CHAPTER 18 – MARINE ECOLOGY

GULF ALUMINA LTD – SKARDON RIVER BAUXITE PROJECT
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18. MARINE ECOLOGY

18.1 Introduction

This chapter describes the marine ecosystems, fauna and flora within and surrounding the Project area, based on field surveys and desktop reviews, and defines environmental objectives and performance outcomes for freshwater marine ecology. Matters of national environmental significance (MNES) and matters of state environmental significance (MSES) associated with marine ecology and Commonwealth Marine Areas are described. This chapter identifies potential Project impacts on the marine environment, including MNES and MSES, describes measures to mitigate and manage impacts, and provides a risk assessment for residual impacts. The significance of residual impacts on MNES and MSES is assessed and potential biodiversity offsets identified.

Information in this chapter is primarily based on the information provided in Appendix 8 – Marine Ecology and Coastal Processes and Appendix 17 – Coastal Processes Supplementary Report.

Chapter 15 describes the terrestrial ecology (including MNES and MSES) of the Project and assesses Project impacts on terrestrial ecology. Chapter 16 describes the freshwater aquatic ecology (including MNES and MSES) of the Project and assesses Project impacts on freshwater aquatic ecology, noting that the marine and freshwater aquatic environments are not discrete and elements of marine ecology and freshwater aquatic ecology are described in both chapters. Chapter 17 describes coastal processes and assesses Project impacts on coastal processes.

18.2 Environmental Objectives and Performance Outcomes

The environmental objectives and performance outcomes below are based on Schedule 5, Table 2 of the Environmental Protection Regulations 2008 (EP Regulation). The mitigation and management measures presented in this chapter are designed to achieve these environmental objectives and performance outcomes. The environmental management plan (EM Plan) presented in Appendix 13 provides a consolidated description of these mitigation and management measures.

18.2.1 Environmental Objectives

- The activity is operated in a way that protects the environmental values of marine flora and fauna.
- The choice of the site, at which the activity is to be carried out, minimises serious environmental harm on areas of high conservation value and special significance in the marine environment.
- The location of activities in the marine environment protects environmental values of adjacent sensitive uses.
- Minimise direct and indirect impacts on marine fauna and flora.
- Biodiversity offsets are provided for significant residual impacts on marine fauna and flora.

18.2.2 Performance Outcomes

- Activities that disturb the marine environment and associated flora and fauna will be managed in a way that prevents or minimises adverse effects on the environmental values.
- Areas of high conservation value and special significance likely to be affected by the proposal are identified and evaluated and any adverse effects on the areas are minimised, including any indirect impacts on the areas.
Minimise interaction with marine species and habitats on the Skardon River.
Prevent mortality or permanent hearing damage to marine megafauna, and mitigate temporary hearing loss and behavioural modifications by maintaining exclusion zones around piling operations.
Conduct operations so that seagrass meadows remain viable within the Project area.
Prevent establishment of marine pest species.
Minimise the incidence of vessel strike and minimise light spill.
Biodiversity offset plans will be developed for any significant residual impacts on marine fauna and flora in accordance with relevant Commonwealth and State policies.

18.3 Legislative and Policy Context

The legislative and policy context for approvals for activities in marine environment is described in Chapter 2.

MSES are regulated under the Queensland Environmental Protection Act 1994 (EP Act), the Nature Conservation Act 1992 (NC Act), and the Vegetation Management Act 1999 (VM Act), while MNES are regulated under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Further information on these Acts is provided in Chapter 2. Legislation and policy relevant to water quality is described in Chapter 12.

The controlling MNES provisions for the Project are sections 18 and 18A (listed threatened species and communities), 20 and 20A (listed migratory species) and 23 and 24A (Commonwealth marine areas).

The Environmental Offsets Regulation 2014 (EO Regulation) can require offsetting for MSES including endangered and of concern remnant regional ecosystems (REs), REs that intersect with wetlands or are within a defined distance of a watercourse, specific protected wildlife habitat, wetlands and watercourses, protected areas, highly protected zones of State marine parks, fish habitat areas, waterways providing for fish passage, marine plants and legally secured offset areas. Endangered, vulnerable, near threatened animals and special least concern animals are protected under the NC Act.

MNES regulated under the EPBC Act include listed threatened plants and animals scheduled as critically endangered (CE), endangered (E), or vulnerable (V), and threatened ecological communities (TECs). A requirement for biodiversity offsets for MNES may be triggered by the EPBC Act Environmental Offsets Policy (2012).

There are three state marine parks declared under the Queensland Marine Parks Act 2004, none of which occur in the Gulf of Carpentaria.

The Fisheries Act 1994 declares certain areas Fish Habitat Areas in recognition of their importance to fisheries production. A Fish Habitat Area is an area protected against physical disturbance from coastal development, while still allowing legal fishing. The nearest declared Fish Habitat Areas to the proposed development are 80 – 100 km sway at Pine River Bay (adjacent to Weipa) and the Escape River (which drains into Torres Strait. The Act also describes marine plants.

18.4 Field Surveys

Metro Mining are proposing the Bauxite Hills Project, a similar project to the Skardon River Project which will also undertake activities within the Skardon River and offshore. Gulf Alumina and Metro Mining have agreed to share relevant environmental data collected during field surveys.

Benthic habitat and seagrass adjacent Metro Mining’s proposed Port area were surveyed in November 2014 at 48 locations using benthic video techniques.
Benthic habitat and seagrass surveys between the Port area and the Skardon River mouth were undertaken at 116 locations in 2015. Survey sites were distributed randomly or targeted given available bathymetric survey information (i.e. rocky reef). Video data was analysed and biota recorded within key classes including, total live cover, macroalgae, macroinvertebrates, coral and bare substrate cover.

Benthic habitat surveys, using a combination of side-scan sonar and underwater still photography, were undertaken in September 2014 at several offshore locations (four transects) at the offshore transhipment area.

Benthic habitat surveys were undertaken at three potential offshore anchorage area options for Metro Mining’s bauxite Hills Project. Video data was analysed and biota recorded within key classes including, total live cover, macroalgae, macroinvertebrates, coral and bare substrate cover. In addition, side scan sonar was also used along several transects to help identify potential habitat structure (rock etc.).

Incidental observations of mangrove vegetation within the Skardon River were made during habitat surveys, and marine water quality and sediment sampling (refer Chapter 17).

### 18.5 Desktop Review

The desktop review of was undertaken to identify potential matters of ecological significance including species and communities, and other ecological features that may occur on or within the vicinity of the Project activity area.

Desktop reviews were undertaken of the following report, which have direct relevance to the Project area:

- Port of Skardon River: Marine habitat resources survey April/May 2002 (Roeloffs et al, Marine Ecology Group, QFS, Northern Fisheries Centre, Cairns, 2002)
- Port of Skardon River: Marine Habitat Resources Survey, December 2006 (Rasheed, Marine Ecology Group, QFS, Northern Fisheries Centre, Cairns, 2007)
- Benthic marine habitat of the Skardon River mouth, May 2010 (Chartrand and Thomas, Marine Ecology Group, QFS, Northern Fisheries Centre, Cairns, 2010)
- Skardon River Bauxite Project Marine Ecological Survey, November 2014 (RPS, 2014)
- Port of Skardon River: Oil Spill Contingency Plan, Ports Corporation Qld (2003).

As described in Appendix 8, other literature sources with relevance to the regional and local marine environment and ecology were also reviewed.

Reliance for the identification of the potential occurrence of Commonwealth and State listed marine fauna was placed on published literature, other environmental studies for the region (e.g. The Pisolite Hills Project EIS which assessed marine fauna in the Port of Musgrave and Rio Tinto’s South of Embley EIS which assessed marine fauna near Weipa). Additional fauna surveys of the Skardon River were not considered necessary due to the low potential for detection of listed species. Therefore, the assessment has been conservative (e.g. consider species to be likely rather than unlikely to occur) is assessing likelihood of occurrence.

Desktop review also included an assessment of the following information:
Queensland Wetland Mapping. Mapping was sourced from the EHP wetland database and the Protected Matters Search Tool

- Protected matters database of MNES. This database applies a range of bio-models to predict the presence of species of flora and fauna and other MNES within a given radius of the site
- Marine species listed as threatened under the Queensland NC Act
- Marine species listed as threatened by the International Union for the Conservation of Nature (IUCN).

Over the course of marine ecology studies undertaken for the Project, a number of different searches of publically available databases (e.g. EPBC Act Protected Matter Search) have been generated for the Project area and surrounding buffer zones. Over time, the information provided in these searches has changed including the list and status of threatened species. The most recent publically available information has been used as a reference point for assessment of marine ecology values, although ecosystems or species of conservation significance identified through previous searches may also be described and assessed.

### 18.6 Environmental Values – Marine Habitats

The Skardon River and adjacent inshore and off-shore areas encompass several marine habitats, including; saltmarsh, mangroves, seagrass, rocky reef, oyster reef, coral reef, and broad areas of intertidal and subtidal soft substrates, being either bare or variably colonized by macroinvertebrates and macroalgal communities. Marine habitats of the Skardon River are shown in Figure 18-1 and offshore marine habitats are shown in Figure 18-2.

The regional ecosystems associated with marine environments are associated with mangroves habitat and salt marshes. All these REs are least concern or not of concern under State legislation.
No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.


Figure 18-1
Gulf Alumina Limited
18.6.1 Saltmarsh

Saltmarsh is characterised by low oxygenated, deep grey or black marine clay substrates, salt tolerant vegetation to less than 0.5 m tall and are generally only inundated during the highest spring tides. Vegetation with salt marshes is described in Appendix 8, with all regional ecosystems described as least concern or not of concern. Saltmarsh habitat is not a listed threatened ecological community (TEC).

Defined clearly within aerial imagery, saltpan and fringing saltmarsh habitats are present throughout the Skardon River system, as shown in Figure 18-1. The Port infrastructure area is not within a saltmarsh habitat.

18.6.2 Mangroves

Mangrove communities of Cape York are considered one of the world’s most species rich, supporting over 30 mangrove species that are unique to the region. The western coastline of Cape York from Doughboy River south to Hey River (known as the Weipa region) supports more than 47,740 ha of mangrove communities, with the greatest distributions found in the adjacent Port Musgrave and Albatross Bay areas and their associated river systems. A community of fringing mangrove habitat exists along the shores of the Skardon River, extending from just inside the mouth to the upper estuary/freshwater interface, as shown in Figure 18-1. The mangrove vegetation of the Skardon River is in good condition, with little evidence of disturbance and a well distributed range of life stages from juveniles to flowering adults. Types of mangrove vegetation along the Skardon River are described in Appendix 8.

The mangroves and adjacent saltmarsh / saltpans are considered to form part of the Port Musgrave Wetland Aggregation and Skardon River – Cotteral River Aggregation and defined as estuarine wetland by EHP (refer Chapter 16). This wetland is listed under the Commonwealth Directory of Important Wetlands, however it is not a MNES.

Historical clearing of a thin mangrove fringe has been undertaken at the existing Skardon River Port area, and covers the majority of river frontage proposed for Project development. Apart from a small area (300 m²) of mangroves in the conveyor alignment, mangroves are not present within the proposed Project footprint.

18.6.3 Seagrass Habitat

Several surveys for the distribution and abundance of seagrass and associated benthic habitats, including those undertaken specifically for the Project, have been undertaken within the Skardon River, as shown in Table 18-1. Based on these surveys, the known distribution of seagrass habitat within the Skardon River is shown in Figure 18-1.

Initial surveys by Coles et. al. (1986) identified two isolated patches of seagrass nearer the Skardon River estuary entrance. Further baseline investigations were undertaken during 2002 (wet season) and 2003 (dry season) (Roelofs, et. al., 2003). Seagrasses were recorded within a tributary to the main river channel during both these events (Halodule Uninervis). Another species, Halophila dicepiens, was reported only during the dry season (2003) survey. This included three small meadows located within 500m of the existing barge ramp at the then kaolin processing area. Subsequent surveys were undertaken in 2006 adjacent to the barge ramp facility (Rasheed et al, 2007). These surveys extended the distribution of seagrass nearer the existing barge facility, adding another small meadow which fringed the mangrove banks upstream to the extent of the Port of Skardon River limits. Distribution of Halodule uninervis was also extended, reporting a low density meadow adjacent to the existing barge facility along the northern shore. Seagrasses are located approximately 230m from the proposed wharf on the opposite river bank and approximately 500m from the proposed wharf upstream along the southern river bank.
The seagrass surveys conducted within the Skardon River to-date indicate variability in meadow condition and distribution between the wet and dry seasons. The meadows mapped as seagrass habitat have been estimated based on available survey data and consideration of bank conditions and water depths.

During the 2014 survey, deeper locations central to the channel did not appear to provide suitable conditions for seagrass colonisation. This follows the findings of previous investigations in the area (Rasheed et. al (2007)) where seagrasses occurred nearest the river banks where light conditions remain favourable. The seagrass meadows of the Skardon River are adapted to living in a highly variable benthic light regime, influenced by sediment type, ambient currents, wind and wave forces and deposition processes.

During 2014 nine small *Halophila dicepiens* meadows were located in thin (<5-10m wide) patchy bands adjacent to the mangrove banks upstream of the existing barge facility. In conjunction with available bathymetry, these results have been used to inform the broader benthic habitat mapping presented within Figure 18-1. The seagrass habitats encountered during these surveys averaged 19.9 % cover±19.8%, ranging between 0.5% and 57.8% cover.

The 2015 benthic habitat survey did not identify any seagrass from locations downstream of the known seagrass meadows near the existing Port area.

Seagrass patches tend to be discontinuous and patchy, favouring establishment over gentle intertidal slopes, within a suitable tidal and light regime, with approximately 20% seagrass cover (based on 2014 survey).

The benthic light loggers (PAR) deployed adjacent to the proposed Metro Mining wharf facility identified a significant degradation in light penetration between approximately -1mLAT and -2.8mLAT and supports that light limitations are likely to restrict colonisation by seagrasses within deeper waters. Deeper locations central to the channel did not appear to provide suitable conditions for seagrass colonisation given restricted light regimes and more mobile sediments.

Naturally occurring turbidity changes and light regimes drive habitat suitability for seagrass establishment.

The proposed wharf is located adjacent to seagrass habitats, though the existing mapping does not place seagrass within the direct Project footprint. Survey conducted by Roelofs et. al (2003) and Rasheed, et. al, (2007) did not record seagrass within the footprint area. (Note: Roelofs survey during 2003 identified a limited bed approximately 500m to the north). The extent of the known beds was initially identified by Rasheed, 2007. The nearest seagrass habitat to the proposed barge loading facility is situated along the northern banks, approximately 230 m. The nearest seagrass bed along the southern banks has been identified at approximately 500m.

The Project wharf options are located adjacent to seagrass habitats, though the existing mapping does not place seagrass within the direct Project footprint. However, conditions within the shallow water fringes along the shorelines have the potential to support seagrass establishment.

The survey of the Skardon River entrance undertaken in 2010 targeted 230 sites, however only one seagrass habitat was identified approximately 2 km upstream of the River mouth entrance, as shown on Figure 18-1. There are no seagrass habitats in the bed levelling area or in the offshore transhipment area.

**Table 18-1  Benthic Habitat Surveys Undertaken of the Skardon River**

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coles et al</td>
<td>1986</td>
<td>Entrance</td>
</tr>
<tr>
<td>Roelofs et al.</td>
<td>2003</td>
<td>Whole river dry season</td>
</tr>
<tr>
<td>Roelofs et al.</td>
<td>2003</td>
<td>Whole river wet season</td>
</tr>
</tbody>
</table>
18.6.4 Benthic Habitats

18.6.4.1 Skardon River

The majority of subtidal benthic habitats within the Skardon River estuary are dominated by open bare substrates of silt, silty/sand, sand and rock (~77%). Only a very limited live benthic cover has been recorded within the River. Of the live cover recorded (22%), macroalgae was dominant (17%). Higher density locations appeared related to the occurrence of less mobile benthic structure, include rock, rubble and gravel (shell areas). Mobile sands did not favour the establishment of dense benthic communities. Macroinvertebrates were greatest within rocky shoals and rubble fields which provide stable substrate for colonisation. Deep holes presented within bathymetry charts (mid estuary section adjacent to the first estuary branch) provide total light exclusion with no benthic biota being observed.

Detailed survey undertaken by Chartrand and Thomas (2010), confirmed an absence of benthic habitat within the ebb tide bar and surrounding area (i.e. the area where bed levelling will occur and surrounding area). This incorporated over 200 sampling locations. Substrates were described as bare sand.

18.6.4.2 Offshore Transhipment Area

Still imagery transects of the offshore transhipment area showed a relatively homogenous seabed. The offshore transhipment area is dominated by bare coarse shell and sandy substrates (96%). Substrates were dominated by bare sands with scattered occurrence of low density biota. Sidescan imagery did not identify the presence of any rock or reef structure, which would signify significant habitat potential. The area is largely comprised of sandy and silty sediments with shell grit, and had numerous burrows. Small patches of gorgonians (sea fans), sponges, algae and bryozoans were identified in areas where larger shell fragments and/or rubble allowed for attachment. These areas were estimated to cover less than 0.5% of the total area based on occurrence within the transects.

Within Metro Mining’s proposed anchorages, benthic habitats were dominated by bare coarse shell and sandy substrates (96%). A sparse cover of sea whips, sponges, gorgonian fans, ascidians and hard corals was observed in one anchorage option. These biota appear to have created a scattered low profile sponge, soft coral and minor hard coral reef.

A single drop video camera inspection was undertaken outside the southern edge of the proposed transhipment area. This inspection site was selected based on published bathymetric survey data indicated some benthic structure may be present in the vicinity. Video indicated low density sponge and soft coral biota to be associated with this location. The area presents no navigation hazard and remains outside the proposed offshore transhipment area. Given vessel soundings, the structure appeared to be less than 0.5 m in elevation.

18.6.5 Intertidal

Intertidal habitats surrounding the entrance to the Skardon River are dominated by sand beaches, exposed to prevailing wind and waves from the Gulf of Carpenteria. As the shoreline progresses into the estuary and river system, silty sands and muds begin to dominate the intertidal substrate. This is accompanied by an increasing mangrove habitat, and decline in exposed sandy shores, ironstone banks and *Casuarina* sp. habitat. The distribution of intertidal mud and sand banks at the entrance and inner estuary system is quite extensive. However, as the river progresses upstream the width of the primary
waterway narrows. The edge of the banks become steeper, particularly on the outer bank curves, favoring the establishment of mangroves such as the *Rhizophora* sp as dense bank communities. Further upstream within the small tributaries the channels may dry completely, or almost completely at low tide. These intertidal habitats are predominately bare mud and silty/sand, with the presence of some isolated patches of filamentous algae and oyster beds having been recorded.

### 18.6.6 Offshore Reef Habitats

Offshore reef habitats are shown in Figure 18-2. In addition to the known coral reef system at nearby Kerr Reef (approximately 18 km southwest of the mouth of the Skardon River), two additional offshore locations were also surveyed using underwater video and side scan transects. Both locations contained rock/reef substrate as identified from side scan sonar transects. The nearest of these locations to the Skardon River mouth (~6 km southwest) presented a high cover of hard corals (37%), associated soft corals and benthic macroinvertebrates (6%). The complex extended over 600m in length and 300m in width resulting in approximately 18 ha of potential rocky reef habitat. The location of this inner reef system is over 4 km from the nearest shoreline and 6-7 km from the proposed bed levelling locations within the Skardon River ebb bar. Waters are naturally turbid, with the reef being situated in shallow coastal waters between ~4 m LAT to approximately ~5 m LAT.

### 18.7 Environmental Values – Commonwealth Marine Areas

The Commonwealth marine area stretches from 3 to 200 nautical miles (nm) from the coast, as defined by the ‘territorial sea baseline’. The Commonwealth marine areas in Project area are shown in Figure 18-3. State ‘coastal waters’ occur between the territorial sea baseline and 3 nm.

In the vicinity of Skardon River, the activities that occur within Commonwealth marine waters are:

- barging of bauxite, outside of coastal waters
- loading of bauxite to bulk carrier vessels
- bulk carrier vessel shipping movements
- potentially the supply of materials, fuel and equipment by boat.

Bed levelling activities occur within coastal waters, approximately 4 km from the coastal waters boundary with the Commonwealth marine waters.

Mining and Port activities occur approximately 15 km upstream of Commonwealth marine waters.

### 18.7.1 Commonwealth Marine Reserves

To the north of the Skardon River, from the coastal waters boundary there is the West Cape York Commonwealth Marine Reserve. This comprises a series of Commonwealth Marine Reserves, extending west and north, that were originally proclaimed on 17 November 2012 (refer Figure 18-4). However these Reserves will not result in changes on the water until the North Commonwealth Marine Reserves Network Management Plan comes into effect. The West Cape York Commonwealth Marine Reserve comprises multiple use zones, a special purpose zone and, to the north of these zones, a marine national park zone. Project activities will not occur in these zones, except for bulk carrier vessel shipping movements.
18.7.2 Marine Bioregional Plan for the North Marine Region

The Commonwealth has prepared the Marine Bioregional Plan for the North Marine Region. The Plan area covers approximately 625,689 square kilometres of tropical waters in the Gulf of Carpentaria and Arafura and Timor seas, and abuts the coastal waters of Queensland and the Northern Territory. The key ecological features of the North Marine Region are shown in Figure 18-5. Those of relevance to the Project are Gulf of Carpentaria coastal zone and the Gulf of Carpentaria basin (bulk carrier vessel ship movements only).

The marine bioregional plan identified 12 regional priorities comprising 6 conservation values and 6 pressures. The 6 conservation values are:

- listed marine turtles
- listed inshore dolphins
- listed sawfishes and river sharks
- dugong
- listed sea snakes
- Gulf of Carpentaria coastal zone

The 6 pressures are:

- marine debris (e.g. derelict fishing nets, discarded plastic)
- bycatch
- extraction of living resources (illegal, unreported and unregulated fishing)
- physical habitat modification
- climate change (sea level rise, ocean acidification, changed temperature)
- changes in hydrological regimes

The 6 conservation values are all relevant to the Project, and the listed marine species known or likely to occur in the Project area are described in Section 18.8. The 6 pressures that are regional priorities are less relevant to the Project, as the Project:

- will not increase pressure associated with marine debris, bycatch, extraction of living resources (illegal, unreported and unregulated fishing) or climate change.
- will involve some physical habitat modification in the form of bed levelling and Port infrastructure construction, however these activities are not within Commonwealth marine waters, nor are they likely to result in impacts to Commonwealth marine waters (refer Section 18.9).
- will involve minor modification of hydrological regimes from mining activities and bed levelling, although these are highly unlikely to impact Commonwealth marine waters (refer Section 18.9).

The marine bioregional plan identifies that the pressures of potential concern on ecosystem functioning and integrity on the Gulf of Carpentaria coastal zone are the 6 pressures listed above.

The marine bioregional plan identifies that the pressures of potential concern on ecosystem functioning and integrity on the Gulf of Carpentaria basin are illegal, unreported and unregulated fishing, marine debris and climate change. Project shipping in the Gulf of Carpentaria basin will not contribute to these pressures.

In terms of the marine bioregional plan strategies to address regional priorities, the Project contributes to Strategy D, through the EIS process, by increasing collaboration with relevant industries to improve
understanding of the impacts of anthropogenic disturbance and address the cumulative effects on the region’s key ecological features and protected species.

Figure 18-5  Key Ecological Features of the North Marine Region

18.8  Environmental Values – Marine Fauna

18.8.1 Listened Marine Species

The EPBC Act Search for the Project activity areas identified:

- 29 listed threatened species, of which 15 are marine species
- 32 listed migratory species, of which 17 are migratory marine species
- 77 listed marine species
- 11 whales and other cetaceans

The Commonwealth and State listed marine species that are known to occur or likely to occur at or adjacent to the proposed Project activity areas are provided in Table 18-2. Other listed species which are considered unlikely to occur are provided in Table 18-3, with justification provided. Those species that are considered unlikely to occur are not considered further in the assessment of potential Project impacts.

A review of the relevant schedules of the Nature Conservation (Wildlife) Regulation 2006 identifies that all marine species listed in those schedules that are likely to occur in the Gulf of Carpentaria are also listed under the EPBC Act as threatened, migratory or a listed marine species.
### Table 18-2  Listed Marine Species Known or Likely to Occur

<table>
<thead>
<tr>
<th>Species</th>
<th>EPBC Listing – Threatened</th>
<th>EPBC Listing – Migratory or Marine</th>
<th>Queensland NC Act</th>
<th>IUCN Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Marine Reptiles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flatback turtle <em>Natator depressus</em></td>
<td>Vulnerable</td>
<td>Migratory marine species, listed marine species</td>
<td>Vulnerable</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Loggerhead turtle <em>Caretta</em></td>
<td>Endangered</td>
<td>Migratory marine species, listed marine species</td>
<td>Endangered</td>
<td>Endangered</td>
</tr>
<tr>
<td>Green turtle <em>Chelonia mydas</em></td>
<td>Vulnerable</td>
<td>Migratory marine species, listed marine species</td>
<td>Vulnerable</td>
<td>Endangered</td>
</tr>
<tr>
<td>Olive Ridley turtle <em>Lepidochelys olivacea</em></td>
<td>Endangered</td>
<td>Migratory marine species, listed marine species</td>
<td>Endangered</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Hawksbill turtle <em>Eretmochelys imbricata</em></td>
<td>Vulnerable</td>
<td>Migratory marine species, listed marine species</td>
<td>Vulnerable</td>
<td>Endangered</td>
</tr>
<tr>
<td>Estuarine crocodile <em>Crocodylus porosus</em></td>
<td>n/a</td>
<td>Migratory marine species, listed marine species</td>
<td>Vulnerable</td>
<td>Least concern</td>
</tr>
<tr>
<td>Freshwater crocodile <em>Crocodylus johnstoni</em></td>
<td>n/a</td>
<td>Listed marine species</td>
<td>Not listed</td>
<td>Least concern</td>
</tr>
<tr>
<td>Sea snakes (19 species)</td>
<td>n/a</td>
<td>Listed marine species</td>
<td>Not listed</td>
<td>Not assessed, least concern or data deficient</td>
</tr>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dugong <em>dugon</em></td>
<td>n/a</td>
<td>Migratory marine species, listed marine species</td>
<td>Vulnerable</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Indo Pacific humpback dolphin <em>Sousa sahulensis</em></td>
<td>n/a</td>
<td>Migratory marine species, whales and other cetaceans</td>
<td>Near threatened</td>
<td>Near threatened</td>
</tr>
<tr>
<td>Australian snubfin dolphin <em>Orcaella heinsohni</em></td>
<td>n/a</td>
<td>Migratory marine species, whales and other cetaceans</td>
<td>Near threatened</td>
<td>Near threatened</td>
</tr>
</tbody>
</table>

(Previously known as the Irrawaddy dolphin *Orcaella brevirostris*).
<table>
<thead>
<tr>
<th>Species</th>
<th>EPBC Listing - Threatened</th>
<th>EPBC Listing – Migratory or Marine</th>
<th>Queensland NC Act</th>
<th>IUCN Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pantropical dolphin <em>Stenella attenuata</em></td>
<td>n/a</td>
<td>Whales and other cetaceans</td>
<td>Not listed</td>
<td>Least concern</td>
</tr>
<tr>
<td>Indo Pacific Bottlenose dolphin *Tursiops truncatus s. st.*¹</td>
<td>n/a</td>
<td>Whales and other cetaceans</td>
<td>Not listed</td>
<td>Least concern</td>
</tr>
<tr>
<td>Indian ocean bottlenose dolphin <em>Tursiops aduncus</em></td>
<td>n/a</td>
<td>Whales and other cetaceans</td>
<td>Not listed</td>
<td>Least concern</td>
</tr>
</tbody>
</table>

**Fish and Sharks**

<table>
<thead>
<tr>
<th>Species</th>
<th>EPBC Listing - Threatened</th>
<th>EPBC Listing – Migratory or Marine</th>
<th>Queensland NC Act</th>
<th>IUCN Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speartooth shark <em>Glyphis glyphis</em></td>
<td>Critically endangered</td>
<td>n/a</td>
<td>Not listed</td>
<td>Endangered</td>
</tr>
<tr>
<td>Dwarf sawfish <em>Pristis clavata</em></td>
<td>Vulnerable</td>
<td>n/a</td>
<td>Not listed</td>
<td>Endangered</td>
</tr>
<tr>
<td>Largetooth sawfish <em>Pristis</em></td>
<td>Vulnerable</td>
<td>n/a</td>
<td>Not listed</td>
<td>Critically endangered</td>
</tr>
<tr>
<td>Green sawfish <em>Pristis zijsron</em></td>
<td>Vulnerable</td>
<td>n/a</td>
<td>Not listed</td>
<td>Critically endangered</td>
</tr>
<tr>
<td>Pipefishes (including pipehorses, seadragons, seahorses) (33 species)</td>
<td>n/a</td>
<td>Listed marine species</td>
<td>Not listed</td>
<td>Not assessed, least concern or data deficient</td>
</tr>
</tbody>
</table>

¹ The taxonomy of bottlenose dolphins remains highly controversial.
### Table 18-3  Listed Marine Species Unlikely to Occur

<table>
<thead>
<tr>
<th>Species</th>
<th>EPBC Listing - Threatened</th>
<th>EPBC Listing – Migratory or Marine</th>
<th>Justification for no further assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leatherback turtle</td>
<td>Endangered</td>
<td>Migratory marine species, listed marine species</td>
<td>No major nesting has been recorded in Australia, although scattered isolated nesting (one to three nests per annum) occurs in southern Queensland and the Northern Territory. Some nesting has occurred in northern NSW near Ballina. However, no nesting has occurred in Queensland or NSW since 1996. Nesting in Western Australia is still unknown or unconfirmed. The species is most commonly reported from coastal waters in central eastern Australia (from the Sunshine Coast in southern Queensland to central NSW); southeast Australia (from Tasmania, Victoria and eastern South Australia) and in south-western Western Australia. Based on this information leatherback turtles are highly unlikely to nest on western Cape York beaches or use the Gulf of Carpentaria as an important feeding area. It should be noted that the measures on place to mitigate the risk to the other five turtle species would also benefit the leatherback turtle if new information demonstrated regular use of the relevant area by the species.</td>
</tr>
<tr>
<td>Blue whale</td>
<td>Endangered</td>
<td>Migratory marine species, whales and other cetaceans</td>
<td>The only known areas of significance to blue whales in Australian waters are feeding areas around the southern continental shelf, notably the Perth Canyon, in Western Australia, and the Bonney Upwelling and adjacent upwelling areas of South Australia and Victoria. Blue whales are not known to regularly migrate through, aggregate, feed or breed in the Gulf of Carpentaria and as such the area is considered to be outside of their normal range.</td>
</tr>
<tr>
<td>Humpback whale</td>
<td>Vulnerable</td>
<td>Migratory marine species, whales and other cetaceans</td>
<td>The feeding, migratory and calving areas for the eastern Australian and Western Australian populations of humpback whales are known. The Great Barrier Reef complex and the Kimberley Region are important breeding and calving grounds for Humpback Whales. Hervey Bay and the Whitsundays appear to be important resting grounds for mothers and calves of the east coast population on their southward migration. Humpback whales are not known to regularly migrate through, aggregate, feed or breed in the Gulf of Carpentaria and as such the area is considered to be outside of their normal range.</td>
</tr>
<tr>
<td>Species</td>
<td>EPBC Listing – Threatened</td>
<td>EPBC Listing – Migratory or Marine</td>
<td>Justification for no further assessment</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------------------</td>
<td>----------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>False water rat (<em>Xeromys myoides</em>)</td>
<td>Vulnerable</td>
<td>n/a</td>
<td>The false water-rat has not been recorded anywhere in Cape York, with the nearest known populations occurring in scattered coastal areas between Proserpine and the Qld border, and in Arnhem Land and the Top End in the Northern Territory. Recently released draft EPBC significant impact guidelines for the False Water-rat have identified suitable habitat on Cape York (including the Project area) as ‘May’ occur. The species creates nests in the supralittoral zone of mangroves and saltmarsh. The water mouse constructs five types of nests: free-standing, termite-like mound nests or mounds at the base of mangrove trees, mounds on small elevated ‘islands’ within the tidal zone, mound nests or holes in supralittoral banks; nests inside hollow tree trunks, and nests in spoil heaps created as a result of human activity. These various nest are distinctive. As well as being outside the recorded known range of the species, the Port area lacks the specific habitat features required by the animal for nesting. General field observations of the mangroves and associated habitat at the Port area have identified an absence of suitable habitat and an absence of nests. Additional pre-construction surveys will be undertaken to determine if the animal does occur, however for the reasons provided, its occurrence is highly unlikely.</td>
</tr>
<tr>
<td>Bryde’s whale (<em>Balaenoptera edeni</em>)</td>
<td>n/a</td>
<td>Migratory marine species, whales and other cetaceans</td>
<td>There are two forms of Bryde’s whale: the coastal from of Bryde's Whale appears to be limited to the 200 m depth isobar, moving along the coast in response to availability of suitable prey. The offshore form is found in deeper water (500 m to 1000 m). No specific feeding or breeding grounds have been discovered off Australia. While Bryde’s whale may infrequently occur in the Gulf of Carpentaria, the region can be considered outside their normal distribution.</td>
</tr>
<tr>
<td>Killer whale (<em>Orcinus orca</em>)</td>
<td>n/a</td>
<td>Migratory marine species</td>
<td>Killer whales are more common in cold, deep waters, or inshore shelf waters near seal and sea lion colonies. As such the Gulf of Carpentaria can be considered to be outside its natural range.</td>
</tr>
<tr>
<td>Species</td>
<td>EPBC Listing – Threatened</td>
<td>EPBC Listing – Migratory or Marine</td>
<td>Justification for no further assessment</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------------</td>
<td>-----------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Common dolphin (Delphinus delphis)</td>
<td>n/a</td>
<td>Marine species</td>
<td>Common Dolphins are found in offshore oceanic waters and are rarely seen in northern Australian waters. Common Dolphins appear to occur in two main locations around Australia, with one cluster in the southern south-eastern Indian Ocean and another in the Tasman Sea. As the species is found in offshore oceanic waters, the Gulf of Carpentaria can be considered to be outside its natural range.</td>
</tr>
<tr>
<td>Risso’s dolphin (Grampus griseus)</td>
<td>n/a</td>
<td>Marine species</td>
<td>Risso’s dolphin has a marked preference for deep oceanic water. They occur mainly on steep sections of the upper continental slope, usually in waters deeper than 1000 m, in tropical and warm temperate latitudes. As the species is found in deep offshore oceanic waters, the Gulf of Carpentaria can be considered to be outside its natural range.</td>
</tr>
<tr>
<td>Great white shark (Carcharodon carcharias)</td>
<td>Vulnerable</td>
<td>Migratory marine species</td>
<td>The northern-most Queensland record is Mackay. Areas where observations are more frequent include waters in and around some Fur Seal and Sea Lion colonies such as the Neptune Islands (South Australia); areas of the Great Australian Bight as well as the Recherche Archipelago and the islands off the lower west coast of Western Australia. Juveniles appear to aggregate seasonally in certain key areas including the 90 Mile Beach area of eastern Victoria and the coastal region between Newcastle and Forster in NSW. Therefore, white sharks are not known to regularly migrate through, aggregate, feed or breed in the Gulf of Carpentaria and as such the area is considered to be outside of their normal range.</td>
</tr>
<tr>
<td>Species</td>
<td>EPBC Listing - Threatened</td>
<td>EPBC Listing – Migratory or Marine</td>
<td>Justification for no further assessment</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------------------</td>
<td>----------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Giant manta ray <em>(Manta birostris)</em></td>
<td>n/a</td>
<td>Migratory marine species</td>
<td>The giant manta ray lives mostly in the open ocean, traveling with the currents and migrating to areas where upwellings of nutrient-rich water increase prey concentrations. As such the Gulf of Carpentaria can be considered to be outside its natural range. A species of manta ray not listed under the EPBC Act <em>(Manta alfredi)</em> does occur in coastal waters and is known to occur in the Gulf of Carpentaria.</td>
</tr>
</tbody>
</table>
18.8.2 Conservation Advices, Threat Abatement Plans, Recovery Plans, Conventions and Agreements

Conservation advices, threat abatement plans and recovery plans have been developed by DoE for species and ecosystems and the Commonwealth has entered into international conventions and agreements for migratory species. Relevant conservation advices, threat abatement plans, recovery plans, conventions and agreements for species of conservation significance in the Project area and surrounds are described in Chapter 26.

18.8.3 Marine Turtles

A detailed description of the ecology (distribution, biology, behaviour, nesting, breeding, etc) of marine turtles in the Project region is provided in Appendix 8.

The physical coastal developments proposed for the Project do not impact upon turtle nesting habitat. The wharf / barge loading facilities within the Skardon River are situated within a mangrove fringed estuary environment, with suitable nesting habitat situated at the mouth approximately 10 km downstream. Coastal beaches in the Mapoon and Skardon area provide suitable and regionally important nesting habitat, with beaches north and south of the Skardon River entrance demonstrating nesting activity.

18.8.3.1 Flatback Turtle

Flatback turtles have a preference for shallow, soft-bottomed sea bed habitats away from reefs. Flatback turtles are the commonest nesting species in marine environment surrounding the Project activity areas and the species nests only in Australia. While nesting occurs at a large number of beach locations between Queensland and Western Australia, some key rookeries have been identified in the Gulf of Carpentaria. The most significant is Crab Island approximately 75 km north of the Project. Along the part of western Cape York that has been surveyed, the beach between Port Musgrave and the Skardon River has the greatest prevalence of flatback turtle nesting. Flatback turtles nest all year round with a peak in May through to September.

Egg predation by feral pigs is identified as a significant impact on nesting success, and entanglement in marine debris (e.g. discarded fishing nets) a significant impact on adults and hatchlings.

18.8.3.2 Loggerhead Turtle

Loggerhead turtles are widely distributed on a global scale in warm temperate and subtropical oceans. The beaches adjacent to the proposed Project area are not important locations for loggerhead turtles (and this applies to the whole western Cape), although the waters are used for feeding.

18.8.3.3 Green Turtle

There are seven widely separated breeding aggregations of green turtles that are considered separate stocks from the southern Great Barrier Reef to the Northwest Shelf. Western Cape York is not an important nesting location. Adult green turtles eat mainly seagrass and algae. The biomass of seagrass and algae in the Skardon River area is unlikely to be suitable to support green turtles, even for a short period of time.

18.8.3.4 Hawksbill Turtle

Australia’s hawksbill turtle is considered to comprise two distinct genetic stocks, one in the north-east of Australia and the other in Western Australia. Hawksbill turtles are known to nest along western Cape York beaches, although the high density nesting locations are in Torres Strait and islands in the northern Great Barrier Reef.
18.8.3.5 Olive Ridley Turtle

The Olive Ridley turtle has a worldwide circumtropical distribution, including northern Australia. Low-density nesting occurs along the northwestern coast of Cape York Peninsula between Weipa and Bamaga. Olive Ridley turtle populations on western Cape York are at significant risk from the foraging activities of feral pigs. Olive Ridley turtles nest year round, although most nesting occurs during the dry season, from April to November.

18.8.4 Cetaceans

No species of cetacean (whales or dolphins) that are listed by the State or Commonwealth as threatened species are likely to occur at or adjacent to the proposed Project activity areas.

Five species of cetaceans (not threatened) are highly likely to occur at or adjacent to the proposed Project activity areas: Indo-Pacific humpback dolphin, Australian snubfin dolphin, pantropical spotted dolphin, Indian Ocean bottlenose dolphin and Indo-Pacific bottlenose dolphin. These species, other than the spotted dolphin, are collectively referred to as ‘inshore dolphins’. Additional information on the biology and ecology of these cetaceans is provided in Appendix 8.

There have been a number of incidental inshore dolphin sightings within and near the Skardon River as part of marine studies for the Project and other projects.

18.8.4.1 Indo-Pacific Humpback Dolphin (Inshore Dolphin)

It is now recognised that there are four species of Indo-Pacific humpback dolphin with the Australian species being *Sousa sahulensis*. Indo-Pacific humpback dolphins occur in the coastal northern waters of Australia from approximately the Queensland – New South Wales border to Ningaloo Reef (Western Australia). Population structure has not been determined within the Gulf of Carpentaria. Habitat preference of Indo-Pacific humpback dolphin is for shallow turbid estuarine and coastal waters. The species does co-exist in areas such as the western side of Moreton Bay (Brisbane) where port development and coastal development is extensive and long standing.

18.8.4.2 Australian Snubfin Dolphin (Inshore Dolphin)

The preferred habitat of Australian snubfin dolphins can vary regionally. The largest recorded population of Australian snubfin dolphin is in Blue Mud Bay (Northern Territory). There is no information to describe habitat preference of the species in the Gulf of Carpentaria, although it prefers shallow water (1 to 18) metres in other areas. The species persists in areas with development such as Cleveland Bay (Townsville).

18.8.4.3 Indo-Pacific Bottlenose Dolphin and Indian Ocean Bottlenose dolphins (Inshore Dolphins)

The taxonomy of the genus *Tursiops* is highly controversial and not completely resolved. Both species are found in tropical and temperate waters where they inhabit inshore areas, nearshore (open coast) and offshore environments. Indo-Pacific bottlenose dolphins are usually more abundant in waters greater than 30 metres deep. In Australia, the Indian Ocean bottlenose dolphin is restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters including coastal areas around oceanic islands. Both species inhabit inshore areas where significant amounts of recreational vessel and commercial water-based activities occur including Moreton Bay (Brisbane).

18.8.4.4 Pantropical Spotted Dolphin

Pantropical spotted dolphins are mostly found in oceanic tropical zones both nearshore and oceanic habitats. They are among the most common dolphin species with population estimates being in the millions of individuals. While the location of the Project is unlikely to be an important location for the species given its preference for more oceanic waters, it is nonetheless known from the region.
18.8.5 Sharks and Sawfishes

The Commonwealth DoE’s Recovery Plan for Sawfish and River Sharks (2014) contains objectives and actions aimed at securing the remaining populations of sawfishes and northern river sharks in Australia. These species are at risk from commercial and recreational fishing. Australia is considered to possibly be the last country where viable populations of sawfishes potentially remain and as such the populations that occur there are of global significance. The northern river sharks are endemic to Australia and parts of Papua New Guinea.

Detailed information on the biology and ecology of these species is provided in Appendix 8.

As described in Chapter 16, due to Namaleta Creek’s limited freshwater extent (small system) and ephemeral nature, the system is not considered to contain preferred habitat features for listed sharks and sawfishes.

18.8.5.1 Speartooth Shark

The speartooth shark has been recorded from the lower reaches (salinity between 0.8 and 28 ppt) of the Wenlock and Ducie Rivers and Port Musgrave as well as the Bizant River, and a number of river systems in the Northern Territory. It is plausible that speartooth shark does occur in the Skardon River and Namaleta Creek.

There are substantial gaps in knowledge of the biology and ecology of speartooth sharks. A significant information gap relates to the habitat use of adult speartooth sharks as none have been found. Newborn to sub-adult speartooth sharks exclusively inhabit areas with fast currents, muddy bottoms and high turbidity. The speartooth shark presents a small eye and a large number of sensory papillae, an adaptation suited to existing in highly turbid waters. Younger sharks are generally found further upstream than older juveniles and sub-adults ones. Adult speartooth sharks are assumed to occur in offshore waters. From a limited amount of tagging work, speartooth sharks are considered to move up and down an estuary system with the tide and repeatedly use the same available habitat. Although not confirmed, pupping may occur between October and December, prior to the start of the wet season. Pillans (2015) describes the movement of speartooth sharks upstream near freshwater following pupping, where they may stay for 3-6 years. The migration pattern relates to accessing reduced salinity. Juveniles may then move downstream to avoid peak wet season flows, but return to their preferred lower salinity ranges, perceivably until they approach adult stages.

18.8.5.2 Dwarf Sawfish

The dwarf sawfish is distributed throughout northern Australian waters from the Gulf of Carpentaria and then across northern Australia and down into the Pilbara region of Western Australia. There are considered to be distinct populations on the west coast, the north coast and the Gulf of Carpentaria, with no migration between these locations. The dwarf sawfish occurs on sand and mudflats and upstream estuarine habitats, including in inundated mangrove habitats that the species access at high tides. The species breeds in estuarine areas during the wet season with juveniles remaining in these areas up until about three years of age before migrating to other areas, with adults returning to the estuarine areas for pupping.

Thorburn et al. (2004) captured 19 dwarf sawfish in a survey across northern Australia in 2002. All individuals were caught over fine substrates (mainly silt) in sections of the river channels almost completely devoid of in-stream structure. All dwarf sawfish were taken from fully marine water at lower estuarine sites with high turbidity (where measured) and low dissolved oxygen. Peverell’s (2005) observations on reproductive staging and the capture of neonate specimens suggest that pupping occurred through the wet season until the beginning of the dry season in May.

Given the habitat preference of the species it is likely to occur in the Skardon River.
18.8.5.3 Largetooth or Freshwater Sawfish

The largetooth or freshwater sawfish may potentially occur in all large rivers of northern Australia from the Fitzroy River in Western Australia to western Cape York and has a preference for river channel habitat. It utilises both marine and freshwater habitats, but does not generally extend into coastal habitat such as the flats at the mouth of rivers, and appears to have a preference for waters of low salinity. Available information suggests that mature largetooth sawfish enter less saline waters during the wet season for pupping. Freshwater areas (including isolated large pools) are considered to be important nursery areas for the species.Namaleta Creek is not considered to contain suitable freshwater habitat and the Project does not impact freshwater sections of the Skardon River. Unlike the dwarf sawfish, the largetooth sawfish does not associate with riparian vegetation such as mangroves.

Peverell (2005) describes that mature largetooth sawfish enter less saline water to give birth, with pupping occurring late in the wet season.

Given the habitat preference of the species it is highly likely to occur in the Skardon River and may occur at and adjacent to the wharf area. However, given the salinity during the dry season is ambient seawater (35 ppt) and the species appears to have a preference for lower salinity water, the wharf area is unlikely to constitute critical habitat, at least during the dry season. Construction and operational activities for the proposed Project are planned in the dry season.

18.8.5.4 Green Sawfish

The green sawfish is distributed from about Cairns north to Shark Bay in Western Australia. It has been recorded in inshore coastal environments and offshore to 70 metres of water, as well as estuaries and river mouths in slightly reduced salinities, but it does not enter freshwater habitats. The species is considered to be widely distributed throughout the Gulf of Carpentaria, however it has a preference for sand and mud flats outside of river mouths. Given the current information on the habitat preference of the green sawfish, it is unlikely to be present at or adjacent to the wharf. Individuals may occur at the river entrance shoals and at the offshore transhipment location on the basis that adults are known to extend into deeper waters in the vicinity of river mouths. Peverell (2005) indicated that pupping may occur during, or just before, the wet season.

18.8.6 Dugong

The dugong is the only herbivorous mammal that is strictly marine and a seagrass community specialist. Dugongs are abundant at many locations in the Gulf of Carpentaria and are usually associated closely with seagrass beds. Of the estimated 27,602 (± 3,110) dugongs in the Gulf of Carpentaria, only 15% occurred in the waters of the Queensland coast, reflecting the much greater area of seagrass along the Northern Territory coast. Dugongs are known to occur in low densities in Port Musgrave and are closely associated with the areas of seagrass beds in the area. While some seagrass species preferred by dugong occur adjacent to the Port area, and most probably elsewhere in the Skardon River (at least seasonally), it is unlikely to constitute a sufficient biomass to sustain a population of dugong. The proposed Project is not at or adjacent to seagrass habitat that constitutes important dugong habitat. The main feeding locations for dugong in the Gulf of Carpentaria are known and are remote from the proposed Project location.

18.8.7 Estuarine and Freshwater Crocodiles

The estuarine or saltwater crocodile is widespread throughout northern Australia and its range includes all of the Gulf of Carpentaria. The north-west Peninsula of Cape York is the most important region in Queensland for estuarine crocodile populations. The Port Musgrave area, and in particular, the Wenlock River, is recognised as containing significant habitat for the estuarine crocodiles with one of the largest breeding populations in Queensland. The habitat of the estuarine crocodile includes marine habitats such as mangroves, but they also commonly occur in freshwater habitats such as rivers, lakes and swamps.
The freshwater crocodile (*Crocodylus johnstoni*) also has a range throughout much of northern Australia, and while ostensibly a freshwater species, it can use estuarine and marine waters of some rivers and creeks.

### 18.8.8 Migratory Shorebirds

Port Musgrave meets the requirements for nationally important habitat for migratory shorebirds. The entrance to Skardon River presents a similar habitat layout to Namaleta Creek, with adjacent creek systems and intertidal sandy shores and beaches. The entrance to the Skardon River presents a diverse system of sandbars and shoreline sand flats which are variably exposed during tidal movement. Inside the relatively narrow entrance to the river the water way expands and presents broad intertidal flats on the southern and northern edges of the river. The extent of these intertidal habitats reduce markedly as the river progresses upstream. Open saltmarsh, grassland and salt pan habitats are also present within the Skardon River, similar to habitats on the Ducie River (Port Musgrave). Potential impacts on listed migratory shorebird species are described in Chapter 15.

### 18.8.9 Sea Snakes

The Gulf of Carpentaria contains a diverse and abundant assemblage of sea snakes with at least 17 species occurring. The sea snake fauna has been assessed in detail in the Weipa area, and the numerically dominant sea snake species is *Lapemis hardwicki* comprising approximately 90% of the sea snake fauna. All sea snake species have been recorded from multiple locations elsewhere in the Gulf of Carpentaria. The main impact on sea snake populations in the Gulf of Carpentaria is incidental capture in fisheries. The proposed Project is unlikely to result in any meaningful or measurable impact on sea snakes.

### 18.8.10 Pipefishes

The Gulf of Carpentaria also has a rich pipefish fauna. The distribution and abundance of pipefishes in the Gulf of Carpentaria is poorly known, but it is known that the species groups forms a component of by-catch in the Northern Prawn Fishery. The proposed Project is unlikely to result in any meaningful or measurable impact on pipefishes.

### 18.8.11 Marine Pests

Extensive surveying for marine pest species has been undertaken at the nearby Port of Weipa, with no marine pest incursions having been recorded. Current review of the National Database for Marine Pest Incursions confirmed an absence of introduced marine pest records for Weipa Port.

The Australian Fisheries and Management Authority (AFMA) commissioned Aquenal to perform a targeted marine pest monitoring program for the Skardon River during 2008. Twenty three locations were sampled as part of the adopted survey design targeting nine pest species of interest (*Table 18-4*). None of the target species were identified during the survey. Given the range and nature of habitats sampled and the survey intensity, the absence of these species is concluded at a high level of confidence. Since 2008 there have been minimal marine activities within the Skardon River, and therefore low potential for introduction of marine pests not identified in the 2008 survey.

*Table 18-4 Pest Species Surveyed by Aquenal (2008)*

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>Taxonomic Group</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Eriocheir sinensis</em> crab</td>
<td>Chinese mitten</td>
<td>Decapoda</td>
</tr>
<tr>
<td><em>Hemigrapsus sanguineus</em></td>
<td>Japanese/Asian shore crab</td>
<td>Decapoda</td>
</tr>
<tr>
<td><em>Crepidula fornicata</em></td>
<td>American slipper limpet</td>
<td>Gastropoda</td>
</tr>
</tbody>
</table>
18.9 Potential Impacts

In considering impacts to marine ecology (habitats, flora and fauna) reference is made to Chapter 17 which describes Project impacts on coastal processes and the physical marine environment. Impacts to marine ecology are a function of impacts to coastal processes and the physical marine environment and also a function of direct impacts.

The activities with the potential to impacts on marine ecology are:

- Port construction
- bed levelling
- shipping operations within the Skardon River and near shore
- offshore transhipment of bauxite
- bulk vessel movements

Potential impacts from these activities on marine ecology may result from:

- direct disturbance within the footprint of the wharf construction, bed levelling area or anchoring zone in the offshore transhipment area
- changes in lighting affecting marine fauna behaviour
- noise in the underwater environment affecting marine fauna behaviour
- direct strike of vessels on marine fauna
- changes to marine water quality or sediment quality from mining, construction, Port activities or maritime operations impacting marine habitat
- vessel wave action on shoreline vegetation
- increased sediment in marine waters impacting marine habitat
- exposure of acid sulphate soils
- increased abundance and distribution of marine pests

Design, construction and management measures to minimise impacts on coastal processes and the physical marine environment are described in Chapter 17. These measures will also minimise impacts to marine ecology.

This section describes potential impacts to:

- mangroves and saltmarshes
- seagrasses and other benthic habitats
- listed marine fauna that are known or likely to occur in the Project activity areas
- Commonwealth marine areas.
During the construction and operational stages of the Project, physical interaction with significant marine species will be primarily based upon movement of bauxite barges, supply barges, and miscellaneous small vessel activity supporting the Project (survey, monitoring, maintenance etc). Bulk carriers may also interact with species at the proposed offshore transhipment area and during transit through Australian waters. The annual vessel movements proposed during operations will be approximately 2000 through the Skardon River and adjacent waters. Interaction due to vessel strike and indirect disturbance is potentially possible, though the slow nature of the majority of these vessel movements reduces the severity of these impacts and suggests vessel strike is of minor concern.

The risk of habitat disturbance near the proposed wharf facilities due to propeller wash (primarily seagrass along the northern bank) may lead to a minor interaction with significant species. A combination of intertidal and subtidal pile based construction has minor potential for sediment disturbance, minor chemical spills and direct habitat disturbance. Construction based noise will present an indirect impact to many marine species, particularly during pile driving activities. Benthic habitats within proposed bed levelling area, offshore transhipment area, and barge navigation channel do not represent significant habitat. Disturbance at these locations via anchoring, bed levelling or by way of propeller wash is not predicted to be a significant impact to these marine species. Offshore reef locations have been identified which may provide important feeding habitat for several significant fauna. However, proposed marine activities will remain clear of these locations. Bed levelling is located approximately 6 km from these habitats, with modelling predicting potential maximum extent of turbidity plumes at approximately 3,000 m.

18.9.1 Mangroves and Saltmarshes

18.9.1.1 Construction of Wharf

Construction of the proposed wharf / barge loading facility will require minimal disturbance of fringing mangrove or saltmarsh vegetation communities of approximately 300m² as shown in Figure 18-6. The design of the wharf includes abutments for the proposed gantry and pile construction that are situated away from the shoreline and therefore broad clearing of mangroves is not required. The conveyor, situated on trestles or piles passes through approximately 300m² of mangrove and very minor saltmarsh habitat. Trimming of vegetation is proposed with removal only where required for construction purposes. The abutment is situated on land away from the mangroves. The duration of wharf piling activities is anticipated at 2 months, occurring during the dry season. Ongoing impacts to mangroves from operations are limited to the possible control of regrowth over gantries and access point around the marine construction.
18.9.1.2 Port Infrastructure Area Stormwater Management

Ports sediment pond design and management is described in Chapter 6. Chapter 17 describes Port sediment pond release monitoring, monitoring of Skardon River water quality and monitoring of marine ecosystems in the vicinity of the Port.

The sediment ponds will incorporate overflow weirs, overflow drainage stabilised structures, and flow spreaders to ensure that no erosion is caused by discharge events (overflows or controlled release). The overflow point of the proposed sediment pond is located at least 100 m from the mangroves and 150 m from the Skardon River and flows through *Eucalyptus tetrodonta* woodland, before entering mangroves approximately 50 m wide. The release point from the existing sediment pond is located approximately 200 m from the Skardon River, at a point where mangrove communities are very limited (5m wide), and flows through *Eucalyptus tetrodonta* woodland. Released water will spread over this grassed native vegetation area resulting in dissipation of flows and a reduction in velocity and erosion potential.
Overflow events will occur during wet season rainfall events that exceed the design capacity of the sediment ponds. Port area sediment ponds will minimise impacts on the Skardon River by:

- discharging through the nominated overflow weir
- managing releases to prevent scouring (e.g. rock spillways)
- maximising the distance through which discharges flow through vegetation prior to entering the mangroves and Skardon River, thereby allowing for additional sediment control.

Given the findings of logger data captured from the upper estuary (Chapter 17), and the results reported by the Port Musgrave estuary, mangrove systems experience broad fluctuations in turbidity, TSS and a range of associated physicochemical processes. Mangroves also experience change, driven by flood and ebb tide, spring and neap periods and the seasonal perturbations associated with the wet season. It is expected that the Port sediment ponds will achieve a totals suspended solids concentration of less than 50 mg/L during release. Mangrove ecosystems are well adapted to broad ranging fluctuations in water quality between the dry and wet seasons, becoming inundated by freshwater flood flows for large periods of the wet season.

The design of the release to the mangrove habitats would be such that no erosion or scour would occur, and waters would be spread over a broad area at the rear of the mangrove communities. The discharge process would not be continuous, and during the operational period controlled releases would be expected. Additional monitoring data will be captured prior to construction to refine release criteria and capture ambient water quality conditions within the landward extents of the mangroves potentially impacted by proposed stormwater release. Detailed monitoring strategies (refer to Chapter 17 and Section 18.10.11) have been proposed to ensure stormwater releases do not have a detrimental effect on the adjacent mangroves, including the assessment of potential fines deposition and mangrove health.

18.9.1.3 Mining

Mine pits will be internally draining to prevent release of sediment affected water to the environment, including the Skardon River.

18.9.1.4 Contaminant Management

Management measures will be in place to prevent the release of chemicals or hydrocarbons (refer Chapter 11). In the event of a spill, response plans (oils, diesel, chemical etc.) would be enacted to control any such incidents. Therefore there is a low significant impacts to mangroves or saltmarshes from accidental release of hydrocarbons.

No impacts from nutrient or toxicant releases are anticipated from the Port infrastructure area.

18.9.1.5 Dust

Dust impact to adjacent mangrove vegetation is considered a minor risk during operations due to the proposed dust controls for Port operations such as dust suppression of haul roads and bauxite stockpile, sprayers along the conveyor and telescopic chute for barge loading.

18.9.1.6 Acid Sulphate Soils

Potential risks and management of acid sulphate soils is described in Chapter 17. Impacts to mangroves and saltmarshes are expected to be minimal.

18.9.1.7 Vessel Wake Waves

The passage of vessels within the Skardon River will increase the existing regime of shoreline wave action. The existing condition of the banks of the Skardon River is very stable. No evidence of shoreline erosion has been observed during field investigations. The shoreline at the proposed barge facility is further
protected by existing mangrove vegetation and the presence of nearshore rock rubble and oyster reef structure.

Modelling has identified that vessel wake is of minor concern (maximum impact at lowest operating tide of 0.07 – 0.03 m waves) (see Chapter 17). This assessment considers the passage of the bauxite barge (the largest vessel of the proposed operational fleet) travelling at a speed of 6 knts. As the vessel leaves and arrives at the barge loading facility, speeds will be in the order of 1-2 knts. Vessel wake waves adjacent to the Port will remain significantly below the adopted predictions. Vessel speed is critical in obtaining the modelled wave heights. Vessel speed will be managed so that prediction of limited vessel wake wave conditions is achieved.

Predicted wake waves remain within estimated ambient ranges, and below typical guideline values which assess bank erosion management levels from wake waves (refer to Chapter 17). In addition, the passage of barges is expected to occur infrequently (6-8 passages per day). Support vessels accessing the Skardon River will adopt a no wash policy to ensure all vessel operations consider the potential for wake wave generation.

### 18.9.2 Seagrasses

#### 18.9.2.1 Seagrass Resilience

Appendix 8 describes findings from a number of studies on seagrass resilience to anthropogenic changes, and are summarised below.

Port activities such as properly conducted dredging and shipping within the Cairns, Weipa and Hay Point harbour areas have not resulted in significant impacts to seagrass. Rather, factors such as climatic variability (flood/drought) and adjacent land uses are considered more relevant to the overall sustainability of adjacent seagrass communities. However, studies clarify that whilst port operations have not noticeably impacted seagrasses, if weakened by other factors, such as climate and adjacent land uses, then port activities may result in cumulative stresses.

The significant influence of climatic factors as primary drivers of seagrass variability in seagrass habitats is commonly reported by State government departments for port areas in Queensland, including the nearby Embley River Estuary at Weipa. The consistency of conclusions following review of long-term seagrass monitoring studies for a range of Queensland Ports over a wide spatial scale presents powerful evidence that routine port operations and maintenance dredging operations of ports are having negligible impact on seagrass habitats, and that ports and seagrasses can readily co-exist.

Dredging undertaken within the Embley River estuary targets 800,000 to 1,000,000 m³ annually. The Port of Weipa also processes hundreds of bulk carriers and thousands of small vessel movements associated with the port activities. Stable seagrass communities are established within 100 m of berth and channel alignments at several locations. Recently completed reports by State government have identified changes in these communities are driven by seasonal and longer-term climatic affects. The key determinants of seagrass community condition are thought, amongst other issues, to be associated with longer-term cycles of increased daytime aerial exposure leading to desiccation of some species and partial mortality of the community.

The length of light deprivation events naturally encountered by seagrasses range between 2–3 days from minor perturbations (wind events) to several weeks as a result of catchment flooding. Tolerances of seagrass species to light attenuation vary amongst species and between habitat locations. Thresholds have been identified between 4-weeks (i.e. *Halophila ovalis*) to over 20 weeks (*Thalassia testudinum*).

The existing seagrass meadows of the Skardon River are well adapted to the natural variability in turbidity, deposition and light availability, though the processes are not yet fully understood by way of captured data. Thomas and Chartrand (2010) suggested that seagrasses in the Skardon River area are likely to be subjected to periods of naturally high turbidity associated with high wind and wave action as well as pulses.
of high turbidity from wet season flooding. It is probable then, that seagrasses in the area are adapted to pulsed high turbidity events and would have a reasonable resilience to any turbidity associated with Project activities (e.g. construction or propeller wash).

18.9.2.2 Wharf Footprint

Although no seagrasses have been identified within the proposed Project footprint, seagrasses have been identified adjacent to the both wharf / barge loading facility options. Seagrasses have been identified immediately adjacent to the proposed development approximately; being ~230m to the northern bank and ~ 500m along the southern bank of the Skardon River. The width of these habitats along the mangrove fringe are in the order of 5-10 m. The relatively steep bed and bank formations and turbidity of the water limits the available area for colonisation.

The bathymetric conditions adjacent to the proposed wharf do not favour the establishment of seagrass being too deep to receive sufficient benthic light and the shoreline being dominated by rocky rubble and oyster reef.

The proposed trestle conveyor alignment will cross over a small section of habitat potentially suited to seagrass establishment, although none has been identified. The relatively steep bed and bank formations and turbidity of the water limits the available area for seagrass colonisation. The proposed wharf line is within deeper waters outside the surveyed occurrence of seagrass meadows due to depth limitations.

Seagrasses within the Skardon River appear limited in distribution, favouring shallower waters adjacent to the immediate subtidal zone. The contours of the waterway in the wharf area provide only limited habitat suited to seagrass establishment. The seagrass meadows of the Skardon River are adapted to living in a highly variable benthic light regime, influenced by sediment type, ambient currents, wind and wave forces and deposition processes. Given the absence of seagrasses adjacent to the proposed wharf facility, impacts from shading are not predicted.

Prior to development clearance surveys will be undertaken to define the detailed distribution of seagrass within the proposed construction area, if any.

18.9.2.3 Wharf Construction

The existing seagrass meadows of the Skardon River are well adapted to the natural variability in turbidity, deposition and light availability.

The construction of the wharf infrastructure has the potential to disturb sediments during piling and vessel access. Impacted waters may be mobilised with the tide upstream to known habitats (southern bank). However, given the distance (~500m) and prevailing ambient processes (high natural variations in turbidity), impact by way of reduced benthic light, or increased deposition, it is not considered a significant risk. Plumes would not migrate across the river to the seagrasses on the opposite bank (~230m), being taken away by prevailing currents which follow the river alignment. Should plumes reach seagrass habitats, recovery in water quality during the changing tide, and reductions in water depths during the ebbing tide are anticipated to provide respite in water quality conditions and available benthic light.

While impacts are not predicted, monitoring would be undertaken during construction to ensure tolerances developed during pre-construction baseline monitoring are not exceeded.

No dredging of the wharf area is proposed.

18.9.2.4 Bed Levelling Area and Offshore Transhipment Area

No seagrass is present in the bed levelling area or offshore transhipment location. Based on surveys conducted near the ebb bar and entrance to the Skardon River (Chartrand and Thomas, 2010), there is no potential seagrass habitat within the potential sediment plume zone from bed levelling.
Propeller Wash

The operation of either small or large vessels in shallow waters can result in the generation of potential propeller wash effects. Propeller wash generates increased turbidity and sediment mobilisation surrounding the immediate location of vessel operation. These suspended materials are then transported by the prevailing ebb or flood tides. The influence of propeller wash is greatest at the lower end of the tidal range, when under keel depths are smallest, and where fine sediments dominate the sediment profile. It is also known that vessel propellers can directly damage submerged aquatic vegetation in shallow waters by causing bed erosion. Damage may include physical removal of plants, part of the plant, or their rhizome system. Disturbance of potential seed banks may also occur where sediment erosion is affected.

Given the distribution of seagrasses (220 m to 500 m distant to the wharf facility), and shallow water depth requirements for growth in the study area (i.e. depths not accessible by vessels), direct physical impact via propeller wash is not predicted.

Dedicated propeller wash modelling has been conducted adjacent to the proposed wharf (Chapter 17). These findings outline that at high, or near high water conditions, erosion of benthic substrates via propeller wash is not predicted. However, during minimal operational depths (i.e. where a loaded barge can navigate the Skardon River – approximately MSL) propeller wash has the potential to mobilise sediments and cause erosion. These processes could physically disturb seagrasses by erosion of substrates (if close enough to the impact), or generate turbid plumes which may result in changed deposition regimes.

While propeller wash may increase turbidity, the duration and frequency of impacts is not considered to represent a sustained impact regarding turbidity or benthic light (once every 3–4 hours). Tidal movement would readily mitigate benthic light conditions as the plume progressed from the impact zone (i.e. plumes would migrate around 500 m in 20–30 min). The influence of tidal movement and reductions in benthic light due to ambient turbidity plumes is described in Chapter 17. Seagrasses of the Skardon River are adapted to such changes. The key impact from propeller wash is the potential physical erosive forces and the occurrence of altered deposition patterns once materials are suspended.

Modelling suggests that potential erosive forces during MSL could occur to a distance of ~150m. Figure 18-7 presents a spatial analysis of propeller wash impact for a vessel returning to the wharf. Upon its return the barge is required to turn and come alongside the wharf. Figure 18-7 demonstrates that as the barge conducts turning manoeuvres into the wharf, propeller wash may cause erosion to benthic substrates within or in close proximity to known seagrass habitat along the northern banks. The defined impact areas within Figure 18-7 relate to the modelled erosion forces presented in Chapter 17. The impact presents an initial erosion zone between 0 to 50m from the stern of the vessel. Peak erosive forces may be experienced between 50 to 100m, and reduced erosive forces between 100 and 150m. While erosive forces are predicted to stop at approximately 150m from the stern of the vessel, the propeller wash is estimated to remain above ambient near bed velocities up to a distance of approximately 220m.

To clarify, these processes would occur only during manoeuvring periods as an unladen barge returns to the loading facility. Modelling adopts a speed of 6 knts, which the vessel will not be undertaking during such a manoeuvre. The adopted impact estimates presented within Figure 18-7 are also for a laden barge, sitting lower in the water. Should an unladen barge return to the barge facility below MSL, then these estimates are considered suitable conservative. Should the barge return at depths above MSL then these impacts are considered an over estimate. The timing of vessel movements presents an opportunity to minimise benthic impacts to the greatest extent.

The manoeuvring of the vessel may present close to 5-10 minutes of exposure, with a frequency of impact of 3 – 4 times per day. Impacts will be mitigated at high tides. During the return to the wharf, the vessel...
will be empty with increased draft, and the vessel will be moving slowly with intermittent thrust applied during turning. Predicted water quality impacts are comparable to dry season conditions.

Once the vessel is loaded, and leaving the barge facility, the direction of the propellers will be facing upstream, and away from seagrass habitats. While erosive forces may occur (refer to Chapter 17), no significant benthic habitats are likely to be impacted. Propeller wash modelling (Chapter 17) further described water quality impacts as a result of propeller wash and outlined that relatively low levels of total suspended solids are predicted (0 - 2.8 mg/L). However, during manoeuvring, the barge will not be making way, and additional time may be spent in a given area. In such circumstances increases in suspended material within the water column may be expected and concentrations of sediment in the water column may potentially increase.

From this assessment, the key impact of propeller wash over the longer term with respect to adjacent seagrass includes:

- potential erosion of local seagrass patches (along the northern shoreline)
- altered local sediment deposition processes
- potential alterations to local seagrass seedbanks.

Propeller wash may cause erosion of sediments and change deposition patterns within and adjacent to the seagrass beds along the northern shoreline over time. Turbidity would increase for short periods during each event. However, prevailing current flows and tidal movements provide regular respite to the passage of turbidity plumes from vessel operations. Given the shallow nature of the beds, natural variability in water quality and in conjunction with tidal and current respite, water quality conditions are expected to remain within limits sustainable for seagrass health. Localised deposition of heavier fraction silts and sands is considered a potential impacting process should rates exceed the ability of seagrasses to adapt.

Monitoring of water quality and the health of seagrass beds will be undertaken (refer to Chapter 17 and Section 18.10.11).
Figure 18-7  Seagrasses and Modelled Propeller Wash Impacts
18.9.3 Benthic Habitats

The interaction with benthic habitats, other than seagrass, is limited to the proposed barge route and offshore transhipment anchorages.

18.9.3.1 Skardon River Barge Route

The Skardon River downstream of the proposed wharf contains predominantly bare sediment substrates (~78%), with patchy live benthic cover. Cover recorded amongst survey locations was highly variable (mean 22%, standard deviation 28%), with a handful of higher density sites increasing the mean. The median (50th percentile) recorded 8% cover which may be more representative of the area as a whole. Patchiness in habitat distribution was primarily attributed to substrate type, with coarser sediments, gravels and rocks providing more stable growth conditions than mobile silts and sands. Benthic biota downstream of the wharf facilities are dominated by brown macroalgae, and filamentous algae, with additional biota including sponges and soft coral around adjacent rocky reef structure. These habitats are outside the navigational channel are therefore not at risk of impact from barge operations.

Modelling for propeller wash has identified the potential for bed erosion along the proposed navigation channel during MSL operations (Chapter 17), but not MHHW operations. This is estimated to extend up to 150 m behind the barge within the upper estuary and 170 m behind the barge within the mid estuary. As waters deepen (such as found at the mouth) no erosion is predicted. As the barge continues through the ebb bar erosion is again predicted, extending up to 180 m behind the barge. Modelling indicates that increasing tidal depths would act to mitigate this impact, with MHHW tides resulting in no predicted bed erosion along the entire barge route.

The extent of propeller wash impacts will encompass a track as wide as the proposed barge vessel (i.e. 20 - 25m). Modelling confirms that bed shear stresses and current impacts would return to ambient levels within approximately 10 m either side of the barge. Impact to the substrates would be limited to the channel alignment (given a nominal channel width of 70m), including a buffer of 10 m, either side of the vessel, an impact zone of 45m may be described (25m + 10m + 10m = 45m).

Current modelling has identified peak currents within the River largely align to the proposed navigation channel. Sediments are dominated by sands and silts (PSD samples). However, video analysis indicates a substantial proportion of the survey sites also incorporated a large percentage of shell fragments and gravel sized materials. Bed features within the channel alignment include flat open sediments, rock and gravel, sand wave patches and ripples. These features are recorded in the bathymetric survey imagery captured in 2015.

Impacts predicted by the passage of barges would occur for approximately 60 seconds at any given location (Chapter 17). Given 4 deep water passages and 4 MSL passages each day modelling predicts an exposure from propeller wash of around 4 minutes per day at any given location along the barge route. Natural processes would continue to sort sediments and remobilise material in the interim. Overtime, the sediments within the barge route may experience armouring, whereby coarser fractions remain and the required bed shear velocities needed to mobilise them increase. In such circumstances, the process of propeller wash mobilisation and disturbance would decrease after an initial impact period.

While erosion is predicted, the predicted volume of suspended materials is limited. Water quality impacts as a result of suspended sediments would range up to 2.8 mg/L. Increasing water depths will reduce this impact to some extent, with no erosion predicted on the MHHW tides.

Barges will remain within the navigation channel thereby reducing the distribution of potential disturbance.

18.9.3.2 Intertidal Habitat

Bare intertidal habitats extend from the mangroves, predominantly within the lower estuary where these features are widest. Some incidences of oyster reef have been described. The proposed barge route is
located away from these habitats. Vessel wake waves have been assessed. Predicted wake heights are considered small and within the range naturally experienced. Barges are only capable of clearing the ebb bar at mean sea level (MSL) and as such intertidal areas will not be fully exposed to barge passages when loaded. Unladen drafts will produce even smaller wake waves. Adherence to proposed speed limits will avoid vessel wake wave and bed/bank erosion impacts.

18.9.3.3 Ebb Tide Bar

Surveys conducted over the entrance channel and surrounding shoals confirms an absence of benthic habitats. This area is dominated exclusively by bare sands and gravels, with minor fines fractions. The proposed bed levelling within the channel alignment at the ebb bar is not expected to impact habitats. The absence of any significant benthic habitat reported from the wider survey area conducted by Chartrand et. al. (2010) also suggests that turbidity and deposition processes resulting from bed levelling or the passage of barges via propeller wash would also be of minor consequence. The sediments of the entrance range from gravel to minor silt/clay fractions but are dominated by fine to coarse sands. These sediments are not suited to generating substantive turbidity plumes. The coarse nature of the particles also indicates that once suspended, deposition would remain very close to the development footprint.

The relatively high suspension rate predicted over the ebb tide bar (40mg/L) and the prevailing ebb tide currents suggests that the process of erosion due to barge passage may work to mobilise finer sands along the channel alignment to the leading edge of the ebb bar. This may reduce the need for bed levelling, though maintenance would still likely be required to make the channel uniform following the wet season. The passage of barges and the generation of suspended sediments at 40 mg/L may produce plumes which would mobilise as for the bed levelling process (Chapter 17). Given the maximum bed levelling source concentrations (Chapter 17), the extent of propeller wash plumes may be expected to occur over a shorter distance of 1,000 – 1,500m, remaining within the southern edge of the ebb tide bar, and well away from significant known habitats located some 6,000m to the south.

18.9.3.4 Offshore Transhipment Area

The proposed location for transhipment area contains very low density benthic communities (estimated at <0.5% cover). Broader surveys of the transhipment area have also concluded a dominance of bare substrates offshore, with live cover being in the order of 1-4%. Low density sponge and soft coral rubble have been identified outside the southern extents of the proposed transhipment area, similar in density and composition to broader survey areas.

The proposed bulk carriers for transhipment will arrive at the area and anchor. Anchoring provides direct disturbance to the substrate and impact to benthic biota. Continual anchoring within the area will act to physically remove or damage portions of the community, if present. The typical extent of anchor damage would follow a 4-5m wide corridor. As the chain is deployed the anchor would move to the seabed. A portion of the anchor chain would be located on the seabed and movement (drag) will disturb sediment and potential benthic biota within that zone. Upon retrieval the anchor and chain would be lifted from the seabed with some additional disturbance. The impacted areas would be expected to recover over a short period of time. Given the findings of side scan survey, no substantive reef structure has been identified which would be physically destroyed by the anchoring process.

Propeller wash will also be generated at the transhipment area. While the bauxite barges will not have sufficient draw to impact the substrates due to depth, the bulk carriers will be loaded to a maximum of 2m from the seabed. At this distance modelling indicates that as the vessel moves off its mooring to sail away, erosion of the substrate would be experienced. Modelling estimates that an area extending approximately 180 - 200m from the stern of the ship would be open to potential erosive forces due to increase bed shear stresses. The peak of these forces being experienced within approximately 50 – 100 m (Chapter 17).
Given the prevailing substrates, a process of bed armouring may be expected within the transhipment area. As finer sediments are winnowed from the primary anchoring and departure areas, the bed will increase in particle size and increase the bed shear stresses required to move materials into suspension. Over time the impact of propeller wash on bed disturbance, erosion, water column suspension and altered deposition processes will decline.

Following the removal of these forces the area would return to ambient conditions as finer sediment return and benthic conditions become stable for the colonisation of biota.

Vessels will be restricted to the nominated transhipment area and a departure path to limit the extent of impacts.

### 18.9.3.5 Nearshore Reef

Nearshore rocky reef habitat containing significant coral and soft coral cover has been identified approximately 6 km south west of the entrance to the Skardon River (refer to Section 18.6.6). These habitats provide substantial resources for turtles, dolphins and other marine species of conservation significance. The extent of this habitat has not been fully defined, and potential exists that it is larger than the estimated 18 ha area. Operational activities are not proposed within this nearshore zone given its shallow depths and risk of grounding. No impact to this habitat area is expected from Project operations.

Modelling of bed levelling impacts has been conducted (Chapter 17) which concludes that although suspended sediment plumes will migrate south along the shoreline, the extent and concentrations are not sufficient to reach the nearshore reef habitat. Modelling indicates concentrations less than 1-2 mg/L at the outermost extent of the plume, which would end approximately 3 km from the reef area.

### 18.9.4 Marine Turtles

Project disturbance to preferred foraging and nesting habitat is negligible given the absence of dredging or excavation, and distances between nesting shorelines and the Port infrastructure. Proposed bed levelling does not influence any significant benthic habitats and is well away from potential foraging areas. The potential impacts attributable to lighting are not considered a significant issue given the distance between the nesting beaches and proposed Port activities within the upper reaches of the Skardon River.

Increased vessel movements within the Skardon River and adjacent coastal regions present the greatest potential for interaction, though the risks are considered minor given the slow speed of vessel activities and habituation of these species to shipping and port development.

Turtles may encounter vessels within the proposed channel alignments and during offshore operations. Displacement of turtles due to the passage of a vessel is anticipated to be relatively short lived, with individuals diving to avoid vessels in the immediate vicinity. The application of defined vessel access channels and go-slow zones in proximity to potential habitat are considered important mitigation measures. Research has identified that visual cues rather than noise induces avoidance behaviour in turtles, making reduced speeds the most appropriate tool for prevention of boat strike incidents. The barges will operate at speeds of 4 - 6 knts within the Skardon River. Whilst the vessel master will not have opportunity to conduct avoidance manoeuvres, the speed to response ratio is much greater than for faster moving vessels. The size, displacement and lack of mobility of operational vessels associated with the Project will necessitate a slow speed when operating. Barges and supply vessel operations do not present a substantive risk of vessel strike with turtles. Vessels at an increased risk of collision with marine fauna (small survey or service vessel) will be used on the Project infrequently. These vessels have capacity to avoid collisions and will also operate within the nominated vessel access and speed restrictions. With operational access and speed limit zones in place, the impact of vessel strike on marine turtles will be minimised.

The mining areas, Port area and camp are not adjacent to beaches used by nesting turtles and will therefore have minimal impact on turtle behaviour from lighting. The nearest location to beach nesting
areas is mining areas surrounding portions of the Namaleta Creek systems that are 3 km inland of the coastal dune system. These locations are screened by native vegetation and changes in topography (dunes and coastal swales). The Port is approximately 10 km from nesting beaches. Lighting at the offshore transhipment area will be approximately 15 km offshore. Gulf Alumina will adopt turtle friendly lighting for barge lighting to minimise light spill potential.

There are two major anthropogenic threats to marine turtles along the beaches of western Cape York – predation by feral pigs and entanglement in discarded high seas fishing net (ghost nets). Gulf Alumina will discuss (likely with Land and Sea Rangers) logistical support and funding for management of the beach to allow the removal of ghost nets from beach areas. Gulf Alumina proposes feral pig control, as described in Chapter 15. Project workers will not be allowed recreational and vehicle access for Project workers to beaches.

Marine turtles do not have an external hearing organ. However, they can detect sound through bone conducted vibration with the skull and the shell. Their response to sound varies with different frequencies and intensities of the sound. Although little is known about the potential impacts on marine turtles from increased noise exposure, McCauley et al. (2000) suggested that marine turtles may show avoidance behaviours at 164 dB. Piling noise from wharf construction is expected to exceed this noise level within the Skardon River, but the duration of piling is short term (2 months). Noise from vessel operations will only exceed this noise level within less than 10 m of vessels. Management measures for piling noise are described in Section 18.10.7.

Some increases in turbidity within the Skardon River and the ebb tide bar may be experienced during the mid-tidal period as loaded vessels are nearest the seabed. Propeller wash is predicted to generate turbidity effects at or below the surveyed dry season conditions (Chapter 17). The processes of propeller wash would be intermittent, with water quality impacts being negligible at high tide for both loaded and unloaded barges. Modelling within the Skardon River estimate that at any single location along the barge channel propeller wash would provide an impact to the navigation channel for ~60 sec during passage of the barge. Currents would then disperse any suspended sediments along the channel alignment (given strong directional currents). Turbidity regimes for inshore rocky reef and coral reef (outside the Skardon River) are expected to also be within these natural ranges (inshore rocky reef would demonstrate additional turbidity given their shallow water and proximity to the intertidal mangrove community).

Chemical water quality impacts are unlikely given attention to chemical management and spill responses processes. The proposed processes will not produce any significant chemical emissions or result from operations or processes. However, significant hydrocarbon spillage may be possible in the event of an accidental release from shipping or the onsite storage facilities due storage or refilling periods. While the probability of such an occurrence is remote with proposed management measures, impacts could be high. An onsite emergency spill response capability will be provided to ensure rapid deployment in this relatively remote area.

No habitats used for foraging by turtles will be removed by the Project. Some potential for propeller wash impact is possible along seagrass beds adjacent to the proposed wharf. Video survey confirms presence of additional seagrasses upstream of the Port location which will remain unimpacted. Minor algal communities have also been identified within the substrates of the proposed barging channel which may be impacted by propeller wash to some degree during low tidal conditions. However, algal, sponge and soft coral communities within the inshore rocky reef habitat will remain unimpacted, as will the adjacent inshore coral reefs south of the ebb tide bar entrance.

18.9.5 Cetaceans

There are two potential impacting processes from the Project with the potential to impact on cetaceans; underwater noise and the potential for vessel collision.
The predominant underwater noise sources during construction will be pile driving activities with some minor impacts from vessels involved in construction. The piling program is scheduled to be completed in 2 months by a single barge mounted piling hammer at the Port area only. During operations, noise sources from operational vessels will include bauxite barges, bed levelling vessel and supply vessels.

Underwater noise levels from these sources have been estimated, with results presented in Chapter 20 (based on Appendix 10) and repeated in Appendix 8.

It has been estimated that:

- permanent hearing loss in cetaceans may occur at greater than 198 dB
- temporary hearing impact and behavioural disturbance may occur at greater than 183 dB
- potential behavioural response in cetaceans may occur at greater than 160 dB

Pile driving activities may exceed 198 dB within 200 m of these activities and exceed 183 dB within approximately 1,000 to 2,000 m of pile driving. For mobile marine animals, avoidance behaviour is the common response to underwater noise when that noise reaches a certain threshold. There is potential for permanent or temporary hearing loss or other tissue damage from pile driving during the 2 month construction period. Behavioural responses may also be anticipated over greater distances, though given the shallow nature of the river system, bends and reaches, sound may not propagate as far as estimated. Mitigation measures have been proposed for piling construction noise.

Vessel movements during construction and operation are not predicted to exceed 183 dB and may exceed 160 dB within 10 m (i.e. the immediate vicinity) of vessels. Underwater noise mitigation measures are not proposed during operations.

Shipping and vessels pose a potential risk to marine megafauna through collisions and general disturbance. The proposed Project will increase the number of vessels active in the Skardon River. The majority of vessel movements will consist of barge movements. A key determinant in the potential for collisions between vessels and cetaceans is the speed of the vessel. Given the slow speed of vessel (barge) movements within the operational Port limits, vessel strike on cetaceans is not considered a risk requiring specific mitigation. The general disturbance of cetacean and other marine megafauna will occur during both construction and operations. Potential for habituation to these disturbances may reduce the impact to these species over the longer term.

The co-existence of dolphins at a large number of locations on the Queensland east coast at or directly adjacent to port facilities where vessel movements are substantially greater than proposed for the Project provides an indication that animals can adapt to this disturbance and maintain viable populations.

In terms of the movements of the bulk carriers, specific Project level mitigation is not proposed. Any mitigation measures should occur on a state-wide or nation-wide basis to be effective. The Australian Government is working on improving the management of ship strikes in its waters with reference to actions identified in the United States’ guidance document for minimising the risk of ship strikes, endorsed by the Marine Environment Protection Committee (MEPC) of the International Maritime Organisation (IMO).

### 18.9.6 Sawfishes and the Speartooth Shark

The most significant overall threat to sawfishes and the speartooth shark is very clearly associated with incidental capture by commercial fishing operations. A lesser impact is from recreational fishing activities. Neither of these activities are associated with the Project.

It is considered likely that two species of sawfish – the largetooth sawfish and the dwarf sawfish may occur in Skardon River in the vicinity of the proposed wharf area. A further species, the green sawfish may occur at the proposed offshore transhipment area given deeper water requirements. While not confirmed as occurring in the Skardon River, it is plausible that the speartooth shark may also occur there. The key
known location for the speartooth shark is the adjacent Port Musgrave/Ducie River/Wenlock River area directly to the south of the Skardon River. Namaleta Creek which drains the southern catchment has direct access to Port Musgrave and may also function as habitat for these species.

The catchments of the Skardon River and the Namaleta are small, and are supplied with only minor freshwater flows during the dry season. The life history of speartooth shark pups indicate they move into the upper estuary adjacent to freshwater flows with lower salinity regimes. If flows in the Skardon River or Namaleta are not sufficient (given their small size, especially Namaleta Creek), then the river may not be suitable to sustain this strategy for the estimated 3-6 years before migration to more saline waters occurs. Water quality analysis indicates the development of a strong salinity maximum within the upper estuary during the dry season, which declines during wet season flows. If speartooth sharks utilise the river for pupping then the habitat for sustaining these individuals would be very limited (and perhaps unsustainable where seasonal catchment flows are insufficient to push back the growing salinity maximum in the dry season). The conditions presented within the Wenlock and Ducie River systems are vastly different. These systems maintain a freshwater base flow throughout the dry season, being fed by adjacent groundwater resources and much larger catchments.

The impacting processes from the Project are highly unlikely to result in substantial impacts to sawfishes or the speartooth shark. The species will not plausibly be negatively impacted by artificial lighting, underwater noise or shipping movements. However, as for other marine species, some potential for habitat avoidance during construction may be exhibited given proposed piling construction methods.

Proposed construction and operational activities are outside the wet season which is identified as the key pupping period for sawfishes. Known information suggests speartooth shark pup during the early wet (October/December). Construction will be targeted for the early dry season to minimise potential impacts on speartooth shark and sawfishes.

Bed levelling activities and the periodic passage of export barges (resulting propeller wash at lower tidal levels) will increase turbidity during construction and operations for short periods. Given the sand dominated sediments, modelling estimates propeller wash elevations to be within ambient ranges for the dry season (<5ntu or 1-2.8 mg/L). Wet season turbidity approaches 30-36 ntu throughout the estuary. The speartooth shark and sawfish are preferential bottom feeders, living in often shallow and highly turbid water. Adaptations to limited light conditions suggests that periodic increases in turbidity as a result of Project activities would not be a significant impacting factor.

While the Port development activities will not directly or indirectly alter the hydrology of the Skardon River, development of culverts within the Namaleta Creek system is proposed. Construction would occur during the dry season, and would unlikely impact access by either speartooth shark or sawfish. In fact, by upgrading the existing crossing, these culverts will act to improve upstream connectivity which presently consist of several pipes of insufficient design within a level crossing. As freshwater flows in Namaleta Creek cease during the dry season, and the crossing is within the zone of no flows in the dry season, it is highly unlikely that speartooth sharks or sawfishes would be found at the crossing location.

The placement of the piling at the wharf, may create a local habitat that is not utilised by largetooth sawfish (these fish avoid structures), but this habitat modification does not provide a barrier to movement of animals up and down the river as the wharf infrastructure only extends a short distance into the river. The area to be disturbed is not consequential given the area of the Skardon River and is highly unlikely to have any impact on largetooth sawfish at the population level. Large areas of open shallow water habitats (as favoured by the sawfish) is present within the lower and mid estuary reaches.

The Sawfish and River Sharks Multispecies Recovery Plan was released in 2015 and is the Australian National Recovery Plan for the largetooth sawfish (formerly known as the freshwater sawfish), green sawfish, dwarf sawfish, speartooth shark and the northern river shark. As assessed and described Chapter

2 Australian Government, Department of the Environment, Sawfish and River Sharks Multispecies Recovery Plan, 2015
26, the Project is not inconsistent with the objectives and associated actions for the recovery of sawfish and river sharks.

18.9.7 Dugong

Slow moving displacement vessels such as barges and tugs as proposed within this Project do not pose a substantial risk of vessel strike. With speed limits in place for particular types of vessel, and the operation of all marine craft to agreed vessel access channels, a low impact upon dugong is anticipated.

Dugong are potentially sensitive to underwater noise, and construction activities such as pile driving have the potential to temporally drive dugong from the area. The noise impacts presented for cetaceans above are considered applicable to the response by dugong. The proposed barge loading facilities have recorded seagrass within its immediate vicinity, though the extent of these meadows is small. Given the occurrence of dugong within heavy industry Ports such as Gladstone Harbour, and busy coastal waterways of Moreton Bay and Cleveland Bay, the severity of impacts from vessel movement and barge loading during operations are likely to be low.

Dugongs considered to possess poor vision, relying more substantially on their hearing senses (Lawler et al. 2002). There is evidence to suggest that there is some disturbance to dugong feeding when boats pass nearby, although boats further than 50 m from dugongs generally do not elicit a disturbance response (Hodgson and Marsh 2007).

While a single dugong observation has been recorded from the Skardon River (Roleof, et.al. (2003)), the proposed Project is not at or adjacent to seagrasses that constitutes important dugong habitat. The main feeding locations for dugong in the Gulf of Carpentaria are known and are remote from the proposed Project location.

18.9.8 Crocodiles

Crocodiles are a common resident of the Skardon River. An increase in vessel operations may influence the behaviour of crocodiles frequenting the Skardon River. However, habituation of crocodiles to increased anthropogenic activity is common place and its impact on crocodiles is expected to reduce over time. Core habitat for crocodiles is not being manipulated, and vessel wake waves are not predicted to impact the banks of the Skardon River. The Skardon River is not recorded as a significant breeding area.

18.9.9 Migratory Shorebirds

Disturbance associated with the construction and operation of the Project is expected to be localised to the vicinity of the Project area, and therefore have local impacts only. Such impacts are not likely to affect the identified important shorebird feeding areas or sandy beaches around the entrance or lower Skardon River estuary. Worker access to important migratory shorebird feeding, roosting areas and beach nesting areas will be restricted, noting that none of these areas are in the Project disturbance area.

18.9.10 Marine Pests

The risk of introduction of marine pests by the proposed Project is likely to be reduced compared to the current risks associated with operations at the Port of Weipa. This is primarily due to the fact that bulk vessels are remaining offshore, and not entering the estuarine and inshore waters of the Skardon River, where a range of additional habitat refuges exist. However a risk remains of transfer of pest species from other Australian Ports where they have been introduced, and direct introduction via ballast water discharge or hull fouling from international trading vessels.

18.9.11 Commonwealth Marine Areas

The Marine Bioregional Plan states:
Human pressures on marine ecosystems and biodiversity in the North Marine Region are low by global standards. This is partly due to the relatively low levels of marine resource use and low coastal population pressure across the region (the exception being in proximity to the large urban centre of Darwin), and partly due to Australia’s generally sound management of the marine environment.

The main drivers and sources of pressure on conservation values in the region are:

- climate change and associated large-scale effects, including shifts in major currents, rising sea levels, ocean acidification, and changes in the variability and extremes of climatic features (e.g. sea temperature, winds, and storm frequency and intensity)
- harvesting of living resources
- increasing industrial development in areas adjacent to the region
- growth in marine industries and infrastructure.

The Project will contribute to increased pressure from increasing industrial development in areas adjacent to the region and growth in marine industries and infrastructure. The Project will not contribute to pressures associated with climate change (other than as an insignificant contributor to global greenhouse gas emissions) and harvesting of living resources. The additional pressure on the marine environment in the Gulf of Carpentaria is not expected to alter the assessment that human pressures are low by global standards.

The Marine Bioregional Plan identifies several issues of concern within the study area. Marine debris is considered of high concern. Operations would ensure that all waste management plans are adhered to and materials will not be disposed at sea. Habitat disturbance or construction has been identified as of potential concern. The plan describes disturbance to inshore habitats such as seagrass, mangroves and coral reefs. Alterations to hydrological connectivity is also identified. The potential impacts from propeller wash within the offshore transhipment area are considered highly localised, and of short duration. Such impacting processes are experienced broadly within the adjacent ports and shipping lanes. Issues of less concern include chemical pollution, fishing and invasive species. The Project proposes continuation and extension of the marine pest monitoring program to encompass the proposed transhipment area. Fishing within the Project area by staff and contractors will be prohibited. Chemical pollution will be managed as per the standards required by The International Convention for the Prevention of Pollution from Ships (MARPOL). This is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.

Bulk carrier vessel movements in the Gulf of Carpentaria basin are highly unlikely to impact on the ecology of the Gulf of Carpentaria basin. Port activities are approximately 9 km upstream on the Skardon River and a further 7 km from the Coastal Waters boundary, and hence will not impact on Commonwealth marine waters. Chapter 17 demonstrates that Project activities will have an insignificant on impact coastal processes and physical marine environment within Commonwealth marine waters.

### 18.10 Management Measures and Plans

Management measures for potential impacts to coastal processes and the physical marine environment are described in Chapter 17. These management measures will also reduce impacts to marine ecology.

#### 18.10.1 Direct Disturbance

**18.10.1.1 Wharf Construction**

Wharf construction methods will minimise direct impacts to marine ecology through use of piling for construction.
The wharf location has been selected so that there is sufficient natural depth of water in the Port area to avoid dredging.

Construction areas will be demarcated prior to construction to prevent activities occurring in sensitive environmental areas. Although no seagrasses have been identified within the proposed wharf footprint, seagrasses have been identified adjacent to both wharf / barge loading facility options.

Pre-clearance surveys will be conducted for seagrasses within the finalised wharf alignment. Seagrasses will be monitored during construction and operations.

Approximately 300 m² of mangrove may be disturbed through construction of the conveyor to the wharf. Trimming of mangroves will be undertaken in preference to removal, where practicable. Access will be restricted to saltmarshes and mangroves, which are not within the proposed Project footprint, other than the conveyor.

The Code for self-assessable development Minor impact works involving the removal, destruction or damage of marine plants MP06 does not apply to Port construction activities within the mining lease. Despite not being applicable to Port construction activities, the following Code requirements will be incorporated into Port construction:

- Minimise marine plant disturbance.
- Minimise the area of land disturbed.
- The least volume of soil / sediment will be excavated.
- Use of machinery will be minimised and will be no greater than the capacity required for the purpose.
- Sediment and erosion protection measures will be implemented.
- Works will be undertaken at times that minimise disruption to fish migration and the flowering and fruiting of marine plants.
- All tidal lands disturbed by the development works, other than those with infrastructure, will be restored to pre-work profiles to promote natural restoration of marine plants and other fish habitats.
- Any spoil from excavation work (noting that this is not expected), excluding that used for re-profiling the substrate, will be removed at least 5 m from tidal lands and other wetlands and managed to prevent sediment runoff and acid sulfate soil oxidation.
- All pruning and trimming will be conducted according to the following requirements:
  - Mangrove branches greater than 25 mm in diameter will be pre-cut to prevent splitting.
  - Cutting equipment will be kept sharp and clean at all times.
- Subsurface roots of mangroves from which the trunk and branches have been removed will be left in-situ to minimise substrate disturbance, unless removal is reasonably required to be able to complete the works (e.g. within the footprint of pylons for the wharf).
- All marine plants and marine plant parts that are removed, will be removed from tidal lands.
- Chemicals will not be used on marine plants.

During construction in the marine environment, the following mitigation measures are proposed:

- Monitor turbidity, deposition and benthic light availability during construction and amend work practices if required.
- Time marine construction works during spring tidal periods, where practicable where materials are dispersed a greater distance, and deposition impacts are minimised.
Sediment curtains may be used during periods of activity where substantial sediments may be disturbed.

If sediment curtains are not practical, periods of substantial bed disturbances will be preferentially conducted during spring tidal periods (where practicable) as materials are dispersed a greater distance, and deposition impacts are minimised.

The need for these sediment controls will be informed by water quality monitoring (refer Chapter 17).

18.10.1.2 Bed Levelling
The targeted bed levelling depth, duration of bed levelling and methodology for the works (refer to Chapter 17) is designed to minimise impacts to the marine environment, whilst allowing efficient operation of barges.

No seagrass or reef habitats are located within the bed levelling area or the area of estimated sediment plume from bed levelling.

18.10.1.3 Offshore Transhipment Area
The offshore transhipment area location was selected on the basis of benthic habitat and sediment surveys which identified very low density benthic communities and sediments that are sand dominant. This location will minimise impacts to marine ecology from offshore anchoring and bauxite transhipment.

Offshore transhipment of bauxite from barges to bulk vessels will not involve any permanent structures in the marine environment and therefore there are expected to be negligible impacts on coastal processes and the physical marine environment.

Barging activities are not proposed within any nearshore zone containing rocky reef habitat. The proposed Project activities will not occur near the identified offshore reef habitats, and supply vessels and general shipping will remain clear of these reefs.

Moorings areas within the offshore transhipment area will be defined. Vessels will remain within the defined offshore transhipment area.

Pre-disturbance surveys of the proposed offshore mooring areas will be undertaken to ensure higher density habitats, if present, are avoided. Bulk vessel shipping anchorage times will be minimised. Vessels will remain within the designated area to avoid spread of anchoring and propeller wash impact. Departure paths will be defined for laden vessels leaving the area.

18.10.1.4 Cyclone Moorings
The requirement for cyclone moorings and their potential location will be determined in conjunction with MSQ and the Regional Harbour Master.

Cyclone moorings, irrespective of their location, are unlikely to create a significant impact on the marine environment, with safety of mooring vessels being the primary consideration in their design and location.

Gulf Alumina will design, construct and locate cyclone moorings such that impacts to marine environment are minimised, without compromising the safety function of the cyclone moorings.

Proposed cyclone mooring locations will avoid offshore reef habitats or any other sensitive marine areas, marine species and/or MNES. Cyclone moorings will be operated such that impacts on reefs and/or seagrass due to chain drag are avoided. Surveys will be carried out prior construction of the cyclone moorings to ensure that no sensitive marine ecosystems will be impacted.
18.10.1.5 Restricted Access Zones

Access for Project personnel and vessels will be limited to the wharf area, navigation channel and offshore transhipment area. Access will be restricted to habitats containing seagrass, mangroves (other than during conveyor construction), salt marsh, intertidal habitat, rocky reef, oyster beds and offshore reefs. Gulf Alumina will restrict access to the beaches, and a feral animal and marine debris program will be established (refer to Section 18.10.9).

18.10.2 Changes to Water and Sediment Quality

18.10.2.1 Port Infrastructure Area

Management measures to prevent the release of contaminants from the Port infrastructure area, including hydrocarbons, fuel, chemicals and wastes are described in Chapter 11.

Port area sediment management, including design, construction and operation of Port sediment ponds is described in Chapter 6. Release criteria for the Port sediment ponds are described in Chapter 17. The release of waters from the dam will be managed such that suspended sediment release is minimised. Wet season runoff to the mangrove system with potentially elevated sediment levels is a natural occurrence. Mangroves are adapted to this process of wet season inundation. However, the design of the dam outflow will minimise the potential for erosion.

18.10.2.2 Mining Activities

Management measures to prevent and minimise sedimentation of the marine environment from mining activities are described in Chapter 6 and Chapter 12.

As described in Chapter 15, a wetland buffer zone is proposed along the Skardon River South Arm supratidal wetland, which will provide at least 100 m separation distance between mining and wetland areas. This buffer zone will also act to contain any sediment runoff from mining.

Dust management is described in Chapter 19, and will aid in minimising release of particulate matter to the Skardon River.

18.10.2.3 Port Operations

Commercial vessels involved in the site construction and operational phases will be subject to international, national and state policies and guidelines to restrict environmental impacts as a result of spillages, anticorrosion products, wastewater products, and solid wastes. The following plans have been produced for the management of the Port of Skardon River:

- Oil Spill Contingency Plan (Ports Corporation Queensland, 2003)
- First-Strike Oil Spill Response Plan - A supplement to the Queensland Coastal Contingency Action Plan (MSQ, 2005)
- Port Rules (Ports North, 2015)

These plans will be reviewed in conjunction with Port North and updated as required to meet Project requirements. Marine transport and operations management, including pollution controls and oil spill response plan are further described in Chapter 22.

18.10.3 Increased Sediment

18.10.3.1 Bed Levelling

The bed leveling methodology (refer Chapter 17) is designed to minimise the potential for sediment plume dispersion. No seagrass or reef habitats are located within the bed levelling area or the area of estimated sediment plume from bed levelling.
18.10.3.2 Propeller Wash

Vessel movements will be controlled and vessels will be operated at speeds to minimise propeller wash (as per the vessel speed and access plan in Chapter 22). Proposed barge speeds (6 knts) will minimise propeller wash sedimentation impacts. Barge movements will be limited to the navigation channel, thereby limiting the distribution of potential impacts. Timing of barge movements will preferentially target higher tide levels, where practicable, to avoid potential sedimentation impacts associated with propeller wash.

Return barge movements at the wharf would target higher tides to reduce potential for impact on seagrasses on the north side of the Skardon River. Vessel passage over or immediately adjacent to seagrass habitats will be limited. Barge speed will be limited to 4 knts within 500m of seagrass beds near the wharf facility. Barge operation, when manoeuvring return barges to wharf facility will be undertaken so as to minimise propeller wash impacts on adjacent seagrasses.

18.10.4 Vessel Operation

Vessel navigation routes (vessel access) and speeds will be managed to minimise impacts from:

- direct strike of vessels on marine fauna
- vessel wave action on shoreline vegetation

Marine vessel activities will be conducted in compliance with the vessel access and speed limit plan provided in Chapter 22. Vessel movements will be restricted to dedicated zones, areas of sufficient water depths and at speeds suited to safe vessel operation.

18.10.4.1 Direct Strike

This vessel speed and access plan will minimize interaction with marine species (including turtles, dolphins, dugong, speartooth shark and sawfishes) and adjacent habitats (e.g. seagrass and other benthic habitat). Vessel speed limits (e.g. 4 knots) will apply within 500 m of seagrass beds near the Port area.

By constraining operations according to the proposed access zones, and predominantly within the barge channel, interaction with marine fauna and adjacent benthic and shoreline habitats will be minimised to its greatest extent.

In addition to defined speed zones vessel masters will manage speed and direction where safe to do so to avoid collision with marine fauna.

Research has identified that visual cues rather than noise induces avoidance behaviour in turtles, making reduced vessel speeds the most appropriate tool for prevention of boat strike incidents.

Observations of marine fauna will be recorded (including species and location). Incidences of direct interaction such as vessel strike, or near vessel strike will be reported.

Vessels servicing the Project will be restricted in speed to minimise the potential for boat strike. The proposed bauxite barges are large slow moving vessels and would operate in the river at a speed of 6 knts. Any smaller, faster vessels would utilise fauna spotters.

18.10.4.2 Vessel Wake Waves

Vessel wake waves are not predicted to impact shorelines. Barge speeds will be limited to 6 knots to prevent wake wave impacts along the shoreline of the Skardon River. Barge speed will only be increased if it can be demonstrated that increased speeds do not result in vessel wake wave impacts to the shoreline. Barge movements will be limited to the navigation channel.
Wherever possible, existing native riparian vegetation around the Port will be maintained (noting that the only disturbance is along the conveyor alignment). No other disturbance to riparian vegetation is proposed.

River bank position and bank vegetation monitoring will be undertaken to indicate any potential changes resulting from the vessel wake waves should wave height monitoring indicate that vessel wake wave heights are greater than modelled. (refer Chapter 17).

18.10.5 Acid Sulphate Soils

Management of acid sulphate soils is described in Chapter 17, and will minimise or prevent impacts on marine ecology.

18.10.6 Lighting

It is not expected that light spill from Project activities will alter the sea finding behaviour of turtles. If necessary a plan to reduce light spill will be implemented for the Project. A number of contingency measures for light spill are presented in Appendix 8 to the EIS. Monitoring of fauna near Project activity areas, particularly the Port area, will provide information as to whether any of these light spill mitigation measures should be implemented. Lighting of barges will include measures to reduce light spill impacts on turtles.

18.10.7 Underwater Noise

The 'Underwater Piling Noise Guidelines’ published by the Government of South Australia (2012) provides suitable standard operation procedures during piling activities. The proposed piling program will incorporate a mix of the following mitigation measures to reduce the potential for adverse impacts on marine fauna (dolphins, turtles, dugong) from piling noise:

- Marine-based pile driving operations to take place during daylight only (daylight is defined as where there is adequate light to see a minimum distance of 1000 m).
- A 500 m safety exclusion zone will be established around piling works. The adequacy of this zone to protect against adverse noise impacts to marine mammals and reptiles will be confirmed by measuring noise from initial marine piling operations. If the 500 m safety exclusion zone is not deemed adequate to protect against adverse impacts to marine fauna the zone will be redefined.
- Pre-start procedure – the presence of marine mammals will be visually monitored by a suitably trained crew member for at least 30 minutes before the commencement of the soft start procedure. Particular focus will be put on the exclusion zone but the observation zone (approximately 1,000m beyond the exclusion zone) will also be inspected as well, for the full extent where visibility allows. Observations will be made from the piling rig or a better vantage point if safe and possible.
- Fauna spotters and vessels will attempt to coax fauna (turtles, dolphins, dugong) away prior to start-up of piling operations.
- Soft start procedure – If marine mammals have not been sighted within or are likely to enter the exclusion zone during the pre-start procedure, the soft start procedure may commence in which the piling impact energy is gradually increased over a 10 minute time period. The soft start procedure will also be used after long breaks of more than 30 minutes in piling activity. Visual observations of marine mammals within the safety exclusion zones will be maintained by trained crew throughout soft starts. The soft start procedure may alert marine mammals to the presence of the piling rig and enable animals to move away to distances where injury is unlikely.
Stand-by operations procedure – If a marine mammal is sighted within the observation zone during the soft start or normal operation procedures, the operator of the piling rig will be placed on stand-by to shut-down the piling rig. An additional trained crew member will continuously monitor the marine mammal in sight.

Shut-down procedure – If a marine mammal is sighted within or about to enter the exclusion zone, the piling activity will be stopped immediately. If a shut-down procedure occurred and marine mammals have been observed to move outside the shut-down exclusion zone, or 30 minutes have lapsed since the last marine mammal sighting, then piling activities will recommence using the soft start procedure. If marine mammals are detected in the shut-down exclusion zone during poor visibility, operations will stop until visibility improves.

Fauna spotters may try to coax marine fauna away from proposed piling areas, if present. Observations of marine fauna will be recorded.

Correct specifications of piles and the pile driver for the proposed constructions works will be used to avoid excessive energy requirements to achieve pile penetration.

All impact and vibratory piling works will adopt a soft start approach. In the first instance, this could incorporate piling commencing at low energy levels, say at 25% power, and then building up progressively to full impact force. If this is not possible, then a single pile impact could be conducted followed by another single pile impact after about 5 minutes. Then normal piling can then begin after another 10 minutes, so as to allow any marine mammals who may be approaching to leave the area.

A suitably trained observer will be on-site conducting observations for marine fauna.

18.10.8 Pests

Since 2001, requirements have been in place for the management of internationally sourced ballast water that apply to all ships arriving from overseas. These requirements are implemented through the Quarantine Act 1908 and are administered by the Seaports Program within the Australian Quarantine Inspection Service (AQIS). No ballast water may be discharged from internationally trading vessels in Australian waters without express written permission from AQIS.

Ships servicing the Project will be required to manage ballast waters in line with the proposed management strategy. Recently released guidance into the design, operation and reporting of marine pest monitoring within Australia has been published by the Australian Government Department of Agriculture Fisheries and Forestry. Documents include the Australian Marine Pest Monitoring Guidelines and Australian Pest Monitoring Manual. Gulf Alumina will follow these documents in establishing a practical monitoring, management and reporting program for introduced marine pests.

The National System for the Prevention and Management of Marine Pest Incursions provides guidance regarding port operations and use of non-trading vessels on projects. The 'National bio fouling management guidance for non-trading vessels' is a voluntary guidance document which demonstrates attention to techniques to minimise risks of marine pest relocation. The guidance provides practical recommendations on managing bio fouling on hulls and niche areas. Prior to arrival on site marine vessels and plant will undergo inspection as per this guidance documentation.

The risk of introducing marine pest species as part of the proposed operations is considered small, owing to the existing management controls regarding ballast water, and proposed offshore transhipment operations (i.e. limiting possible access to more complex inshore habitats). Where equipment is brought in from other ports, a process of inspection and pre-clearance would be undertaken before being brought into the operational fleet on the Skardon River.
During the construction process marine equipment will be transported from various other ports, either nationally or internationally. Guidelines outline a process for inspecting and approving marine plant and equipment for use on-site. Gulf Alumina would follow this process.

The Project may have indirect beneficial impacts on turtles through pest control, especially pigs and potentially assisting in the management of ghost nets on nearby beaches.

The proposed Ship-sourced Pollution Prevention Management Plan is provided in Chapter 22 and describes management of:

- release of ballast water and introduction of exotic marine organisms
- release of shipping waste
- spills
- ship sourced pollution

18.10.9 Workforce Management, Environmental Training and Community Support

Environmental awareness and induction training will be provided to all staff. All contractors and staff will be trained in marine species awareness and to understand the marine vessel access and speed plan and how it influences their operations. All contractors will be trained in the risks of marine pest incursions. Specific pest species awareness information will be provided to marine operations services. All contractors and staff are to be trained in marine water quality pollution prevention and spill response. Specific education and training will be provided also for significant marine species.

No recreational fishing by the workforce will be allowed from Project operational areas.

Access will be restricted to important migratory shorebird feeding and roosting areas and beach nesting areas within Skardon River during October to March, to minimise disturbance to shorebirds and nesting little terns and beach stone-curlews. An education program for workforce members regarding the importance of these areas and the need for disturbance to be minimised, will be implemented.

Workers will be transported to site by air and will therefore not have their own vehicles on site. Access to turtle nesting beaches from the mining leases is not practical, other than in a four wheel drive vehicle. Workers will not be allowed to use mine site vehicles for off tenement recreational activities.

However, once workers have returned to their place of residence (e.g. Cairns or Weipa) at the end of their shifts, they are members of the general public and hence have the same rights of access to Skardon River beaches as other members of public. As stated in Chapter 11, public access to the beaches at Skardon River is controlled by Traditional Owners through a permit system.

Gulf Alumina will develop a Foreshore Management Plan that incorporates the controls on workforce movement described above and:

- consultation with EHP, traditional owners and the Western Cape Communities Coordinating Committee (WCCCC)
- protection and management of turtle nesting areas are in partnership with the traditional owners.

Recreational fishing by Project workers will not be allowed.

Gulf Alumina would support fisheries research for target species within the Skardon River. Of interest to the Project is the determination of presence/absence, life history, and a defined spatial and temporal utilisation of the system. With these basic data sources, Gulf Alumina can best manage operations to facilitate avoidance and minimise interaction where it is unavoidable, if these species are present.
Gulf Aluma will consider funding the preparation of signage at the nearby township of Mapoon and the entrance to the Skardon River advising local and visiting fishers of the conservation significance of these fauna.

Gulf Aluma will discuss (likely with Land and Sea Rangers) logistical support and funding for management of the beach to allow the removal of ghost nets from beach areas. Gulf Aluma proposes feral pig control, as described in Chapter 15.

18.10.10 Species Management

18.10.10.1 Turtles

Gulf Aluma will develop a turtle species management program (Turtle SMP) for Project activities with the potential to impact turtles, in consultation with EHP, Traditional owners, and the Australian Government Department of the Environment. The actions of the Turtle SMP will coordinate with other programs being implemented on Cape York Peninsula. The Turtle SMP, its outcomes and progress will be published on the Project website to ensure full disclosure and information sharing with TOs, the broader community and government. Gulf Aluma will seek to involve Indigenous Rangers and Traditional Owners (TOs) in the implementation of the Turtle SMP.

18.10.10.2 Sawfish and Speartooth Shark

Mitigation and management measures are described above. Those relevant to sawfish and the speartooth shark are provided below:

- Gulf Aluma have proposed environmental awareness training and a no fishing policy for all staff and contractors within the Skardon River and immediate offshore areas.
- The proposed design of the Port infrastructure has adopted minimal impact construction methodologies utilising pile and gantry techniques. This will reduce and eliminate impacts to intertidal habitats.
- Propeller wash identified as a potential impact to substrates within the channel. Operations will target high water windows, wherever possible, as impacts are reduced or avoided at high water levels.
- Active monitoring and reporting processes to define changes to baseline water quality conditions will be undertaken and this information used into operational processes where scope to reduce interactions is possible.
- Vessel wake waves will be controlled by incorporating the results of modelling into established speed limits for large vessel.
- The Project will shut down in the wet season, avoiding potential access conflict for adults returning to the estuary to pup (if they utilise this river system). The program of construction will target the dry season, and be completed over a period of approximately 4 months. This timing will assist in minimising interactions with marine fauna such as the sawfishes and speartooth shark, which potentially may access the estuary system for pupping between the late dry/early wet season and through the wet season.
- Barge and vessel operational areas and speeds will be strictly controlled.
- Gulf Aluma propose to contribute to the removal of marine debris from the environment and maintain a record of the type, time and location of material removal. All waste from shipping and marine operations will be disposed on land to defined waste management systems.
- Gulf Aluma would support fisheries research for target species within the Skardon River.
18.10.11 Monitoring

Appendix 8 provides a detailed marine monitoring plan for the Skardon River and offshore area, which describes the following:

- water quality monitoring to establish baseline water quality and set site specific water quality objectives in accordance with QWQG for HEV waters for different estuary zones in the Skardon River, open coastal waters and offshore waters
- water quality monitoring during construction of the wharf
- water quality monitoring during bed levelling
- water quality during operations along the navigation channel / barge route for changes in water quality resulting from propeller wash
- water quality monitoring in the River near Port sediment pond release zones
- sediment quality monitoring in the Skardon River and offshore
- vessel wake wave monitoring comprising wave monitoring and river bank monitoring
- monitoring of propeller wash impacts
- seagrass monitoring, primarily near the Port infrastructure area
- mangrove monitoring near the Port infrastructure area
- marine pest monitoring.

Monitoring of the physical marine environment (i.e. water quality, sediment quality, vessel wake waves and propeller wash imagery) is described in Chapter 17. Physical marine environment monitoring will be used as a potential predictor of impacts to marine habitats and species.

18.10.11.1 Fauna Monitoring

Observations of marine fauna will be recorded (including species and location). Incidences of direct interaction such as vessel strike, or near vessel strike will be reported. Observations by a suitably trained operator will be conducted during piling works. Observations of marine fauna will be recorded in a database during construction and operations.

Monitoring of fauna near Project activity areas, particularly the Port area, will provide information as to whether any of these light spill mitigation measures should be implemented.

Underwater noise monitoring will be undertaken during pile driving to ensure adopted noise criteria remain applicable with regards to exclusion distances (i.e. if site based noises records are lower than adopted thresholds, the exclusion zone for operation would be reduced, if they are greater than predicted, extension to the exclusion zone would be undertaken.

18.10.11.2 Seagrass Monitoring

Water quality and sediment sampling within and near seagrass beds is described in Chapter 17.

Monitoring will be undertaken so as to define the extent of seagrass in the immediate study area, its condition and density. Biomass of the beds will be determined by collecting and recorded dry weight mass. This will provide a comparative review to previous government surveys and as a quantitative measure of productivity over the longer term. Water quality loggers will be integrated into data analysis. Video transects and deployed still imagery systems (in conjunction with deposition loggers, PAR, etc) will capture detailed descriptions of sedimentation and deposition processes. Data that will be collected includes:

- density of seagrass beds
- dry weight biomass
spatial distribution mapping

Side scan sonar and low tide intertidal survey will provide detailed mapping of seagrass distributions. Video and still image interpretations will allow density measurements and physical grab samples within meadows (comparative grab sample sizes) will be used to assess dry weight biomass.

Seagrass monitoring locations will include locations near the proposed wharf and within a small bed in the lower estuary.

A late dry season survey will be undertaken prior to operations. This would ensure maximum potential distribution and density is encountered. Water quality will also be recorded. Prior to construction, inspection for seagrass within the proposed wharf footprint will also be undertaken as a pre clearance survey.

During construction there are limited processes which could impact seagrass beds (at their closest they are approximately 230 m from the construction area). Deployed water quality loggers will provide continuous monitoring within these habitats during construction. Data downloads and analysis of results will provide indications of potential impacts to seagrasses due to deposition or benthic light changes. Field surveys will be undertaken should water quality data indicate a potential for impact. Periodic video inspection and still imagery will be collected from the seagrass beds.

Should seagrasses be present in the Project footprint, offsets will be proposed for significant residual impacts in accordance with the State environmental offsets framework.

Annual seagrass monitoring will occur for three years before consideration as to ongoing programs.

Seagrass surveys will be used to:

- define the extent, density and biomass of the seagrass beds.
- define habitat water quality criteria for turbidity, deposition and benthic light for application to management response during construction.
- monitor for potential impacts during construction and, if identified, silt curtains may be used to screen the habitat areas from impact or alternative impact reduction measures will be implemented.
- define the ecological response of seagrass to potential propeller wash adjacent to the wharf, with data used to consider vessel management and speed limit plans.

18.10.11.3 Mangroves

Gulf Alumina would conduct a pre-clearance survey over mangrove habitats which exist within and adjacent to the proposed development footprint. Definition of clearing and trimming areas will be prepared as a site plan.

Mangrove habitat condition will be surveyed in areas potentially impacted by releases from the proposed Port sediment pond. Baseline surveys at 2 sites will be conducted prior to operations. Should water quality release criteria be exceeded during releases (refer to monitoring plan in Chapter 17), additional mangrove surveys (at between 2 and 5 sites) will be conducted including:

- seedling density
- sediment quality
- water quality
- tree diameter (marked trees)
- epiphytic algae cover
- health (leaves, insect attack)
• macro fauna abundance
• video assessment, photo quadrats/photo points.

Should sediment pond releases impact in mangrove health management actions may include amending release criteria and release operations, and / or engineering design changes to Port sediment ponds.

Mangrove health surveys will also be conducted in conjunction with vessel wake wave monitoring (Chapter 17) to identify any changes in health as a result of vessel wake waves.

18.10.11.4 Offshore Transhipment Area

Detailed preclearance surveys of the offshore transhipment area will be undertaken using side scan sonar and video to ensure higher density habitats are avoided. Monitoring of sediments undertaken (Chapter 17) will be undertaken.

18.10.11.5 Marine Pests

Recently released guidance into the design, operation and reporting of marine pest monitoring within Australia has been published by the Australian Government Department of Agriculture Fisheries and Forestry. Documents include the Australian Marine Pest Monitoring Guidelines and Australian Pest Monitoring Manual. Gulf Alumina will follow these documents in establishing a practical monitoring, management and reporting program for introduced marine pests.

Detailed marine pest survey were undertaken in the Skardon River during 2008 and 2011. The data from these surveys will be used to describe present unimpacted conditions. Baseline data collection may also be collected from the offshore transhipment area prior to operations.

A marine pest monitoring program and management plan will be developed. This will be accredited, as required, by the relevant government agency. Construction vessels and barges will be inspected prior to use in the Skardon River. Incoming plant and equipment involved in marine works with the potential for biofouling will be required to meet accepted standards prior to arrival on-site. Evidence of vessel and marine plant inspection in accordance with the biofouling management guidelines will be provided prior to site access being granted by Gulf Alumina.

In combination with a regular (e.g. every 5 years) program of monitoring following national guidelines, the impact from invasive marine species introduction is considered minor. Introduced species monitoring program will be developed in discussion with Ports North.

18.11 MNES Significant Impact Assessment

In determining whether there are significant residual (post mitigation) impacts to MNES the assessment:

• firstly considers whether there are any listed species or ecosystems (identified during desktop review or field surveys) that are known or likely to occur
• secondly, uses the EPBC Act Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (DoE, 2013) to assess, for those listed species or ecosystems identified, whether impacts are significant.

Listed species or ecosystems that are unlikely to occur are not considered to be significantly impacted by the Project.

18.11.1 Commonwealth Marine Areas

An assessment of the likelihood of significant impacts on the Commonwealth Marine Area is provided in Table 18-5. The Project is not expected to have a significant impact on Commonwealth Marine Areas.
### Table 18-5  Commonwealth Marine Areas – Assessment of Significant Impact

<table>
<thead>
<tr>
<th>Impact criteria</th>
<th>Significant Impact</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Result in a known or potential pest species becoming established in the</td>
<td>No</td>
<td>Port developments at Weipa have not been implicated in the introduction of invasive species, and these developments are at a larger scale than that proposed for the Skardon River Bauxite Project. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species. Barges proposed for use are designed to operate with minimum ballast and where ballast is required fresh water will be used thus eliminating the risk of introduction or translocation of invasive species. In an exceptional circumstance where marine water was required for barge ballast, it would be from the local environment and retained onboard for the minimum time to ensure risk was negated. Introduced pest monitoring has been conducted from the Skardon River since 2008 (again in 2011). No evidence of marine pest introduction has been recorded. Monitoring is proposed to continue as part of operational requirements for this Project.</td>
</tr>
<tr>
<td>Commonwealth marine area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modify, destroy, fragment, isolate or disturb an important or substantial area of</td>
<td>No</td>
<td>The transhipping and bulk vessel components of the Project will not result in habitat impacts that will adversely impact the functioning or integrity of the Commonwealth marine area. The benthic habitats have been inspected, and determined to be dominated by sandy substrate with a low live cover. Scattered benthic biota has been recorded, but is well represented in adjacent areas. Given the shallow waters (~2m under keel clearance once loaded), some impact to the benthic community may be expected from propeller wash as the vessel leaves to join the adjacent shipping lanes. This impact would be located within the nominated transhipment area. Effects of disturbance within at any location within the transhipment area may last approximately 10 min as the vessel departs. Such processes are localised and would not result in an impact which would affect ecosystem functioning or integrity of the Commonwealth marine area.</td>
</tr>
<tr>
<td>habitat such that an adverse impact on marine ecosystem functioning or integrity in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a Commonwealth marine area results</td>
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</tbody>
</table>
### Impact criteria

<table>
<thead>
<tr>
<th>Impact criteria</th>
<th>Significant Impact Likely (Y/N)</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution</td>
<td>No</td>
<td>The potential impacts on marine species of conservation significance (including cetaceans) have been assessed elsewhere in this report. No significant adverse impacts are likely to occur.</td>
</tr>
<tr>
<td>Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity; social amenity or human health</td>
<td>No</td>
<td>The proposed Project will not result in substantial changes to air or water quality. Runoff from disturbed areas will be managed to minimise sediment release to the marine environment. The barge designs proposed for use mitigate against oil spills in the unlikely event of a collision. Barging operations and bulk carriers will locally disturb sediments during their passage to and from the transhipment area. However, water quality impacts modelled within the Skardon River indicate concentrations would remain at or below recorded dry season turbidity and TSS levels.</td>
</tr>
<tr>
<td>Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected</td>
<td>No</td>
<td>The proposed Project will not result in the introduction of persistent organic chemicals, heavy metals or other potentially harmful chemicals in the marine environment. Management measures such as bunding of hydrocarbon storage areas, and design measures and operational procedures for fuel transfer, are proposed to minimise risk of release of contaminants. Regular water quality and sediment quality investigations are proposed as indicators of potential contamination processes. Within the Commonwealth waters the Project activities are related to shipping. All shipping activities will be undertaken in accordance with MARPOL. Hydrocarbon storage is undertaken onshore, 20-30 km from the proposed transhipment area. Local spill response resources will be made available at the Skardon River site given its remote nature to enact response in the unlikely occurrence of a spill response being required.</td>
</tr>
<tr>
<td>Have a substantial adverse impact on heritage values of the Commonwealth marine</td>
<td>No</td>
<td>There are no examples of heritage values (including shipwrecks) in the Commonwealth.</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>GulfAlumina</th>
<th>Skardon River Bauxite Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 18</td>
<td>Marine Ecology</td>
</tr>
</tbody>
</table>

Page 18-55
18.11.2 Turtles

An assessment of the significance of impacts, in accordance with the Commonwealths Significant Impact Guidelines, is provided in:

- Table 18-6 for the flatback turtle
- Table 18-7 for the loggerhead turtle
- Table 18-8 for the green turtle
- Table 18-9 for the hawksbill turtle
- Table 18-10 for the olive Ridley turtle

The assessments demonstrate that the Project will not have a significant impact on listed turtle species.

<table>
<thead>
<tr>
<th>Impact criteria</th>
<th>Significant Impact Likely (Y/N)</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>area, including damage or destruction of an historic shipwreck</td>
<td></td>
<td>marine area at or adjacent to the proposed Project activities.</td>
</tr>
<tr>
<td>Impact Criteria</td>
<td>Significant Impact Likely (Y/N)</td>
<td>Justification</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Lead to a long-term decrease in the size of a population</td>
<td>No</td>
<td>The Project is not of a nature or scale that could plausibly lead to a long term decrease in the size of the flatback turtle population.</td>
</tr>
<tr>
<td>Reduce the area of occupancy of an important population</td>
<td>No</td>
<td>The flatback turtle has an extremely large area of occupancy and the Project will not plausibly reduce this area of occupancy in any meaningful or measurable way.</td>
</tr>
<tr>
<td>Fragment an existing population into two or more populations</td>
<td>No</td>
<td>The Project contains no components that could plausibly fragment the existing populations of flatback turtles.</td>
</tr>
<tr>
<td>Adversely affect habitat critical to the survival of a species</td>
<td>No</td>
<td>The Project will not remove habitat that is potentially used as foraging habitat by flatback turtles. Based on the current state of knowledge, no Biologically Important Areas (BIA) have been identified for the flatback turtle in the region.</td>
</tr>
<tr>
<td>Disrupt the breeding cycle of an important population</td>
<td>No</td>
<td>Lighting has the potential to disrupt the nesting activities of marine turtles. The mining and Port operations are sufficiently inland (~ 10 km) away from beach nesting areas and buffered by extensive native vegetation to the extent that light spill from mining operations is highly unlikely to be an impacting process. The nesting beaches themselves are located approximately 3km to 8km east of the mining areas and the beaches will not be traversed during construction or operation of the mine. Staff or contractors will not be permitted to camp on beaches. Vessel operations will incorporate the usage of turtle friendly lighting.</td>
</tr>
<tr>
<td>Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.</td>
<td>No</td>
<td>The Project will not modify, destroy, isolate or decrease the quality of the habitat to the extent that any decline in the species will occur. Predicted benthic impact to seagrass and biota within the channel alignment would be locally insignificant.</td>
</tr>
<tr>
<td>Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species’ habitat.</td>
<td>No</td>
<td>Port projects including those of a larger scale, and in areas adjacent to nesting areas (e.g. central Queensland), have not been implicated in the introduction of invasive species that are harmful to the species. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species. Barges proposed for use are designed to operate with minimum ballast and where ballast is required locally.</td>
</tr>
</tbody>
</table>
Impact Criteria | Significant Impact Likely (Y/N) | Justification
--- | --- | ---
Introduce disease that may cause the species to decline | No | Port projects including those of a larger scale, and in areas adjacent to nesting areas where the abundance of flat back turtles is relatively high (e.g. central Queensland), have not been implicated in the introduction of disease. The Project will not plausibly introduce disease that may cause the population of flat back turtles to decline.

Interfere substantially with the recovery of the species. | No | The nature and scale of the Project will not plausibly interfere with the recovery of the species as outlined in the national Marine Turtle Recovery Plan. The proposed implementation of feral animal control and logistical support or funding of a marine debris clean-up program will assist recovery potential for the region.

**Table 18-7  Loggerhead Turtles - Assessment of Significant Impact**

<table>
<thead>
<tr>
<th>Impact Criteria</th>
<th>Significant Impact Likely (Y/N)</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead to a long-term decrease in the size of a population</td>
<td>No</td>
<td>The Project is not at a nature, scale or location that could plausibly lead to a long-term decrease in the size of a population</td>
</tr>
<tr>
<td>Reduce the area of occupancy of the species</td>
<td>No</td>
<td>The loggerhead turtle has a global distribution throughout tropical, sub-tropical and temperate waters. The spatial scale of the Project is insignificant with respect to the area of occupancy of the species.</td>
</tr>
<tr>
<td>Fragment an existing population into two or more populations</td>
<td>No</td>
<td>The proposed activity does not feasibly create a barrier to movement either directly or indirectly.</td>
</tr>
<tr>
<td>Adversely affect habitat critical to the survival of a species</td>
<td>No</td>
<td>Based on the current state of knowledge, no Biologically Important Areas (BIA) have been identified for the loggerhead turtle at or adjacent to the proposed Project location.</td>
</tr>
<tr>
<td>Disrupt the breeding cycle of a population</td>
<td>No</td>
<td>There is no nesting of loggerhead turtles in the region.</td>
</tr>
</tbody>
</table>
Impact Criteria | Significant Impact Likely (Y/N) | Justification
--- | --- | ---
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. | No | The Project will not modify, destroy, isolate or decrease the quality of the habitat to the extent that any decline in the species will occur.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species’ habitat. | No | Port projects including those of a larger scale, and in areas adjacent to nesting areas where the abundance of loggerhead turtles is relatively high (e.g. central Queensland), have not been implicated in the introduction of invasive species that are harmful to the species. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species. Barges proposed for use are designed to operate with minimum ballast and where ballast is required locally sourced water will be used thus eliminating the risk of introduction or translocation of invasive species.

Introduce disease that may cause the species to decline | No | Port projects including those of a larger scale, and in areas adjacent to nesting areas have not been implicated in the introduction of disease harmful to the species. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species (including disease).

Interfere with the recovery of the species. | No | The nature and scale of the Project will not plausibly interfere with the recovery of the species as outlined in the national Marine Turtle Recovery Plan.

Table 18-8 Green Turtles - Assessment of Significant Impact

| Impact Criteria | Significant Impact Likely (Y/N) | Justification |
--- | --- | ---
Lead to a long-term decrease in the size of a population | No | The Project is not of a nature, scale or location that could plausibly lead to a long term decrease in the size of the green turtle population.

Reduce the area of occupancy of an important population | No | The green turtle has an extremely large (circumglobal) area of occupancy and the Project will not plausibly reduce this area of occupancy in any meaningful or measurable way.
<table>
<thead>
<tr>
<th>Impact Criteria</th>
<th>Significant Impact Likely (Y/N)</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fragment an existing population into two or more populations</td>
<td>No</td>
<td>The Project contains no components that could plausibly fragment the existing populations of green turtles.</td>
</tr>
<tr>
<td>Adversely affect habitat critical to the survival of a species</td>
<td>No</td>
<td>Based on the current state of knowledge, no Biologically Important Areas (BIA) have been identified for the green turtle at or adjacent to the proposed Project location.</td>
</tr>
<tr>
<td>Disrupt the breeding cycle of an important population</td>
<td>No</td>
<td>There is no nesting of green turtles in the region.</td>
</tr>
<tr>
<td>Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.</td>
<td>No</td>
<td>High quality habitat (seagrass) for green turtles is absent at and adjacent to the proposed Project location. The area is to be modified (but not removed) by the construction of barge loading facilities. The available seagrasses do not constitute important foraging habitat for green turtles.</td>
</tr>
<tr>
<td>Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species’ habitat.</td>
<td>No</td>
<td>Port projects including those of a larger scale, and in areas adjacent to nesting areas (e.g. central Queensland), have not been implicated in the introduction of invasive species that are harmful to the species. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species. Barges proposed for use are designed to operate with minimum ballast and where ballast is required locally sourced water will be used thus eliminating the risk of introduction or translocation of invasive species.</td>
</tr>
<tr>
<td>Introduce disease that may cause the species to decline</td>
<td>No</td>
<td>Port projects including those of a larger scale, and in areas adjacent to nesting areas (e.g. central Queensland), have not been implicated in the introduction of disease harmful to the species. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species (including disease).</td>
</tr>
<tr>
<td>Interfere substantially with the recovery of the species.</td>
<td>No</td>
<td>The nature and scale of the Project will not plausibly interfere with the recovery of the species as outlined in the national Marine Turtle Recovery Plan. The proposed implementation of feral animal control and logistical support or funding of a marine debris clean-up program will assist recovery potential for the region.</td>
</tr>
</tbody>
</table>

Table 18-9 Hawksbill Turtles - Assessment of Significant Impact
<table>
<thead>
<tr>
<th>Impact Criteria</th>
<th>Significant Impact Likely (Y/N)</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead to a long-term decrease in the size of a population</td>
<td>No</td>
<td>The Project is not of a nature, scale or location that could plausibly lead to a long term decrease in the size of the hawksbill turtle population.</td>
</tr>
<tr>
<td>Reduce the area of occupancy of an important population</td>
<td>No</td>
<td>The hawksbill turtle has an extremely large area of occupancy and the Project will not plausibly reduce this area of occupancy in any meaningful or measurable way.</td>
</tr>
<tr>
<td>Fragment an existing population into two or more populations</td>
<td>No</td>
<td>The Project contains no components that could plausibly fragment the existing populations of hawksbill turtles.</td>
</tr>
<tr>
<td>Adversely affect habitat critical to the survival of a species</td>
<td>No</td>
<td>Based on the current state of knowledge, no Biologically Important Areas (BIA) have been identified for the hawksbill turtle at or adjacent to the proposed Project location.</td>
</tr>
<tr>
<td>Disrupt the breeding cycle of an important population</td>
<td>No</td>
<td>Lighting has the potential to disrupt the nesting activities of marine turtles. The mining operations are sufficiently inland (~ 10 km) away from beach nesting areas and buffered by extensive native vegetation to the extent that light spill from mining and Port operations is highly unlikely to be an impacting process. The nesting beaches themselves are located approximately 3km to 8km east of the mining areas and the beaches will not be traversed during construction or operation of the mine. Staff or contractors will not be permitted to camp on beaches. A contingency plan to reduce light spill will be implemented should it be deemed necessary.</td>
</tr>
<tr>
<td>Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.</td>
<td>No</td>
<td>The Project will not modify, destroy or decrease habitat through that is potentially used as foraging by hawksbill turtles. Given the available foraging area for the species in the Gulf of Carpentaria, the nature and scale of the disturbance will not isolate or decrease the quality of the habitat to the extent that any decline in the species will occur.</td>
</tr>
<tr>
<td>Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species’ habitat.</td>
<td>No</td>
<td>Port projects including those of a larger scale, have not been implicated in the introduction of invasive species that are harmful to the species. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species. Barges proposed for use are designed to operate with minimum ballast and where ballast is required locally sourced water will be used thus eliminating the risk of introduction or translocation of invasive species.</td>
</tr>
</tbody>
</table>
### Impact Criteria

<table>
<thead>
<tr>
<th>Impact Criteria</th>
<th>Significant Impact Likely (Y/N)</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduce disease that may cause the species to decline</td>
<td>No</td>
<td>Port projects including those of a larger scale, and in areas adjacent to nesting areas have not been implicated in the introduction of disease harmful to the species. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species (including disease).</td>
</tr>
<tr>
<td>Interfere substantially with the recovery of the species.</td>
<td>No</td>
<td>The nature and scale of the Project will not plausibly interfere with the recovery of the species as outlined in the national Marine Turtle Recovery Plan. The proposed implementation of feral animal control and logistical support or funding of a marine debris clean-up program will assist recovery potential for the region.</td>
</tr>
</tbody>
</table>

#### Table 18-10 Olive Ridley Turtles - Assessment of Significant Impact

<table>
<thead>
<tr>
<th>Impact Criteria</th>
<th>Significant Impact Likely (Y/N)</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead to a long-term decrease in the size of a population</td>
<td>No</td>
<td>The Project is not at a nature or scale that could plausibly lead to a long-term decrease in the size of a population.</td>
</tr>
<tr>
<td>Reduce the area of occupancy of the species</td>
<td>No</td>
<td>The olive Ridley turtle has a circumtropical distribution throughout tropical, sub-tropical and temperate waters. The spatial scale of the Project is insignificant with respect to the area of occupancy of the species.</td>
</tr>
<tr>
<td>Fragment an existing population into two or more populations</td>
<td>No</td>
<td>The proposed activity does not feasibly create a barrier to movement either directly or indirectly.</td>
</tr>
<tr>
<td>Adversely affect habitat critical to the survival of a species</td>
<td>No</td>
<td>Based on the current state of knowledge, no Biologically Important Areas (BIA) have been identified for the loggerhead turtle at or adjacent to the proposed Project location.</td>
</tr>
<tr>
<td>Disrupt the breeding cycle of a population</td>
<td>No</td>
<td>Lighting has the potential to disrupt the nesting activities of marine turtles. The mining operations are sufficiently inland (~ 10 km) away from beach nesting areas and buffered by extensive native vegetation to the extent that light spill from mining and Port operations is highly unlikely to be an impacting process. The nesting beaches themselves are located approximately 3km to 8km east of the mining areas and the beaches will not be traversed during construction or operation of the mine. Staff or</td>
</tr>
<tr>
<td>Impact Criteria</td>
<td>Significant Impact Likely (Y/N)</td>
<td>Justification</td>
</tr>
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<td>--------------------------------------------------------------------------------</td>
<td>---------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Modify, destroy, remove, isolate or decrease the availability or quality of</td>
<td>No</td>
<td>The Project will not modify, remove or destroy habitat that is potentially used as foraging by olive Ridley turtles.</td>
</tr>
<tr>
<td>habitat to the extent that the species is likely to decline.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Result in invasive species that are harmful to a critically endangered or</td>
<td>No</td>
<td>Port Projects, including those of larger scale have not been implicated in the introduction of invasive species, and these developments are at a larger scale than that proposed for the Skardon River Bauxite Project. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species. Barges proposed for use are designed to operate with minimum ballast and where ballast is required locally sourced water will be used thus eliminating the risk of introduction or translocation of invasive species.</td>
</tr>
<tr>
<td>endangered or endangered species becoming established in the endangered or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>critically endangered species’ habitat.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduce disease that may cause the species to decline</td>
<td>No</td>
<td>Port projects including those of a larger scale, and in areas adjacent to nesting areas have not been implicated in the introduction of disease harmful to the species. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species (including disease). The Project will not plausibly introduce disease that may cause the population of olive Ridley turtles to decline.</td>
</tr>
<tr>
<td>Interfere with the recovery of the species.</td>
<td>No</td>
<td>The nature and scale of the Project will not plausibly interfere with the recovery of the species as outlined in the national Marine Turtle Recovery Plan. The proposed implementation of feral animal control and logistical support or funding of a marine debris clean-up program will assist recovery potential for the region.</td>
</tr>
</tbody>
</table>

### 18.11.3 Cetaceans

The five cetacean species (all dolphins) known or likely to occur in the Project area are not listed species (refer Table 18-2). A precautionary approach has used in assessing significance of impacts by utilising the assessment criteria applicable to endangered species. All five species have been considered together. As shown in Table 18-11, the Project will not have a significant impact on these five dolphin species.
Table 18-11  Five Dolphin Species Likely to Occur - Assessment of Significant Impact

<table>
<thead>
<tr>
<th>Impact Criteria</th>
<th>Significant Impact Likely (Y/N)</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead to a long-term decrease in the size of a population</td>
<td>No</td>
<td>The Project is highly unlikely to lead to a long term decrease in the size of any population of cetacean.</td>
</tr>
<tr>
<td>Reduce the area of occupancy of the species</td>
<td>No</td>
<td>There are uncertainties regarding the area of occupancy in the Gulf of Carpentaria of the five dolphin species. However, there is no available information which identifies that the proposed Project location is an important area for dolphins. The scale of the Project is small relative to available habitat that may be occupied by the species.</td>
</tr>
<tr>
<td>Fragment an existing population into two or more populations</td>
<td>No</td>
<td>The proposed activity does not feasibly create a barrier to movement either directly or indirectly. The available information from areas including Cleveland Bay and Moreton Bay where port developments are extensive and vessel movements are substantial, demonstrate that populations do not fragment in response to this type of disturbance, even when it is of a scale and intensity much greater than proposed in this Project.</td>
</tr>
<tr>
<td>Adversely affect habitat critical to the survival of a species</td>
<td>No</td>
<td>Based on the current state of knowledge, no Biologically Important Areas (BIA) have been identified for the dolphin species at or adjacent to the proposed Project location.</td>
</tr>
<tr>
<td>Disrupt the breeding cycle of a population</td>
<td>No</td>
<td>The Project is highly unlikely to disrupt the breeding cycle for the dolphin species considered.</td>
</tr>
<tr>
<td>Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.</td>
<td>No</td>
<td>The Project will potentially modify (but not remove) habitat through vessel anchorage that is potentially used as foraging habitat by dolphin species. This habitat though is not critical habitat.</td>
</tr>
<tr>
<td>Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species’ habitat.</td>
<td>No</td>
<td>Port developments at Weipa have not been implicated in the introduction of invasive species, and these developments are at a larger scale than that proposed for the Project. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species. Barges proposed for use are designed to operate with minimum ballast and where ballast is required fresh water will be used thus eliminating the risk of introduction or translocation of invasive species. In an exceptional circumstance where marine water was required for barge ballast, it...</td>
</tr>
</tbody>
</table>
Impact Criteria | Significant Impact Likely (Y/N) | Justification |
--- | --- | ---
Introduce disease that may cause the species to decline | No | Port developments at Weipa have not been implicated in the introduction of disease, and these developments are at a larger scale than that proposed for the Skardon River Bauxite Project. Given the proposed controls managing ballast water, the project will not plausibly introduce disease that may cause the population of dolphin species to decline.

Interfere with the recovery of the species. | No | The nature and scale of the Project will not plausibly interfere with the recovery of the species.

18.11.4 Sawfishes and the Speartooth Shark

An assessment of the significance of impacts, in accordance with the Commonwealths Significant Impact Guidelines, is provided in Table 18-12 for sawfishes and the speartooth shark. This assessment demonstrates that the Project will not result in significant impacts to sawfishes and the speartooth shark.

Table 18-12 Sawfishes and the Speartooth Shark - Assessment of Significant Impact

| Impact Criteria | Significant Impact Likely (Y/N) | Justification |
--- | --- | ---
Lead to a long-term decrease in the size of a population | No | The Project is highly unlikely to lead to a long term decrease in the size of any populations of sawfish or speartooth shark. The proposed Project will not plausibly result in the death of any individual animals, and the impacting processes are not of a type or scale where a long-term decrease in the size of the population is plausible.

Fisheries impact are widely considered the key impacting factors influencing populations.

Reduce the area of occupancy of the species | No | The Skardon River is not currently included as part of the published estimate of the area of occupancy of the speartooth shark (Stevens et al., 2005). If the species does occur there, the estimated area of occupancy for the species will increase. The impacting processes that will occur as a result of the proposed Project will not feasibly reduce the area of occupancy. The area of occupancy for the largetooth and green sawfishes is northern Australian waters (north of 20°S). The dwarf sawfish has an area of occupancy from the Gulf of Carpentaria and then across northern Australia and down into the Pilbara region of Western Australia. The
### Impact Criteria

<table>
<thead>
<tr>
<th>Impact Criteria</th>
<th>Significant Impact Likely (Y/N)</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project will not feasibly reduce the area of occupancy of sawfishes.</td>
<td>No</td>
<td>The proposed activity does not feasibly create a barrier to the movement or migration of sawfish or the speartooth shark - either directly or indirectly.</td>
</tr>
<tr>
<td>Fragment an existing population into two or more populations</td>
<td>No</td>
<td>The critical habitat for the survival of the speartooth shark on western Cape York is the Port Musgrave/Ducie River/Wenlock system. Namaleta Creek is located within this region and will receive catchment drainage from the Project site. Critical habitat for the largetooth sawfish are the freshwater areas (including isolated pools) which the species likely uses as a nursery area. Freshwater habitat is also considered important nursery habitat for speartooth sharks. Low potential for limited interaction may be experienced during installation and construction of the upgraded crossing of Namaleta Creek using a culvert system, which will improve access for fish species. This would occur during the dry season construction period, and be completed before the wet season. The culvert system will not alter or preclude flows between freshwater and marine systems. Available information suggests dwarf sawfish use mangrove habitat and shallow waters adjacent to mangroves and such habitat will not be altered to any significant extent by the proposed Project. Available information suggests that the green sawfish prefers the sand and mud flats outside of river mouths, although it does extend into deeper coastal waters. The offshore transhipment operations will not substantially alter habitat such as the shallow sand and mud banks that the green sawfish prefers. The bed levelling process will be conducted over a short duration and influence &lt;1% of the available sandy banks and shoals of the river entrance system.</td>
</tr>
<tr>
<td>Adversely affect habitat critical to the survival of a species</td>
<td>No</td>
<td>The Project is highly unlikely to disrupt the breeding cycle for sawfish or the speartooth shark. For sawfish, pupping occurs during the wet season when construction and operational activities will not occur. Although uncertainties exist, pupping activities of speartooth shark (if they occur at all in the Skardon River) are also likely to principally occur when Project activities are not being undertaken.</td>
</tr>
<tr>
<td>Impact Criteria</td>
<td>Significant Impact Likely (Y/N)</td>
<td>Justification</td>
</tr>
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</tr>
<tr>
<td>Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.</td>
<td>No</td>
<td>The Project will modify (but not remove) habitat through bed levelling activities and the placement of pilings at the barge landing facility. The nature, scale and location of these habitat modifications will not plausibly result in the decline of sawfishes or the speartooth shark. The installation of culverts between the freshwater and estuarine reaches of Namaleta Creek will improve hydrological flows of the area. Connectivity between the freshwater and marine system will not be degraded.</td>
</tr>
<tr>
<td>Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species’ habitat.</td>
<td>No</td>
<td>Port developments at Weipa have not been implicated in the introduction of invasive species, and these developments are at a larger scale than that proposed for the Project. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species. Barges proposed for use are designed to operate with minimum ballast and where ballast is required fresh water will be used thus eliminating the risk of introduction or translocation of invasive species. In an exceptional circumstance where marine water was required for barge ballast, it would be from the local environment and retained onboard for the minimum time to ensure risk was negated.</td>
</tr>
<tr>
<td>Introduce disease that may cause the species to decline</td>
<td>No</td>
<td>Port developments at Weipa have not been implicated in the introduction of disease, and these developments are at a larger scale than that proposed for the Project. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species. Barges proposed for use are designed to operate with minimum ballast and where ballast is required fresh water will be used thus eliminating the risk of introduction or translocation of invasive species. In an exceptional circumstance where marine water was required for barge ballast, it would be from the local environment and retained onboard for the minimum time to ensure risk was negated.</td>
</tr>
<tr>
<td>Interfere with the recovery of the species.</td>
<td>No</td>
<td>The nature and scale of the Project will not plausibly interfere with the recovery of the species. The proposed Project can contribute positively to recovery through active education of staff and contractors of the conservation status and threats to sawfishes and the speartooth shark. Restrictions on fishing and support of research within the study area will contribute to the</td>
</tr>
</tbody>
</table>
### Impact Criteria

<table>
<thead>
<tr>
<th>Impact Criteria</th>
<th>Significant Impact Likely (Y/N)</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>overall management objectives of the draft recovery plan.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 18.11.5 Dugong

An assessment of the significance of impacts, in accordance with the Commonwealths Significant Impact Guidelines, is provided in **Table 18-13** for dugong. This assessment demonstrates that the Project will not result in significant impacts to dugong.

**Table 18-13 Dugong - Assessment of Significant Impact**

<table>
<thead>
<tr>
<th>Impact criteria</th>
<th>Significant Impact Likely (Y/N)</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.</td>
<td>No</td>
<td>The extent of seagrass habitat in the Skardon River is unlikely to be sufficient to support dugong populations. The habitat impacts that will result from the proposed Project will not destroy or isolate an area of important dugong habitat.</td>
</tr>
<tr>
<td>Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.</td>
<td>No</td>
<td>Port developments at Weipa have not been implicated in the introduction of invasive species, and these developments are at a larger scale than that proposed for the Project. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species. Barges proposed for use are designed to operate with minimum ballast and where ballast is required fresh water will be used thus eliminating the risk of introduction or translocation of invasive species. In an exceptional circumstance where marine water was required for barge ballast, it would be from the local environment and retained onboard for the minimum time to ensure risk was negated</td>
</tr>
<tr>
<td>Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.</td>
<td>No</td>
<td>The proposed Project is not in a location that contains habitat suitable to support an ecologically significant dugong population. As such, there is little or no scope for the Project to seriously disrupt the species lifecycle.</td>
</tr>
</tbody>
</table>
18.11.6 Crocodiles

An assessment of the significance of impacts, in accordance with the Commonwealth’s Significant Impact Guidelines, is provided in Table 18-14 for estuarine and freshwater crocodiles. This assessment demonstrates that the Project will not result in significant impacts to crocodiles.
Table 18-14  Crocodiles - Assessment of Significant Impact

<table>
<thead>
<tr>
<th>Impact criteria</th>
<th>Significant Impact Likely (Y/N)</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.</td>
<td>No</td>
<td>While estuarine crocodiles utilise the Skardon River, the proposed Project Port area cannot be considered important habitat. The scale of habitat modification at the Port is not sufficient to alter the carrying capacity of the habitat to the extent that river wide populations of the estuarine crocodile will be impacted. The critical habitat for the estuarine crocodile is the Wenlock River which is not impacted by the proposed Project. Freshwater habitat will not be modified to the extent that freshwater crocodiles will be impacted.</td>
</tr>
<tr>
<td>Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.</td>
<td>No</td>
<td>Port developments at Weipa have not been implicated in the introduction of invasive species, and these developments are at a larger scale than that proposed for the Project. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species.</td>
</tr>
<tr>
<td>Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.</td>
<td>No</td>
<td>The construction and operation of the Project is largely outside of the breeding season for the estuarine crocodile. The proposed Project contains no aspects that will create a barrier to the movement of the estuarine crocodile or alter the foraging of a key population. While the freshwater crocodile breeds during the dry season, no aspects of the Project will create impacts on an ecologically significant population.</td>
</tr>
</tbody>
</table>

18.11.7  Migratory Shorebirds

An assessment of the significance of impacts, in accordance with the Commonwealths Significant Impact Guidelines, is provided in Table 18-15 for migratory shorebirds. This assessment demonstrates that the Project will not result in significant impacts to migratory shorebirds.

Table 18-15  Migratory Shorebirds - Assessment of Significant Impact

<table>
<thead>
<tr>
<th>Impact criteria</th>
<th>Significant Impact Likely (Y/N)</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantially modify (including by fragmenting, altering fire regimes,</td>
<td>No</td>
<td>The scale of habitat modification at the proposed Port area is not sufficient to alter the</td>
</tr>
</tbody>
</table>
Impact criteria | Significant Impact Likely (Y/N) | Justification
--- | --- | ---
altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species. |  | carrying capacity of the habitat to the extent that populations of migratory shorebirds will be impacted. Extensive areas of intertidal habitat and saltmarsh habitat exist within the Skardon River. Operational activities represent <0.1% of the available habitat on the Skardon River.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species. | No | Port developments at Weipa have not been implicated in the introduction of invasive species, and these developments are at a larger scale than that proposed for the Project. Ballast water of vessels in bulk carriers will adhere to relevant national and international standards aimed at preventing the spread of invasive species.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species. | No | The operation of barges within the Skardon River may present some potential for disturbance to utilisation of feeding or roosting habitat at Skardon River entrance and along intertidal mudflats and sand bars within the Skardon River estuary. However, significant habitat areas for migratory shorebirds such as Moreton Bay (Brisbane) and Cleveland Bay (Townsville) demonstrate far greater vessel utilisation and physical disturbances than that proposed on the Skardon River. These locations maintain significant populations of migratory shorebird, and remain as significant habitat for these species.

18.12 MSES Significant Impact Assessment

MSES, and the chapter of the EIS in which an assessment of whether there are significant impacts to MSES, are described in Table 18-16. The Queensland Environmental Offsets Policy Significant Residual Impact Guideline (EHP, December 2014) has been used for guidance in assessing whether there are significant residual impacts to MSES. As noted in this document, the criteria used to assess significance will be considered in the context of each project and should be used as guidance only.

Table 18-16  Chapter of EIS Describing Each MSES

<table>
<thead>
<tr>
<th>MSES</th>
<th>EIS Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endangered regional ecosystem</td>
<td>Chapter 15</td>
</tr>
<tr>
<td>Of concern regional ecosystem</td>
<td>Chapter 15</td>
</tr>
<tr>
<td>Regional ecosystem intersecting with vegetation management wetlands</td>
<td>Chapter 16</td>
</tr>
<tr>
<td>Mapped essential habitat</td>
<td>Chapter 15</td>
</tr>
</tbody>
</table>
### 18.12.1 Habitat for Endangered, Vulnerable or Special Least Concern Marine Animal

**Section 18.8** describes the likelihood of occurrence of endangered and vulnerable marine fauna under the NC Act. There are no special least concern marine fauna species (defined under the Queensland Significant Residual Impact Criteria). Species that are unlikely to occur are not predicted to be experience significant residual impacts from the Project. The endangered and vulnerable NC Act marine fauna species that are known or likely to occur in the Project activity area are:

- Flatback turtle (*Natator depressus*)
- Loggerhead turtle (*Caretta caretta*)
- Green turtle (*Chelonia mydas*)
- Olive Ridley turtle (*Lepidochelys olivacea*)
- Hawksbill turtle (*Eretmochelys imbricata*)
- Estuarine crocodile (*Crocodylus porosus*)
- Dugong (*Dugong dugon*)

All species listed under the NC Act are also listed under the EPBC Act and therefore any assessment of whether there is a significant residual impact to these species under EPBC Act has been undertaken and is presented in **Section 18.11**.
The criteria for assessing significance under the EPBC Act for fauna are effectively the same as the Queensland significant residual impact criteria, and hence the conclusion that there are no significant residual impacts to any these MSES species is unchanged.

18.12.2 Habitat for Near Threatened Animals

Near threatened species are not a MSES. The near threatened marine species that are known or likely to occur in the Project activity area are:

- Indo Pacific humpback dolphin (*Sousa sahulensis*)
- Australian snubfin dolphin (*Orcaella heinsohni*)

An assessment of significance of impact for these species is presented in Section 18.11.3. No significant residual impacts are expected.

18.12.3 Highly Protected Areas of State Marine Parks

There are three state marine parks declared under the *Marine Parks Act 2004*: the Great Barrier Reef Coast Marine Park, the Moreton Bay Marine Park and the Great Sandy Marine Park. There are no declared marine parks under the *Marine Parks Act 2004* in the Gulf of Carpentaria. Given the location of the existing marine parks relative to the proposed Project, no impacts will occur.

18.12.4 Fish Habitat Areas

The nearest declared Fish Habitat Areas to the proposed development are Pine River Bay (adjacent to Weipa) and the Escape River (which drains into Torres Strait. The remoteness of these Fish Habitat Areas to the proposed project (~ 80 km and ~ 100 km respectively) ensures that no impacts will occur.

18.12.5 Marine Plants

Mangrove communities within the proposed conveyor footprint are approximately 300 m². No seagrasses have been confirmed within the development footprint to-date. These estimates will be confirmed during detailed site surveys. The Project is not predicted to have a significant residual impact on marine plants, other than mangroves. The Project is not predicted to have a significant impact on coastal process and the physical marine environment upon which marine plants near the Port area depend.

18.13 Residual Impacts and Offsets

The above assessment demonstrates that there will be no significant residual impacts to marine MNES or MSES from the Project, other than the disturbance of approximately 300 m² of mangroves (MSES) during construction of the conveyor.

Gulf Alumina will consider options for the provision of offsets including financial settlement offsets.

Refer to Chapter 15 and Chapter 16 for consideration of whether there are significant residual impacts on all other MSES (i.e. terrestrial and freshwater aquatic environments).

18.14 Risk Assessment

A risk assessment assessing the likelihood and significance of impacts to marine ecology from the Project is provided in Table 18-17. The risk assessment considers mitigated risk; that is, the impact from the Project with the implementation of management measures. The risks to marine ecology are low to medium.
### Table 18-17  Risk Assessment and Management Measures for Impacts to Marine Ecology

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mangroves and saltmarsh</td>
<td>Refer Section 18.9.1.</td>
<td>Refer Section 18.10</td>
<td>Likely</td>
<td>Minor</td>
<td>Medium</td>
</tr>
<tr>
<td>Seagrasses</td>
<td>Refer Section 18.9.2</td>
<td>Refer Section 18.10</td>
<td>Possible</td>
<td>Minor</td>
<td>Medium</td>
</tr>
<tr>
<td>Benthic habitats</td>
<td>Refer Section 18.9.3</td>
<td>Refer Section 18.10</td>
<td>Possible</td>
<td>Insignificant</td>
<td>Low</td>
</tr>
<tr>
<td>Offshore reefs</td>
<td>Refer Section 18.9.3</td>
<td>None proposed</td>
<td>Rare</td>
<td>Minor</td>
<td>Low</td>
</tr>
<tr>
<td>Marine Turtles</td>
<td>Refer Section 18.9.4</td>
<td>Refer Section 18.10</td>
<td>Possible</td>
<td>Minor</td>
<td>Medium</td>
</tr>
<tr>
<td>Cetaceans</td>
<td>Refer Section 18.9.5</td>
<td>Refer Section 18.10</td>
<td>Possible</td>
<td>Minor</td>
<td>Medium</td>
</tr>
<tr>
<td>Sawfishes and speartooth shark</td>
<td>Refer Section 18.9.6</td>
<td>Refer Section 18.10</td>
<td>Possible</td>
<td>Minor</td>
<td>Medium</td>
</tr>
<tr>
<td>Dugong, crocodile</td>
<td>Refer Section 18.9.7 and 18.9.8</td>
<td>Refer Section 18.10</td>
<td>Possible</td>
<td>Insignificant</td>
<td>Low</td>
</tr>
<tr>
<td>Migratory shorebirds</td>
<td>Refer Section 18.9.9</td>
<td>Refer Section 18.10</td>
<td>Possible</td>
<td>Insignificant</td>
<td>Low</td>
</tr>
<tr>
<td>Marine pests</td>
<td>Refer Section 18.9.10</td>
<td>Refer Section 18.10</td>
<td>Unlikely</td>
<td>Minor</td>
<td>Low</td>
</tr>
<tr>
<td>Commonwealth Marine Areas</td>
<td>Refer Section 18.9.11</td>
<td>Refer Section 18.10</td>
<td>Unlikely</td>
<td>Minor</td>
<td>Low</td>
</tr>
</tbody>
</table>

### 18.15 Cumulative Impacts

The only project considered to have a cumulative impact to marine ecology with the Skardon River Bauxite Project is Metro Mining’s Bauxite Hills project. This project will have similar impacts to the Skardon River Bauxite Project as it will involve Port construction (approximately 1.5 km upstream of the existing Port), mining of bauxite from areas surrounding the Skardon River, barging of bauxite (or barge and tug) and offshore transhipment of bauxite to bulk vessels. The Bauxite Hills project does not propose bed levelling (or other means of increasing the depth of the channel across the ebb bar) and therefore there are no cumulative impacts from bed levelling.

The construction process for both projects is very similar with regards to wharf infrastructure. A short construction period during the dry season is proposed for both projects. This would include pile based construction and an increased vessel traffic for construction and operation. The Bauxite Hills Project is likely to involve greater disturbance of mangrove habitat due to the undisturbed nature of that projects proposed Port infrastructure. Due to separation distance between ports and low potential for simultaneous construction periods, cumulative impacts during construction are likely to be low.
The operational scenario would present a substantial increase in vessel traffic should both projects overlap. To meet the basic annual tonnages and weekly bulk carrier loading targets, up to 100 barge movements would be required within the Skardon River each week (3600 - 4000 movements annually) (in comparison, the Port of Weipa experiences approximately 1000 movements along the channel (in and out) annually. These movements would be accompanied by additional movements associated with fuel and materials supply.

18.15.1 Skardon River

Should both projects occur over the same period, or overlap to some extent the Skardon River would be exposed to significant vessel traffic. The marine ecology impacts associated with such traffic volumes include potential physical disturbance of marine fauna and potential vessel strike.

Gulf Alumina has not identified seagrass within the Project footprint. However, seagrass beds on the opposite bank of the River may be exposed to impact from propeller wash. Metro Mining’s project includes seagrass within and adjacent to the proposed infrastructure in the River. The proximity to seagrasses surrounding the Bauxite Hills project’s facilities is greater than the Skardon River Bauxite Project’s facilities. Direct impacts on mangrove habitat would be significantly greater for the Bauxite Hills project (estimated at 2.2 ha) in comparison to the Skardon River Bauxite Project (0.03 ha).

Cumulative impacts associated with construction may be of greatest concern should pile operations be undertaken together. Additional assessment of noise profiles would be required, and a potential extension of exclusion zones to protect marine fauna.

Lighting from the two projects will result in a cumulative increase in lighting footprints. However, given extensive buffers between nesting beaches from vegetation and topography, the resulting light impacts from proposed mining, Port facility and camp areas will not result in a cumulative lighting impact. Offshore lighting during transshipment may provide a cumulative effect, though over distances between 9 - 15 km, the resulting light impacts are considered minor. Techniques for light spill mitigation may be considered where appropriate. It is expected that mitigation of turtle impact via the selection of appropriate lighting for barges will be proposed by Metro Mining, similar to Gulf Alumina.

The barges exporting bauxite will provide the bulk of vessel movements for both projects. These vessels are relatively large and slow, with both projects expected to operate at approximately 6 knots in the River. At these speeds vessel masters or the marine fauna are thought to have sufficient opportunity to take evasive action to avoid collision, and the likelihood of a substantial increase in vessel strike due to cumulative processes is not a plausible outcome.

The doubling of vessel movements and the doubling of infrastructure footprint would double the potential interaction with significant marine species.

18.15.2 Offshore Transshipment

The proposed offshore transshipment location for both projects are located several kilometers apart, though the passage for vessels exiting the Skardon River for the transshipment area will be relatively similar over most of its length. Bulk carriers will anchor within the transshipment areas and load bauxite from the barges. Gulf Alumina propose the use of self-unloading barges, Metro propose the use of deck cranes.

Potential impacts associated with the transshipment operation include general disturbance to marine fauna and potential vessel strike. Some potential for introduced marine pests has also been identified. Given standard management controls as being applicable for mitigating accidental spills and releases, the primary cumulative impact may be associated with increased fauna disturbance, vessel strike and introduced marine pests.
All bulk carriers engaged in shipment will be required to manage ballast waters as per the relevant Commonwealth standards. The risks of species introductions are thought to be reduced under these protocols. Monitoring programs and periodic inspection of project barges and plant would be undertaken to minimize the risk of translocation from the transshipment area, to more complex habitats within the Skardon River. Given an increase in vessel movements, introduced species management may be considered a cumulative environmental risk factor. Management and monitoring processes would be in place for both projects.

18.15.3 Bulk Carriers

Approximately 140 bulk carriers would be required to service both projects each year. The nearby port of Weipa processes approximately 450-500 bulk carriers annually, exporting some 30 million tons of bauxite. The additional carriers required for the Skardon River Bauxite Project would represent a 10% increase in bulk carrier movements for the local area. A further 10% would be attributable to the proposed Bauxite Hills project.

Given separate transshipment areas, the primary cumulative impacts associated with increasing bulk carrier visitation are propeller wash, vessel navigation and safety and potential for vessel strike.

Outside the existing requirements in place for international trading vessel ballast water management, vessel strike may be considered the greatest potential impact for shipping operations within Commonwealth waters. Actions by the Australian Government to limit impacts from vessel strike will apply to both projects.

18.15.4 Commitments

Gulf Alumina will seek to cooperate and consult with Metro Mining on all aspects of ecological management, including MNES. This will include publication and sharing of data and other information.

The sharing of infrastructure, including Port infrastructure, is subject to commercial arrangements and will be undertaken where this is commercially possible. Gulf Alumina note that Metro Mining are proposing a separate Port area downstream from the existing Port.

As part of the safe and efficient operation of vessels in the Skardon River, vessel management will be subject to the requirements of Maritime Safety Queensland and Ports North. Gulf Alumina will cooperate with these organisations and Metro Mining on vessel operation.

It is expected that both projects will implement similar mitigation measures for ecological impacts (including those to MNES), with vessel speed and access plans being a key mitigation.

Gulf Alumina will adopt strategic and adaptive management approaches for ecological impacts. At a strategic level, Gulf will seek to understand the timing and nature of mitigation measures proposed by Metro Mining and seek to undertake mitigation measures that complement those undertaken by Metro Mining. It is expected that both companies will adopt adaptive management measures and that information will be shared on monitoring and adaptive management to improve ecological outcomes across both projects.

Should offsets be required for both projects, then it is likely that that offsets will be required for impacts to similar ecosystems and species. If commercially viable, and depending on the nature of offsets proposed by each company, then Gulf Alumina will seek to cooperate with Metro Mining on the provision of offsets that maximise ecological benefits.
**18.16 Conclusion**

Surveys and monitoring have been undertaken for marine habitats of the Skardon River and offshore. Desktop reviews have been undertaken for the area potentially impacted by the Project, including published literature by third parties, other environmental studies for the EIS, environmental studies for other projects in the region, and historical data and reports from the Project area.

Marine habitats include mangroves, saltmarshes, seagrass and benthic habitats. The Port infrastructure area is not within a saltmarsh habitat. Apart from 300 m² along the shoreline, mangroves are not present within the proposed Project footprint. The Project wharf options are located between 220 m and 500 m from seagrass habitats, though the existing mapping does not place seagrass within the direct Project footprint. However, conditions within the shallow water fringes along the shorelines have the potential to support seagrass establishment. There are no seagrass habitats in the bed levelling area or in the offshore transhipment area. The majority of subtidal benthic habitats within the Skardon River estuary are dominated by open bare substrates of silt, silty/sand, sand and rock (~77%). The offshore transhipment area is dominated by bare coarse shell and sandy substrates (96%).

There are some small inner reef systems over 6 km from the proposed bed levelling locations. The proposed Project activities will not occur near these offshore reef habitats and modelled sediment plumes from bed levelling are not predicted to impact these reefs.

Of the listed threatened marine fauna species, five turtles, the speartooth shark and three sawfishes were considered likely to occur in the Project activity area. Another eight species listed under the EPBC Act as migratory, marine or whales and other cetaceans (but not EPBC Act listed threatened species) are likely to occur in the Project activity area. Of these EPBC Act migratory, marine or whales and other cetaceans, two are listed as threatened at State level (estuarine crocodile and dugong) and two are listed as near threatened at State Level (Indo Pacific humpback dolphin and Australian snubfin dolphin). In addition, two species groupings (seasnakes and pipefish) listed as marine species are likely to occur in the Project activity area. All other Commonwealth and State listed marine fauna species were considered unlikely to occur.

The Commonwealth marine area stretches from 3 to 200 nautical miles (nm) from the coast. Bed levelling activities occur within coastal waters, approximately 4 km from the coastal waters boundary with the Commonwealth marine waters. Mining and Port activities occur approximately 15 km upstream of Commonwealth marine waters. Activities proposed in the Commonwealth marine area are offshore transhipment of bauxite and bulk vessel movements. The Commonwealth has prepared the Marine Bioregional Plan for the North Marine Region. The 6 conservation values in the Plan are all relevant to the Project, and the listed marine species comprising these conservation values have been assessed. The Project will result in an increase of approximately 3% in the annual number of bulk carriers and supply vessels in the Gulf of Carpentaria.

Potential Project impacts on the marine environment include wharf construction at the Port, Port operations, bed levelling, vessel operations, offshore transhipment and bulk vessel movements. There is no dredging proposed at the Port.

Vessel wake waves predicted to be generated by vessels are small when they reach the shoreline. These waves are therefore not predicted to impact the banks of the Skardon River, including mangrove vegetation.

No significant impacts to saltmarsh, mangrove, seagrasses or other benthic habitats are predicted. There are potential impacts to seagrasses near the wharf from propeller wash during construction and from propeller wash, although seagrasses are adapted to any short duration change in water quality that may result from Project activities. A monitoring program is proposed to determine if the Project is impacting on sensitive marine habitats.
The potential impacts on turtles attributable to lighting are not considered a significant issue given the distance between the nesting beaches and proposed Port activities (10 km) within the upper reaches of the Skardon River. Increased vessel movements within the Skardon River and adjacent coastal regions present the greatest potential for interaction with turtles, though the risks are considered minor given the slow speed of vessel activities and habituation of these species to shipping and Port development.

There is potential for permanent or temporary hearing loss or behavioural responses in cetaceans, dugongs and turtles (to a lesser extent) from underwater piling noise. Therefore underwater noise mitigation measures are proposed during the 2 month piling program. Shipping and vessels pose a potential risk to marine megafauna through collisions and general disturbance. Given the slow speed of vessel (barge) movements within the operational Port limits, vessel strike on cetaceans is not considered a risk requiring specific mitigation.

Sawfishes and the speartooth shark habitats will not be impacted to the extent that recovery of sawfishes and river sharks will be negatively affected and migration of animals will not be impacted.

The primary management and mitigation measures for these impacts are:

- marine vessel operations plan to identify restricted access areas and speed zones
- habitat management, including minimising vegetation clearing and restricted access
- wharf design, using piles, which minimises impacts to the marine environment
- underwater noise mitigation measures for piling (e.g. fauna spotter and soft start)
- compliance with ballast water management regulations and other pollution prevention measures
- monitoring of turbidity, seagrasses, pest species and bank vegetation
- pre-disturbance surveys of the proposed offshore mooring areas.

The EPBC Act Significant Impact Guidelines and the Queensland Environmental Offsets Policy Significant Residual Impact Guideline were used to assess whether the Project would result in significant residual impacts to marine ecology MNES and MSES, and Commonwealth marine areas. These assessments found that there would not be significant residual impacts to marine ecosystems, fauna and flora that are MNES or MSES or to Commonwealth marine areas, except for clearing of mangroves at the Port.