpose of the risk assessment process was to identify management and mitigation measures required to reduce the identified risks to a level that is as low as reasonably practicable and therefore acceptable. The marine and coastal environment management and mitigation measures identified are presented in Section 14.6 and form the basis of the Environmental Management Framework presented in Chapter 24, Environmental Management.

14.7.1 Ship Strike

There will be significant marine vessel activity within the marine study area during construction and operation of the port that will create the potential for direct impacts on marine fauna via boat strike. These increased vessel movements are considered most likely to impact marine mammals due to their need to surface to breathe. Large, slow moving ships (e.g. bulk carriers and tugs) are considered to present a greater risk to larger marine mammals such as whales, than smaller, more mobile mammals such as dolphins and seals. Most ship strikes of marine mammals are associated with smaller, faster moving vessels.

Due to the highly mobile nature of marine fauna, there is a wide range of species that may be present in the area at different times; however there are a number of species that have a higher likelihood of being observed in the waters around Cape Hardy. Australian Sea Lions, New Zealand Fur Seals, Bottlenose Dolphins and Common Dolphins are thought to be present in the area on a year round basis. Two whale species which may occur on a more seasonal basis within the marine study area include the Southern Right Whale and the Humpback Whale.

As there are no known whale aggregation areas within the Spencer Gulf, usage of the study area by whales is considered to be low. However, usage of the Spencer Gulf by individual whales on occasions is likely to occur during operation of the port. Whales tend to prefer shallow areas whilst in Australian waters (SEWPaC 2012a, Appendix T) whereas bulk carrier shipping channels within the Spencer Gulf are aligned to deep water in the centre of the Gulf.

There have been three recorded whale strikes within South Australian waters (IWC 2013), none of which were within the Spencer Gulf. There are currently no recorded whale strikes within the Spencer Gulf; however in 2013 the carcass of a Southern Right Whale was found at Tumby Bay. The cause of death was attributed to a vessel strike but the location of the death was uncertain due to the level of decomposition and it may have drifted into the gulf from open water. The low number of vessel strikes within Spencer Gulf indicates that despite the operation of existing ports/ferry terminals at Port Pirie, Port Bonython, Port Lincoln, Whyalla, Lucky Bay and Wallaroo, the risks to whales are low.

Were a ship strike to occur, mortality of the struck individual could occur, representing a short term minor decrease in the local population, with no lasting effects on population viability, which is considered to be a **minor** consequence. The likelihood of ship strike during construction and operation of the port is considered to be **possible** and could occur at some point during the life of the project. As such, ship strike overall is considered to represent a **low** risk.

Cumulative Ship Movements

A number of port developments have been proposed within Spencer Gulf that would result in a higher likelihood of ships striking marine fauna. Proposed port developments within Spencer Gulf include:

- Lucky Bay (12 additional Panamax vessels per year)
- Port Spencer (277 additional Capesize or Panamax vessels per year)
- Port Bonython (32 additional Capesize or Panamax vessels per year)
- Cape Hardy (i.e. the proposed port facility, 145 additional Capesize or Panamax vessels per year)

Should each of the proposed ports be developed, an additional 466 large commercial vessels will enter Spencer Gulf each year, an increase of approximately 20%. Were a ship strike to occur as a result of the additional vessel movements, mortality of the struck individual could occur, representing a short-term minor decrease in the local population, with no lasting effects on population viability, which is considered to be a **minor** consequence. Given the cumulative increase in ship movements, it is considered **possible** that a ship strike could occur. As such, cumulative ship strike from all proposed ports within Spencer Gulf is considered to represent a **low** risk.

14.7.2 Seagrass Loss or Gain

If there was a large scale loss of seagrass at the site (e.g. as a result of the introduction of IMS), sediment transport processes would be at risk of substantial change, which could result in the redistribution of sediment, or changes to seabed conditions. If large areas of seagrass loss were to occur, a reduced diversity and density of associated infauna and epifauna species would be expected in any resulting unvegetated areas (Stoner 1980; Tanner and McDonald 2014). The loss of macroalgae from reef habitat is expected to cause similar effects for benthic epifauna. The level of impact to epifauna due to loss of seagrass is difficult to predict as communities depend on a complex interaction of variables, including but not limited to hydrodynamics, the seagrass species present, patch orientation, edge effects, and the area of sandy ‘blowouts’ (Edgar and Robertson 1992; Tanner 2003).

The location of the proposed marine infrastructure avoids areas of dense seagrass or macroalgae, thereby reducing the likelihood of effects to these habitats. As detailed in Section 14.5, nominated levels of seagrass clearance and disturbance were based on conservative estimates. The benthic fauna and habitats within the port site are typical of those identified throughout the Spencer Gulf and are not identified as a key locations supporting endangered or protected species. As such, the consequences are considered to be **minor**, resulting in a local short-term decrease in abundance of benthic fauna, but not resulting in lasting effects on the local population. The likelihood of further clearance of seagrass and benthic fauna habitat is considered to be **unlikely** as clearance calculations have been made based on conservative estimates. As such, the overall risk of unintended additional seagrass clearance is considered to be **low**.

Plate 14-11 Areas of Dense Seagrass Including *Amphibolis spp*. Have Been Avoided

The presence of marine structures at the Cape Hardy site, particularly the tug harbour and MOF, is expected to result in only localised changes to the hydrodynamics as discussed in Section 14.5. Changes would include low-level reduction in the rates of sediment transport and bed shear which will generally follow the existing natural dynamics within the Cape Hardy area. Therefore significant changes in coastal processes such as erosion or sediment dynamics are not expected.

There is a risk that unanticipated changes to hydrodynamics could occur as a result of build-up of seagrass wrack on new structures such as the MOF. Ongoing monitoring of the marine environment would identify unpredicted build-up and mechanical removal may be undertaken if required. Unanticipated changes to the hydrodynamic environment at the proposed port site are considered to represent a **low** risk; **minor** in consequence due to the localised effect which could be readily managed through mechanical clearance if required, and **unlikely** to occur given the level of seagrass coverage impacted by the proposed development.

14.7.3 Artificial Light Spill

There is a risk that the introduction of artificial light sources will result in altered behavioural patterns amongst coastal and marine fauna through the attraction of higher levels of marine prey species and marine birds than anticipated. The level of attraction and subsequent effect on resident species as a result of greater utilisation of habitat and foraging resource is largely unknown. It is considered possible that despite design measures to limit artificial light spill, additional marine fauna will be attracted to the site.

The port site does not represent a key habitat or large breeding colony for any bird species, with resident populations limited to isolated pairs and individuals. The introduction of artificial light sources may result in a long-term alteration to the behaviour of fauna at the port site which is considered to be of **minor** consequence. However, the artificial light sources are considered **unlikely** to affect the viability of any species as the port site does not represent critical habitat. As such, the overall risk associated with the introduction of artificial light sources at the port site is considered to be **low**.

14.7.4 Turbidity and Sedimentation

Scour around jetty pilings, vessel scour, sedimentation inside the tug harbour, or other influences on sedimentation, represent a risk to the bathymetry of the site. Vessel scour and hydrodynamic changes can not only change turbidity and sedimentation rates, but also particle size distribution of sediments and total organic carbon. This could subsequently result in flow-on changes in benthic community composition which may influence bathymetry. The consequence of any change is considered **moderate**; limited to the study area but present throughout the operation of the port. The likelihood of changes to the benthic community composition as a result of scour and sedimentation is considered **possible.** As such, the risk associated with scour is considered to be **medium**.

The consequences of resuspending contaminated sediments on the quality of the water are considered **minor**, readily dispersed by the natural wave energy within the study area and not resulting in long-term effects to water quality. As the sediments in the study area were found to be uncontaminated, it is considered **unlikely** that the proposed development will disturb or cause the redistribution of any contaminated sediments. It is therefore considered a **low risk** that existing metals or other contaminants would be released from marine sediments and effect water quality.

Uncontrolled surface water run-off entering the marine environment can also result in increased sedimentation or turbidity. Run-off risks will be mitigated via the stormwater capture design which is proposed for the development. It is noted that uncontrolled run-off would already enter the marine environment, increasing sedimentation during storm events. Run-off would result in a short-term increase of sedimentation within the study area, considered to be of **minor** consequence. Despite the implementation of design controls (such as bunding and retention basins), it is considered **possible** that a severe storm event may result in additional run-off entering the marine environment. Based on the anticipated consequence and likelihood, the overall risk associated with run-off entering the marine environment and causing sedimentation is considered to be **low**.

14.7.5 Spills and Discharges into Marine Environment

This section discusses the risk associated with the unintended discharge of material into the marine environment. Materials identified as having potential to enter the marine environment during construction and operation of the proposed port are oil/chemical (e.g. fuel), magnetite concentrate, stormwater and runoff, and waste products (e.g. rubbish).

Oil/Chemical

Two types of oil/chemical spills were considered as a risk to the marine and coastal environment:

- ***Major spill*** – oil spill from a ship-to-structure, ship-to-ship, or grounding incident
- ***Minor spill*** – spill from general activities e.g. leaking equipment, or accidental discharge of chemicals stored on site

The consequences of a spill incident are dependent on a range of factors, including:

- Weather conditions at time of spill
- Location and timing of the spill (i.e. hydrodynamic environment will influence the rate of dispersion)
- Amount of material spilled
- The type of material spilled

There have been a total of 27 major oil spills in Australian waters from 1903 to 2012 (Australian Maritime Safety Authority 2013). Of the 27 spills, only three have occurred in South Australian waters, one of which was in the Spencer Gulf. The spill in the Spencer Gulf was at Port Bonython in 1992 and was the result of a vessel's bow rupturing during berthing in high winds, resulting in the release of approximately 300 t of fuel (Australian Maritime Safety Authority 2013). The other two spills in South Australian waters were at Port Stanvac; both of which were associated with oil loading activities. The predominant cause of major oil spills in Australia has been grounding as a result of high seas, poor weather or uncharted reefs.

In conjunction with design control measures, effective implementation of the CEMP and OEMP will reduce the likelihood of an oil spill and leaks during construction and operation. The consequences of a minor spill event are considered to be **minor**, and will not result in any long-term effect on marine flora or fauna. It is considered **possible** that a minor spill will occur at some point during construction and operation of the port. As such, the risk to water quality from a minor spill or leak would be considered **low**.

A major spill or leak would have **moderate** consequences for water quality and could result in a long-term effect to flora and fauna within the marine study area. Adverse effects to the marine environment beyond the study area are considered unlikely to occur as the proposed port site is relatively sheltered from a hydrodynamics perspective. A major spill event is considered **unlikely** to occur, and is only anticipated in extreme circumstances. As such, the risk from a major spill or leak is considered to be **medium**.

Magnetite Concentrate

As previously outlined in Section 14.4, design controls have been established to minimise spillage of magnetite concentrate and dust emissions during material handling at the port site. Should these design controls fail, there is a risk that magnetite concentrate could be spilt into the marine environment. Spillage of concentrate would initially affect benthic habitats as the material is insoluble in water. Large amounts of concentrate covering the benthos would change sediment characteristics, smothering benthic organisms and potentially altering habitat structures.

The distribution of benthic fauna can be driven by differences in sediment biogeochemistry (Reynoldson 1987). It is considered unlikely that the emissions of magnetite concentrate dust or potential spillage of concentrate during the shipping process will lead to any significant change in sediment chemistry, or the distribution of benthic fauna in any area, other than the immediate settling area of an accidental spill (see Appendix Q). Iron occurs naturally in marine sediments, but is generally not soluble or bio-available (Canfield 1989). With this in mind, it is expected that the magnetite concentrate which reaches the sediment from dust emissions will not cause elevations in dissolved or bioavailable iron concentrations. As such, spillages are not envisaged to result in long-term effects on the local population, and the consequences are therefore considered to be **minor**. Whilst minor spillage of magnetite concentrate is considered to be **almost certain**, as the study area is relatively sheltered from a hydrodynamics perspective, the consequences of the spillage will be limited to the study area. As such, the overall risk of magnetite concentrate spillage on water quality, and subsequently on benthic fauna is considered to be **medium** as a result of the high likelihood of occurrence.

Stormwater and Runoff

The creation of hardstand areas for the land-based facilities creates the risk of increased flows of run-off channelling into the marine environment that could change the sediment loading and distribution at the site. Run-off from the land-based operations also has the risk of introducing contaminants into marine sediments. Run-off risks will be mitigated via the stormwater capture design which is proposed for the development. The overarching aim in the design of landside stormwater management infrastructure is to minimise discharge into the marine environment. Where natural flows discharge into the ocean, these natural drainage lines will be retained.

As hazardous materials will be stored in facilities capable of managing rainfall up to a 1 in 100 year event, any run-off entering the marine environment is anticipated to be uncontaminated. Therefore run-off entering the marine environment would result in additional freshwater input (as would already occur at the site during storm events). This is anticipated to result in short-term effects on marine flora and fauna that does not impact the viability of any species (i.e. of **minor** consequence). It is considered **unlikely** that a severe storm event may result in run-off entering the marine environment at rates greater than currently observe on site. Based on the anticipated consequence and likelihood, the overall risk associated with run-off entering the marine environment is considered to be **low**.

Waste

Construction and operation of the proposed port will result in the generation of a number of waste streams that may enter the marine environment. Marine debris can significantly affect marine birds and fauna as a result of pollution, injury through collision, entanglement or ingestion of non-biological products. For example, the Silver Gull, Black-faced Cormorant and Nankeen Night Heron along with other marine bird species that may occur in the area (refer Appendix Q) have been identified as having the potential to be attracted to the port activities. Due to these species' characteristics of exploiting human activities in the marine environment, they are considered particularly susceptible to debris within the marine environment. Similarly, fish species and other marine fauna can be affected by waste entering the marine environment through a variety of means, including entanglement or ingestion of non-biological products.

Waste management and handling procedures developed as part of the CEMP and OEMP will control waste streams with the overarching aim of no waste products entering the marine environment. As the study area does not represent a key habitat, breeding area or migration path, the consequences of debris entering the marine environment are considered to be insignificant to the overall viability of marine fauna populations (i.e. of **insignificant** consequence). Despite the implementation of control measures, it is considered **almost certain** that some form of waste/debris will enter the marine environment during construction and operation of the port. As such, the overall risk is considered to be **low**.

14.7.6 Marine Pests

Mitigating the introduction and spread of marine pests into the local marine environment is a key issue in the construction and operation of the proposed port. IMS could be transported to the study area as biofouling on vessel hulls, jack-up barge legs, anchors, anchor chains, mooring lines, internal boat compartments, sediment transported in or on vessels, or in any seawater onboard vessels/barges, including ballast water, in bilge, inside pipes or pumps. The two most likely mechanisms for the spread of marine pests are via ballast water and biofouling (discussed in more detail below).

IMS can exist in low numbers or persist as cysts in an area and can rapidly increase in density after a disturbance to the environment or removal of competitive indigenous species. Construction activities have the potential to either release cysts or propagules of IMS, as well as provide cleared surfaces for IMS to colonise. Due to the opportunistic traits of IMS the hard surfaces of the MOF, tug harbour and jetty will create suitable areas for IMS to colonise.

In recent years, a number of exotic marine pest species have been identified in Australian waters, including the European fanworm *Sabella spallanzanii*, the Northern Pacific seastar *Asterias amurensis*, the eastern Atlantic clam *Corbula gibba* and the tropical seaweed *Caulerpa taxifolia*. Many of these species are toxic to other organisms and have the capacity to overgrow and out-compete native marine flora and fauna.

Ballast Water

Mandatory ballast water management requirements enforceable under the *Quarantine Act 1908* were introduced in 2001. The ballast water management requirements outline obligations to reduce the risk of introducing harmful aquatic organisms into Australia's marine environment by establishing standards and procedures for the management of ballast water and sediments.

All salt water from coastal waters outside Australia is deemed to be capable of introducing marine pests into Australian waters. As such, the discharge of ballast water in Australian ports is prohibited without approval from the Australian Quarantine and Inspection Service.

Sediments from ballast tanks can only be discharged in Australia under certain circumstances. It can only be disposed of as quarantine material in some Australian ports, or it can be dumped back into the ocean in water which is at least 200 m deep and at least 12 nautical miles from shore.

Biofouling

Biofouling is currently considered the principal method of IMS transfer. Although biofouling levels on an individual vessel can seem insignificant, some species with pest potential have the capacity to breed in large numbers. The risk of pest species representing a threat to environmental values is further exacerbated by the frequency of vessels. Risks associated with biofouling can be appropriately mitigated through the treatment and cleaning of vessel surfaces and internal seawater systems.

All vessels utilising the port site will be required to comply with the national guidelines relevant to biofouling and ballast water. As Cape Hardy is relatively isolated from a hydrodynamic perspective, IMS that may colonise the area would not be readily transported by currents beyond the study area and into new regions. IMS would primarily rely on vessel movements for transportation to areas beyond the study area, although some invertebrates can spread widely once established. The early identification of IMS through the proposed marine monitoring program is proposed to minimise the likelihood of IMS establishing in the study area. The consequences of introducing IMS to the Cape Hardy study area may result in a long-term local disturbance to habitat, which is commonly represented throughout Spencer Gulf, and is considered to be a **minor** consequence. The identification of IMS during construction and operation of the proposed port is considered **likely** despite the implementation of control measures. As such, the overall risk associated with IMS to local flora and fauna species is considered to be **medium**.

Should IMS be transported beyond the Cape Hardy study area, flora and fauna communities within the Spencer Gulf may be affected, which is considered to be of **major** consequence. As IMS would primarily rely on vessel movements for transportation to areas beyond the study area, it is considered **possible** to occur. As such, the overall risk associated with IMS to regional flora and fauna species is considered to be **high** as a result of the potentially significant consequences.

The consequences of introducing an algal IMS species would be considered **minor** (localised to the marine study area and algal blooms are typically short term in duration). Although the introduction of IMS is a possibility, the likelihood of introducing an algal IMS species that effects water quality is considered **unlikely** due to the Commonwealth requirements for vessels to discharge ballast water in open waters and the requirement for operators to adhere to a CEMP and OEMP for the port. As such, the risk to water quality from IMS algae is considered to be **low**.

Some IMS, such as mussels, have the potential to build up biological reefs which consequently change the bathymetry and therefore ultimately the hydrodynamics of an area. Seagrass has also been shown to influence the hydrodynamics of coastal areas by physically slowing currents. Therefore if a reef-building, seagrass pest or smothering IMS such as *Caulerpa taxifolia* were introduced to the site, it could cause seagrass loss, which could in turn lead to alterations in hydrodynamics and sediment dynamics. The consequences of such an introduction would be limited to the local study area and will likely be present for a long term and are therefore considered **moderate**. As with any operating port, the introduction of IMS is a possibility; however the likelihood of introducing a specific reef-building or seagrass-smothering IMS is considered **unlikely**. Therefore, the risk of IMS to hydrodynamics and bathymetry is considered **medium**.

14.7.7 Summary of Risks

The residual risks associated with the marine and coastal environment are presented in Table 14-9. Through the adoption of design modification or specific mitigation measures, all but one of the identified risks were reduced to levels of medium or lower. The introduction of an IMS species that affects flora and fauna communities in the Spencer Gulf was considered to be a high risk, as despite the implementation of control measures, the consequences of such an event occurring could be major. Risks will be managed through the CEIP Environmental Management Framework outlined in Chapter 24 and the CEMP and OEMP for the project.

Table 14-9 Residual Risk Assessment Outcomes: Marine and Coastal Environment

Risk Event	Pathway	Receptor	Likelihood	Consequence	Residual Risk
Ships striking marine fauna	Increased vessel movements during construction and operation	Marine fauna	Possible	Minor	Low
Ships from cumulative port developments striking marine fauna	Increased vessel movements	Marine Fauna	Possible	Minor	Low
Loss of additional seagrass due to unforeseen circumstances (e.g. IMS)	IMS in ballast water, ship hulls, machinery etc.	Marine flora within the study area	Unlikely	Minor	Low
Seagrass build up on new structures such as the MOF altering hydrodynamics	Changes to benthic habitat providing new opportunities for seagrass growth	Study are hydrodynamics	Unlikely	Minor	Low
Artificial light spill resulting in increased population of predator species	Artificial light spill attracting prey species	Prey species, existing marine bird inhabitants	Unlikely	Minor	Low

Risk Event	Pathway	Receptor	Likelihood	Consequence	Residual Risk
Increased turbidity altering benthic composition and bathymetry	Scour around jetty pilings or vessel scour	Study area bathymetry	Possible	Moderate	Medium
Mobilisation of contaminated sediments	Mobilisation of sediments with elevated levels of metals	Water quality within study area	Unlikely	Minor	Low
Increased sedimentation as a result of stormwater runoff	Extreme weather events resulting in failure of stormwater infrastructure	Water quality within study area	Possible	Minor	Low
Minor oil / chemical spill into marine environment	Leaking equipment, improper handling	Water quality within study area	Possible	Minor	Low
Major oil / chemical spill into marine environment	Oil spill from a ship-to-structure, ship-to-ship, or grounding incident	Water quality within study area	Unlikely	Moderate	Medium
Magnetite concentrate altering distribution of benthic fauna	Dust emissions, failure of materials handling equipment	Benthic fauna and water quality	Almost certain	Minor	Medium
Runoff entering the marine environment	Extreme weather events resulting in failure of stormwater infrastructure	Water quality and marine flora / fauna	Unlikely	Minor	Low
Waste products entering the marine environment	Improper disposal of waste, accidental release	Water quality, marine fauna	Almost certain	Insignificant	Low
Introduction of IMS to the study area	Ballast water or biofouling	Water quality, marine flora / fauna	Likely	Minor	Medium
Introduction of IMS to broader Spencer Gulf	Ballast water or biofouling	Water quality, marine flora / fauna	Possible	Major	High
Introduction of algal IMS species	Ballast water or biofouling	Water quality, marine flora / fauna	Unlikely	Minor	Low
Introduction of biological reef-building IMS	Ballast water or biofouling	Site bathymetry / hydrodynamics	Unlikely	Moderate	Medium

14.8 Findings and Conclusion

The proposed port development site is not located within an area considered to be of particularly high or notable habitat value, nor is it heavily relied upon by marine fauna for nesting, breeding or foraging purposes.

However, impacts to the marine and coastal environment are expected as part of the proposed port development. The clearance of subtidal habitats to support marine infrastructure will be required and will result in the permanent loss of 2.65 ha of seagrass habitat and 0.51 ha of rocky reef habitat. An alteration to the bathymetry of the study area will also occur as a result of the introduction of the MOF, tug harbour and jetty. Additionally, the hydrodynamics of the subject site will be permanently altered as a resulted of the proposed development, resulting in increased sediment deposition of less than 1%.

Risks to the marine environment will be alleviated wherever possible through the implementation of control and management strategies. The highest residual risk is associated with the potential to introduce an IMS that affects flora and fauna communities in Spencer Gulf. This residual risk remained high despite the implementation of control measures to reduce the likelihood of occurrence as (at worst) the consequences would result in impacts to flora and fauna communities throughout the region. Medium-level risks are associated with the accidental spillage of magnetite concentrate into the marine environment, as well as the risk associated with a major fuel spill, resulting from ship grounding or collision with maritime infrastructure or other vessels.

14.8.1 Findings and Conclusions on EPBC Matters

A referral of the CEIP Infrastructure under Section 68 of the EPBC Act was determined to be a controlled action as a result of potential impacts on the Southern Right Whale. The impacts and risks are discussed above and summarised in Table 14-10. Based on this assessment, taking into account the proposed mitigation measures, the CEIP Infrastructure will not have a significant residual impact on the Southern Right Whale. As the EPBC Act Environmental Offsets Policy (DSEWPaC 2012a) only applies to actions that are likely to have a significant residual impact, an offset under the EPBC Act is not considered to be required.

Table 14-10 Summary of Impacts on Southern Right Whale

Potential Impact or Risk	Assessment	Expected impact
Habitat clearance	As noted in 14.5.1, approximately 3 ha of marine habitat will be cleared, with additional areas subject to periodic disturbance. All affected habitats are well represented in the Spencer Gulf. The Conservation Management Plan for the Southern Right Whale notes that coastal Australian waters are not generally used for feeding.	Nil
Underwater noise	The impact of noise from piling and drilling during construction is discussed in 14.5.2 and mitigation measures are described in 14.6.1. The use of observation and shut-down zones are standard measures that are used for similar activities across Australia. Noise modelling shows the proposed zones will ensure Southern Right Whales do not suffer hearing damage. Operational noise levels are unlikely to affect Southern Right Whales.	Negligible

Potential Impact or Risk	Assessment	Expected impact
Ship strike	The proposed port site is not located within critical habitat, breeding colonies, foraging grounds or migration paths for whales. Shipping lanes in the Gulf avoid the shallower areas that are used more frequently by whales. Ships in the port area will be under the control of tugboats. In addition, large bulk carriers are less likely to strike whales than smaller faster moving vessels, such as ferries. Despite this, 14.6.2 notes that whale management measures will be incorporated into the CEMP and OEMP (respective drafts in Appendix AA and BB).The potential for ship strike is discussed in 14.7.1. It is concluded that the risk of ship strike from the project is low, as is the cumulative risk in the Spencer Gulf.	Low risk
Turbidity and sedimentation	Potential impacts are discussed in 14.5.4 and risks in 14.7.4. Control and management strategies are described in 14.6. Any impacts would be localised and no impact on Southern Right Whales is expected.	Nil
Spills and discharges	The risk of spills and discharges is discussed in 14.7.5. Given the control and management measures described in 14.6, a major oil or chemical spill is considered to be a medium risk to the environment. The risk to whales would be considerably less as it would require two unlikely events – a spill to occur and a Southern Right Whale to be present in the area at the same time. Waste management measures are described in 14.6 and the risk of waste products entering the marine environment is discussed in 14.7.5. Given the proposed measures, it is highly unlikely that waste from the project will result in entanglement of whales.	Negligible

No other threats identified in the Conservation Management Plan for the Southern Right Whale will occur as a result of the project. As summarised in Table 14-10, the project addresses the actions in the Conservation Management Plan that are targeted at assessing and addressing threats:

- It does not change the existing legal and management protection for Southern Right Whales.
- Impacts of construction noise have been assessed and addressed through mitigation measures.
- Operational noise is not expected to have an impact.
- Waste management measures minimise the risk of whale entanglement.
- The potential for ship strike is assessed and addressed, and is considered to be low.
- The CEMP and OEMP provide for a monitoring plan for megafauna habitat use and behaviour for mapping potential threats arising from the port construction and operations. This will also contribute to actions in the plan for measuring and monitoring population recovery.

Consequently, CEIP Infrastructure is considered to be consistent with the Conservation Management Plan for the Southern Right Whale.