Rio Tinto Alcan

Initial Advice Statement

South of The Embley Project for Rio Tinto Alcan

November 2008

MATRIX CONSULTING

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Rio Tinto Aluminium Limited (RTA) currently undertakes bauxite mining at Weipa in two main areas, East Weipa and Andoom, both north of the Embley River. These reserves are gradually depleting while at the same time international demand for bauxite remains strong.

RTA has undertaken exploration drilling on mining tenements north and south of the Embley River. Resource assessment from the drilling programme has identified significant bauxite reserves that could sustain a mining operation south of the Embley River for about 40 years, depending on annual production rate.

Studies have identified that establishing stand-alone infrastructure to support development of a mine south of the Embley River is the preferred configuration. The proposed project, referred to as the South of the Embley (SoE) Project, consists of the construction and operation of a bauxite mine and associated processing and port facilities. The proposed mine would be capable of producing 50 million dry product tonnes per annum (Mdptpa). The initial phase of mining operations would reach 15 Mdptpa in 2014. Expansion up to 50Mdptpa would be subject to market conditions.

The associated port facilities will accommodate RTA's maximum production capacity of 50Mdptpa, although the initial phase of the port would have a capacity of 30Mdptpa. The port facilities will be designed to provide an option for further future capacity expansion from 50Mdptpa to 63Mdptpa, to accommodate a possible additional 13Mdptpa throughput for third parties use in the event that such agreement is reached with RTA. Likewise, the product stockpile would be capable of expansion by 13Mdptpa by third parties, beyond RTA's maximum requirement of 50Mdptpa. The operational workforce would remain based out of Weipa and would commute to site on a daily basis. The optimum method of commuting workers to site from Weipa is by ferry from a new terminal at Hornibrook Point on the northern bank of the Embley River to a new terminal on the western bank of the Hey River. Roll-on roll-off barge landings would be constructed at Hornibrook Point and on the Hey River to transfer equipment and supplies. An access road of approximately 40km in length would be constructed from the Hey River terminal to the main mine infrastructure area south of Boyd Point.

Establishment of the port facilities at SoE would require the construction of a jetty in marine waters, dredging of berth pockets and departure areas, and disposal of the dredge spoil. It is proposed to dispose of approximately 250,000m^3 dredged spoil from the port at a new ocean disposal ground 15km west of the port.

RTA has valid mining leases (ML7024 granted 1 January 1958) and ML6024 (granted 25 July 1985) from a native title perspective. RTA also has an Indigenous Land Use Agreement (ILUA) which covers RTA's MLs and some adjacent areas, and authorises the Project activities within those areas from a native title perspective. Where any proposed activities are outside the ILUA area, to the extent that native title exists in relation to those areas, RTA intends invoking the relevant process under the *Native Title Act* if applicable.

The proposed Hey River ferry and barge terminal is located within ML6024. With the exception of the Hornibrook Point Ferry/Barge Terminal, all other mine and all associated infrastructure will be located within existing ML7024. These mining leases were granted to RTA under the *Commonwealth Aluminium Corporation Limited Agreement Act 1957* (Agreement Act).

This Initial Advice Statement (IAS) has been prepared to provide details of the Project, the existing environment and the anticipated impacts of the development, in accordance with the requirements of the *State Development and Public Works Organisation Act 1971* (SDPWO Act).

The significance of the SoE Project is indicated by the following figures, which assume an initial minimum production level of 15Mdptpa:

1. employment opportunities – the Project construction would employ up to 350 persons, most likely sourced from eastern Australia. The overall number of direct employees employed in the combined Weipa mine operations north and south of the Embley would increase slightly to 870 persons (of which about 400 would be working on the SoE Project);
2. level of investment – RTA would be required to invest about A$900 million for the construction of the Project;
3. contribution to State – approximately $55million per annum in royalties, payroll tax, stamp duties and other fees and charges would flow to the State from the combined Weipa operations north and south of the Embley;
4. strategic significance – the Project would provide for the long term continuation of mining in the Weipa region and enable continued bauxite supply to major alumina refineries in Queensland;
5. potential environmental effects of the Project – the Project is situated in an area that is relatively undisturbed by mining, agriculture and other development activities. The Project would involve clearing of approximately 400ha per annum of land for mining; and
6. complexity of approvals – both State and Commonwealth approval requirements need to be met.

1 INTRODUCTION

1.1 BACKGROUND

Bauxite has been mined and shipped from the existing Weipa operation since 1963 by Rio Tinto Aluminium (RTA). The Weipa township is situated on the western side of Cape York on the Gulf of Carpentaria in northern Queensland (refer to **Figure 1-1**). Weipa is approximately 700km north-west of Cairns.

Mining at Weipa currently occurs principally at the East Weipa and Andoom mining areas on mining lease (ML) 7024 north of the Embley River. Some ore is also mined from the Ely mining lease (ML7031) . Mined bauxite is trucked to the Lorim Point and Andoom beneficiation plants respectively for processing. Product bauxite is railed from Andoom to Lorim Point and stockpiled with product bauxite from the Lorim Point beneficiation plant. The product bauxite is conveyed to RTA's ship-loading facilities located in the Port of Weipa (refer to **Figure 1-2**).

In response to the gradual depletion of bauxite reserves combined with strong international demand for bauxite, RTA has undertaken extensive drilling programmes on selected unmined areas on ML7024 north and south of the Embley River. Bauxite reserves of 1,224 million tonnes have been found within ML7024, with a considerable proportion of the reserve within the SoE portion of the lease.

RTA is the holder of ML7024 (granted 1 January 1958) and ML6024 (granted 25 July 1985) by virtue of a 'Special Agreement Act' granted by the State Government (*Commonwealth Aluminium Corporation Limited Agreement Act 1957* (Agreement Act)). ML6024 is granted for the purposes of access to ML7024. The current term of ML7024 and ML6024 is until 31 December 2041, however, there is a right of renewal until 31 December 2062.

Due to the Embley River estuary, development of the reserves south of the Embley River poses logistical challenges to the use of existing Weipa infrastructure. Studies have identified that new stand-alone infrastructure would be required to develop the reserves south of the Embley River.

The Project is referred to as the South of the Embley (SoE) Project. The key features of the Project include; bauxite mining and processing; product stockpiles, port and ship-loading facilities; ancillary infrastructure (e.g. power station, workshops, offices, fuel storage); water infrastructure (dams and artesian bores); mine access road; and barge and ferry facilities. The operational workforce would remain housed in Weipa.

1.2 THE PROPONENT

The SoE Project would be developed and operated by Rio Tinto Aluminium Limited (a company in the Rio Tinto Alcan group). RTA supplies bauxite, alumina and primary aluminium to Australia, New Zealand and export markets. RTA provides about 26 per cent of Australia's total production of bauxite, 14 per cent of its alumina and 26 per cent of its primary aluminium. The business is a wholly owned subsidiary of Rio Tinto.

RTA's head office for mining and refining is based in Brisbane, Australia, with mining and refining interests in Queensland including the existing Weipa mine, and the Yarwun and Queensland Alumina Limited alumina refineries. RTA also operates the Boyne aluminium smelter in Gladstone.

RTA shall engage in community consultation throughout the development of the SoE Project. Information can be obtained via freecall number 1800308938 or email infoeis@riotintoalcan.com. RTA can also be contacted at Level 25, 12 Creek Street Brisbane, or PO Box 153 Brisbane Qld 4001.

1.3 PURPOSE AND SCOPE

This Initial Advice Statement (IAS) has been prepared to provide details of the Project, the existing environment and the anticipated impacts of the development, in accordance with the requirements of the *State Development and Public Works Organisation Act 1971* (SDPWO Act).

Under Section 27 of the SDPWO Act, in considering whether the Project should be declared a significant project, the Coordinator-General must consider one or more of a range of issues and documents including potential effects on the environment and relevant infrastructure, the IAS, and planning schemes.

Figure 1-1 Locality Map

Figure 1-2 Existing Operations

2 THE PROPOSAL

2.1 LOCATION

The SoE Project is located on the portion of ML7024 which is south of the Embley River and on ML6024. In addition, a barge and ferry terminal would be located at Hornibrook Point, within the Port of Weipa. The main mine infrastructure area of the SoE Project is located near Boyd Point on the western Cape York Peninsula, approximately 45km south-east of Weipa and 50km north of Aurukun. Current access to the site is from the Peninsula Development Road via the Aurukun Road and the Amban access road that traverses the adjacent mineral development licence (MDL) 378 held by the Aluminium Corporation of China Limited (Chalco).

2.2 PROJECT SITE

The northern end of the Project site is bounded by the Embley and Hey Rivers and the southern end by the ML7024 boundary, north of the Watson River. The western side borders the Gulf of Carpentaria with part of ML7024 extending over submerged land between Thud and Boyd Points. The eastern side of ML7024 adjoins MDL378. The gross extent of this area is approximately 106,000ha.

The SoE site is predominantly forested with *Eucalyptus tetrodonta* woodlands on bauxite plateaus. The landform is typically homogeneous in the footprint of the bauxite reserve with variations typically occurring along drainage lines and where the deposit drops down to coastal fluvial plains. The main bauxite reserves lie in the Pera Head and Boyd Point areas, south of Norman Creek, and the Hey Point area. Access tracks and drill lines have been established on the bauxite plateau as part of on-going exploration activities.

2.3 PROJECT DETAILS

Based on studies to date, and subject to future modification, the SoE Project consists of the following components:

- bauxite mining – the Project will have a maximum production capacity of 50Mdptpa. It is anticipated that the initial phase of operations will involve mining of bauxite at a rate of 15Mdptpa covering an area of approximately 400ha per annum to replace the depleted East Weipa production followed by production increases to 30Mdptpa to replace the depleted Andoom production. The Project would also be designed to enable further increase in production up to 50Mdptpa. Mining involves clearing vegetation with bulldozers, salvage of topsoil with scrapers, stripping of overburden with loaders, conventional bench mining of the bauxite with excavators, loaders and haul trucks. Topsoil is replaced after mining and the area revegetated. The average thickness of ore is nearly 4m. Bauxite would be transported using a network of internal haul roads. It is proposed that mining would initially be concentrated in the Boyd Point and Pera Head areas. Mining would then progress to the Norman Creek area with ore being transported from the mine via overland conveyor across Norman Creek. Mined areas would be progressively rehabilitated;
- bauxite processing – the crude bauxite is transported to a truck dump station located approximately 2km south of Boyd Point. The bauxite would be processed in a beneficiation plant located adjacent to the ROM stockpiles. A second beneficiation plant would be constructed south of Norman Creek when the reserves in the Norman Creek area are mined. Beneficiation involves separation of the bauxite and waste materials through screening, crushing, grinding, washing and dewatering. Fine waste materials would be discharged to tailings disposal areas. Tailings would initially be disposed of in a tailings dam of approximately 200ha located external to the mine pit. Subsequent tailings dams would be constructed on disturbed mined land.
- bauxite stockpiles – a stacker-reclaimer would be established adjacent to the port facilities to service product stockpiles capable of expansion up to a maximum capacity of 5.2Mdpt. A product stockpile of approximately 650,000t would be established in the initial phase. Should ore from neighbouring mines operated by third parties be shipped through the proposed port, such ore would be conveyed by others across ML7024 to a stockpile near the RTA stockpile. The aggregate 5.2Mdpt stockpile size assumes the SoE Project produces 50 Mdptpa and others produce 13Mdptpa;
- ancillary infrastructure – diesel-fuelled power station, workshops, warehouse, administration facilities, vehicle wash-down facilities, tyre bay, package sewerage treatment plan, general waste disposal, diesel storage (generally located in the vicinity of the beneficiation plants).

- water infrastructure – initially two freshwater dams on tributaries of Norman Creek are likely to be required, plus pipelines and several artesian bores. Combined surface area for the two dams when full will be approximately 900ha. Increases in production above 15Mdptpa are likely to require additional dams in the Norman Creek and Ward River catchments. The location, size and number of additional dams will be determined during feasibility studies and the potential impacts assessed in the EIS. Various water supply options are currently being evaluated during the Project feasibility study. The volume of surface and artesian water required will be stated in the EIS and associated impacts assessed. Water infrastructure for the SoE Project will operate independently of the existing Weipa operations;
- barge/ferry facilities – RTA would construct and operate a new roll-on roll-off barge/ferry terminal at Hornibrook Point and a new barge/ferry terminal on the western bank of the Hey River. These would be used to transport workforce and equipment between Weipa and the SoE Project. Approximately 15,000m3 of dredged spoil from the Hornibrook Point Barge/Ferry Terminal and around 6,000m3 from the Hey River Barge/Ferry Terminal would require disposal, either onshore, or offshore at the existing Weipa spoil ground (about 22km to the west of Hornibrook Point);
- mine access road – construction of approximately 40km of new "on-lease" access road from the Hey River terminal to the mine infrastructure area. The road would have an all-weather sealed pavement; and
- port and ship-loading facilities – construction and operation of new port and ship-loading facilities by RTA between Boyd Point and Pera Head. Works would include a jetty, berths, ship-loader and dredging of berth pockets and departure areas. In the initial phase of the port, RTA proposes to construct a port capable of shipping 30Mdptpa, with provision to enable future expansion up to 63Mdptpa. The capacity of 63Mdptpa would allow for the option to ship an additional 13Mdptpa from third parties (in addition to RTA's maximum production of 50Mdptpa), in the event that agreement to do so was reached with RTA by third parties. For the initial port development to service RTA's 30Mdptpa production, approximately 250,000m3 of dredged spoil would require disposal offshore at a proposed new disposal ground approximately 15km west of the proposed port site. An extra berth would be added if ship loading capacity was increased to 63Mdptpa and approximately 90,000m3 of additional dredged spoil would be generated for disposal in the same manner.

The main infrastructure elements are illustrated in **Figure 2-1**.

The SoE Project currently has bauxite reserves which could sustain a mine life of about 40 years, depending on annual production rate. Mine life also depends on the extent to which mineable reserves may change in the future subject to on-going exploration and economic factors. There are also extensive bauxite resources in addition to the reserves in the 106,000 ha area of mining lease south of the Embley River. The annual rate of clearing for bauxite mining would be up to 400ha at a production rate of 15Mdptpa, and pro-rata for other production rates. Approximately 550ha would be utilised for mine and other infrastructure, port and roads.

2.4 ALTERNATIVES

A number of options have been considered when designing the Project including transporting the crude bauxite ore back to Weipa, accommodating the operations workforce on site, the method of bauxite processing, configuration of ship-loading and berthing facilities, and dredged spoil disposal locations. The proposed approach is considered the most technically, financially and environmentally appropriate. Further optimisation of the Project configuration may occur during feasibility studies and would be outlined in the EIS.

2.5 TIMEFRAME

Based on current estimates, the EIS process is likely to take 12 to 18 months to complete and the SoE Project would require approximately three years for construction. Production from SoE would begin in about 2013, initially replacing depleting East Weipa reserves. Later SoE production would rise to 30Mdptpa in about 2026 to replace depleted Andoom reserves (although timing depends on production rates at Andoom).

2.6 WORKFORCE

Studies indicate that up to 350 persons will be required for the initial construction phase. At 15Mdptpa, the overall number of direct employees working on the combined north and south of the Embley River operations would average about 870 persons, slightly more than current operations (Weipa had 825 employees in 2007). About 400 of these would be working on the SoE Project. The construction workforce would be housed in a fully serviced camp on site and the operational workforce would be based in Weipa and commute on a daily basis.

2.7 TENEMENTS AND TENURE

The proposed facilities and mining activities are located on mining tenements ML7024 and ML6024 held by RTA, with the exception of the Hornibrook Point Barge/Ferry Terminal, which will be located on Strategic Port Land administered by the Ports Corporation of Queensland (PCQ). The final location of this facility within Strategic Port Land will be determined in consultation with PCQ.

The land parcels and tenure located within the Project area are described in **Table 2-1** below and illustrated in **Figure 2-2**.

Table 2-1 Land Parcels and Tenure

Aspect	Mining Tenement	Land Parcel	Background Tenure	Ownership
Mine and Infrastructure	ML7024 (RTA)	Lot 7024 MP41159	State land	The State of Queensland
	ML6024 (RTA)	Lot 121 SP135863	As above	As above
		Lot 67 WP50	As above	As above
		Lot 68 WP50	As above	As above
Hornibrook Point Barge/Ferry Terminal	Not applicable. Located within strategic port land.	Lot 17 SP116853	Freehold	Ports Corporation of Queensland
		Lot 14 SP1204446	Perpetual Lease	As above
Adjacent Properties	MDL378 (Chalco)	1 SC211	DOGIT	Deed of grant in trust to Aurukun Aboriginal Council
	Not Applicable	11 WP50	Freehold	Napranum Aboriginal Shire Council
		10 WP50	Freehold	Napranum Aboriginal Shire Council
		2 SP161882	State Land	The State of Queensland

2.8 LOCAL GOVERNMENT AREAS

ML7024 lies within the Cook Shire Local Government area and ML6024 lies within the Napranum Shire (refer to **Figure 2-2**). Under the *Integrated Planning Act 1997* (IPA), planning approvals under the local Government planning scheme are not required for mining and mining associated activities which take place on mining leases. The Hornibrook Point Barge/Ferry Terminal is on Strategic Port Land administered by the Ports Corporation of Queensland. The proposed port is outside the Port of Weipa port limits.

The Aurukun and Napranum Shires abut ML7024.

2.9 REGULATORY REQUIREMENTS

The SoE Project would require a number of permits, approvals and licences for various components of the development. Due to the existence of the Agreement Act, the versions of the *Environmental Protection Act 1994* (Reprint 3C), *Environmental Protection Regulation 1997* (Reprint 2A) and *Mineral Resources Act 1989* (Reprint 5C revised) that have applied in the past to ML7024 and ML6024 were the ones in force as of 31 December 2000. The *Environmental Protection Act 1994* (EP Act) has recently been amended such that the current version is now in force at Weipa and the environmental regulation of Special Agreement Act mines will now transition to a regime that is the same for non-Special Agreement Act mines. In accordance with the recent legislative changes, RTA has commenced the process to obtain an environmental authority (mining activities) under the EP Act for the existing Weipa operations. Subsequently an application will be made to amend the environmental authority to include the SoE Project. This is likely to trigger the requirement for an EIS for the SoE Project.

The Project was referred to the Commonwealth Department of Environment, Water, Heritage and Arts under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and was declared a "controlled action" on 2 October 2008. A bilateral agreement between the State and Commonwealth governments enables a single EIS process to be conducted under the SDPWO Act.

A preliminary list of potential permits and approvals is presented in **Table 2-2**.

Table 2-2 Project Approvals

Item	Permit/Approval/Licence	Applicable Act	Authority	Comments
Project Wide				
1	Environmental Impact Statement	SDPWO Act 1971	Dept of Planning & Infrastructure	Subject to Coordinator-General's declaration, required for major projects that have the potential for environmental impact.
2	Controlled Action Approval	EPBC Act 1999	Dept of the Environment, Water, Heritage and the Arts (DEWHA)	Required if potential significant impact on matters of national environmental significance.
3	Environmental Authority	EP Act	Environmental Protection Agency (EPA)	Covers mining and associated activities on ML7024 and ML6024. Associated activities include fuel storage (>500,000L) power station (15MW at 15Mdptpdpa), sewage treatment, tailings disposal, dredging and waste disposal).
Hornibrook Point Terminal				
4	Barge/Ferry terminal - development approval	*Integrated Planning Act 1997* (IPA)	Ports Corporation of Queensland (PCQ)	May be required for operational works on Strategic Port Land under the control of the PCQ; the EPA is concurrence agency for operational works in tidal waters. Hornibrook Point Barge/Ferry Terminal requires some dredging.
5	Dredge management plan	*Coastal Protection & Management Act 1995*	EPA	Required if dredging or disposing of dredged spoil in State waters (ie less than 3 nautical miles offshore).
6	Commonwealth sea dumping permit (for dredged spoil)	*Environmental Protection (Sea Dumping) Act 1981*	DEWHA	Required if disposing of dredged spoil from Hornibrook Point Barge/Ferry Terminal in Commonwealth waters (ie more than 3 nautical miles offshore).
7	Removal of marine plants - development approval for operational works	IPA/*Fisheries Act 1994*	Department of Primary Industries and Fisheries (DPI&F)	Required if marine plants found to be present and required to be removed. Part of combined application to PCQ (above) although DPI&F would be concurrence agency for assessment.
Hey River Terminal				
8	Barge/Ferry terminal - development approval	IPA	EPA	Further consideration will be given to the necessity for any approval to be sought for operational works on ML6024. EPA is lead agency for operational works in tidal waters. No dredging is proposed.
9	Dredge management plan	*Coastal Protection & Management Act 1995*	EPA	Required if dredging or disposing of dredged spoil in State waters (ie less than 3 nautical miles offshore).
10	Commonwealth sea dumping permit (for dredged spoil)	*Environmental Protection (Sea Dumping) Act 1981*	DEWHA	Required if disposing of dredged spoil from Hey River Barge/Ferry Terminal in Commonwealth waters (ie more than 3 nautical miles offshore).
11	Removal of marine plants - development approval for operational works	IPA/*Fisheries Act 1994*	DPI&F	Required if marine plants found to be present and required to be removed. Part of combined application to EPA (above); DPI&F would be concurrence agency for assessment.
Port				
12	Port – development approval	Agreement Act		Harbour works for a port on ML7024 are already authorised under Agreement Act.

Item	Permit/Approval/Licence	Applicable Act	Authority	Comments
13	Removal of marine plants - development approval for operational works	IPA/*Fisheries Act 1994*	DPI&F	Required if marine plants found to be present and required to be removed.
14	Dredge management plan	*Coastal Protection & Management Act 1995*	EPA	Required if dredging or disposing of dredged spoil in State waters (ie less than 3 nautical miles offshore).
15	Commonwealth sea dumping permit (for dredged spoil)	*Environmental Protection (Sea Dumping) Act 1981*	DEWHA	Required if disposing of dredged spoil in Commonwealth waters (ie more than 3 nautical miles offshore).
SoE Mine Facilities				
16	Licence to take water (surface water)	*Water Act 2000*	Department of Natural Resources and Water (DNRW)	Normally needed for the taking of water from a watercourse. However, certain pre-existing rights under s1037A of *Water Act 2000* exist due to the Agreement Act.
17	Development approval for dam - assessable under Schedule 8 of IPA	*Water Act 2000*/IPA	DNRW	Normally needed to construct a dam on a watercourse. However, certain pre-existing rights under s1037A of the *Water Act 2000* exist due to the Agreement Act.
18	Waterway barrier (fish barrier) works approval - development approval for operational works	IPA/ *Fisheries Act 1994*	DPI&F	May be required for a dam or water crossing that inhibits fish movement.
19	Failure impact assessment (of dams)	*Water Act 2000*	DNRW	Will be required for dams with a wall height of >8m in height and storage capacity of >500ML. Water storage dams are likely to require failure impact assessment.
20	Licence to take water (sub-artesian)	*Water Act 2000*	DNRW	A declared sub-artesian area exists in the project area under s1046 of the *Water Act 2000*. Small volumes of sub-artesian water would be sourced for potable purposes.
21	Licence to take water (artesian)	As above	DNRW	The Agreement Act permits 12 artesian bores under section 32(b) (or more with Ministers consent). A *Water Act 2000* licence to take water is still required.
22	Development permit for groundwater bores	*Water Act 2000*	DNRW	May be required for installation of groundwater bores.

There are currently no rivers south of the Embley River that are nominated or declared under the *Wild Rivers Act 2005.* The State Government has previously announced an intention to declare the Watson River as a wild river under the Act. The Watson River is located south of the southern boundary of ML7024 but part of its catchment is within ML7024 (refer to **Figure 1-1**). The proposed footprint of the Project is outside the Watson River catchment/basin boundary. The Cape York Peninsula Moratorium Area has been declared over most of northern Cape York. The Moratorium Area includes the SoE Project area south of Boyd Point. The Moratorium restricts the type and volume of new water licences that can be issued under the *Water Act 2000.*

The Department of Primary Industries and Fisheries (DPI&F) is proposing to declare Albatross Bay as a Fish Habitat Area (FHA) under the *Fisheries Act 1994*. DPI&F is currently conducting public consultation about the proposal. The existing Albatross Bay spoil ground is within the proposed FHA area of interest. A declaration would have the potential to significantly constrain the operation of the Port of Weipa.

Figure 2-1 Infrastructure

Figure 2-2 Land Tenure and Local Government Boundaries

3 EXISTING ENVIRONMENT AND POTENTIAL IMPACTS

3.1 INTRODUCTION

The key geographical features of the SoE Project area are shown in **Figure 1-1.**

3.2 CLIMATE

Weipa's climate is classified as tropical monsoonal and is characterised by a distinct wet and dry season. The average rainfall at Weipa is approximately 2,000mm, with most rainfall occurring from December through to March. Very little rainfall is reported from May to September. Average daily maximum temperatures range from 31°C during the winter months to up to 35°C during the late spring.

It is noted that variability occurs throughout the region. The most reliable source of meteorological data that can be used for the SoE Project is from Weipa. The region is also affected by tropical cyclones during the period December through to April that can cause wind damage and flooding.

3.3 GEOLOGY

Geology in the region is described by 1:250,000 scale geological maps, including the Weipa (sheet SD/54-3) and Aurukun (sheet SD/54-7) map sheets. The SoE Project area contains the following geological units:

- Carpentaria Basin – lies beneath the western side of Cape York Peninsula and is the northern most tectonic unit in the Great Artesian Basin. The basin consists of Jurassic – Early Cretaceous sandstone sequences, the Garraway Beds and Gilbert River Formation, and an overlying shale and siltstone unit, the Rolling Downs Group.
- Karumba Basin – a Cainozoic sequence that unconformably overlies the Carpentaria basin. The basin consists of the Bulimba Formation and Wyaaba Beds.
- Cainozoic Sediments – consist of mainly fine grained sands, silts and clays. Coarser grained sands and gravel occur in association with alluvial deposits along rivers. Fine grained dune sands occur near the coastline.
- Lateritic Weathering – the effects of weathering on the Cape York Peninsula are widespread with several distinct weathering events. The most recent event occurred during the Tertiary period with other events taking place during the Pilocene or Pleistocene periods. The Weipa Plateau has been affected by weathering events and the aluminous laterite developed on this surface is mapped as Tertiary and Quaternary aluminous laterite. Bauxite grades decrease with distance from the sea and with increasing elevation associated with increase in relief and decrease in rainfall.

3.4 SOILS

3.4.1 Existing Soils

The soil types found in the region are detailed in **Figure 3-1**. The predominant soil types over the study area are deep gradational or red massive soils with concretions. The only variations occur along drainage lines with estuarine deposits in tidal areas and deep duplex gradational soils with dark loamy surface in upper reaches. In the reaches of the Ward River, there are uniform frequently cracking saline grey clays. Shallow bleached to deep coloured sands occur on the coastline.

3.4.2 Potential Impacts on Soils

Soils below 5m Australian Height Datum (AHD) have the potential to contain acid sulfate soils (ASS) that when disturbed and exposed to oxygen and water have the potential to result in acidic runoff. Disturbance of soils below 5m AHD will require investigation to ascertain whether ASS is present and if so, their extent. Appropriate management strategies will be developed where ASS require disturbance.

Surface soils will be stripped from mining and infrastructure areas. The topsoil will be reused in rehabilitating mined out areas. The EIS will investigate the depth and suitability of topsoil as a rehabilitation growth medium and the manner in which the soils will be managed.

Figure 3-1 Soil Types

3.5 LAND USE

Lands within the Project area are not used for agriculture and are relatively undisturbed by development. Exploration activities, including drilling and associated road development, have taken place throughout the Project Area. On-going activities such as drilling, ore sampling, creation of associated road access, and other exploration activities are continuing. Fire has had an influence on some habitats.

Land suitability mapping of the Cape York Peninsula (Biggs and Philips, 1995) suggests that the majority of the land is not suitable for improved pasture due to low fertility. These areas correlate with deep gradational or red massive soils. The non-tidally affected reaches of watercourses are regarded as land suitable for low intensity grazing of native pastures.

Rehabilitation of mined-out pits will be undertaken progressively to manage the extent of open pit footprint exposed at any one time.

3.6 TERRESTRIAL ECOLOGY

The SoE Project area and its surroundings are located within the Cape York Peninsula Bioregion (Stanton & Morgan 1977, and Sattler & Williams 1999) which, based on broad vegetation formations and landform is recognised as one of 80 or so distinct biogeographic regions of Australian (IBRA Version 6 - Thackway & Cresswell, 2006).

The Project area is specifically located within the Western Plains province (subregion) of the Cape York Peninsula Bioregion (Sattler & Williams, 1999). This is the most extensive of the six provinces and covers a large area of the central and north-western portions of Cape York Peninsula. This area is relatively homogenous in vegetation and landform, and is characterised by large areas of Darwin Stringybark (*E. tetrodonta*) open forests or woodlands, dissected by smaller areas of more mesic riparian vegetation, vine thicket patches and paperbark swamps.

3.6.1 Regional Ecosystems

In November 2005, the Cape York Planning Land Use Study (CYPLUS) regional vegetation mapping for the Cape York Peninsula Bioregion was revised and incorporated into Version 5.0 of the State Regional Ecosystem (RE) coverage (Queensland Herbarium, 2005). This mapping is based on aerial imagery and vegetation extent as of 2003, and is delineated at a scale of 1:100,000. Consequently, 1:100,000 scale vegetation mapping is available for the Project area.

As at August 2007, a total of 24 RE types were mapped and described for the Project area. These are listed in **Table 3-1** with status under the *Vegetation Management Act 1999* (VMA). RE mapping for the Project area is provided as **Figure 3-2**.

The vast majority of remnant native vegetation within the Project area is mapped as Darwin Stringybark (*E. tetrodonta*) Open Forest to Woodland on lateritic red earths (RE Type 3.5.2). This RE type also corresponds with virtually the entire area potentially subject to disturbance by the proposed mining operations and associated infrastructure. This RE is currently classified as 'not of concern' under the VMA.

The RE types in the riparian zone likely to be affected by water storage dams in the Norman River catchment are classified 'not of concern' (mixed polygon of RE 3.3.9/RE 3.5.22/RE 3.3.64; 50/30/20). The potential water supply dam on the Ward River may have an impact on "of concern" RE 3.3.54 (open heath on streams on low sandstone plateaus). RE mapping shows an area of "of concern" RE 3.2.25 (sparse herb land of mixed herbaceous species on foredunes and beach ridges) at the port, but field surveys have confirmed the RE is not actually present at the port area.

There are currently no 'endangered' REs mapped within the Project area.

Table 3-1 RE Types in Project Area

RE Type	Regional Ecosystem Description	VMA Status
RE 3.1.1a	Closed forest of *Rhizophora stylosa* ± *Bruguiera gymnorhiza*. Occurs as outer mangroves	*not of concern*
RE 3.1.3	*Ceriops tagal* ± *Avicennia marina* low closed forest. Extensive on intertidal areas	*not of concern*
RE 3.1.5	*Sporobolus virginicus* closed tussock grassland. Occurs on coastal plains	*not of concern*
RE 3.1.6	Sparse herbland or bare saltpans. Associated with salt plains and saline flats	*not of concern*
RE 3.2.2	**Semi-deciduous vine thicket on coastal dunes and beach ridges**	***of concern***
RE 3.2.5	*Acacia crassicarpa* ± *Syzygium suborbiculare* ± *Parinari nonda* woodland. On beach ridges	*not of concern*
RE 3.2.10c	***Eucalyptus tetrodonta, Corymbia clarksoniana* ± *E. brassiana* woodland on stabilised dunes**	***of concern***
RE 3.2.25	**Sparse herbland of mixed herbaceous species on foredunes and beach ridges**	***of concern***
RE 3.3.9	*Lophostemon suaveolens* open forest. Occurs on streamlines, swamps and alluvial terraces	*not of concern*
RE 3.3.14a	*Melaleuca saligna* ± *M. viridiflora, Lophostemon suaveolens* woodland on drainage swamps	*not of concern*
RE 3.3.50a	*Melaleuca viridiflora* ± *Petalostigma pubescens* low open woodland on low plains	*not of concern*
RE 3.3.54	***Asteromyrtus lysicephala* ± *Jacksonia thesioides* open heath on streams on low sandstone plateaus**	***of concern***
RE 3.3.60a	*Themeda arguens*, *Dichanthium sericeum* closed tussock grassland on marine plains (*Themeda arguens* dominant)	*not of concern*
RE 3.3.61	*Panicum spp., Fimbristylis spp.* tussock grassland on coastal alluvial plains	*not of concern*
RE 3.3.63	Closed sedgeland dominated by *Eleocharis dulcis*. Occurs on seasonally flooded marine plains	*not of concern*
RE 3.3.64	*Baloskion tetraphyllum* subsp. *meiostachyum* open sedgeland in drainage swamps in dunefields	*not of concern*
RE 3.3.65	Ephemeral lakes and lagoons on alluvial plains and depressions	*not of concern*
RE 3.5.2	*Eucalyptus tetrodonta, Corymbia nesophila* tall woodland on deeply weathered plateaus and remnants	*not of concern*
RE 3.5.4	Semi-deciduous notophyll vine forest. Occurs as small patches on northern plateaus	*not of concern*
RE3.5.7x2a	*Eucalyptus tetrodonta* ± *Corymbia clarksoniana* woodland. Mainly occurs on sand plains	*not of concern*
RE 3.5.11	*Eucalyptus tetrodonta, Corymbia nesophila* woodland on lower slopes of plains and rises	*not of concern*
RE 3.5.22a/ RE 3.5.22c	*Corymbia clarksoniana* + *Erythrophleum chlorostachys* + *Corymbia spp.* + *Eucalyptus spp.* woodland on plains	*not of concern*
RE 3.7.3	*Eucalyptus cullenii* ± *E. tetrodonta* woodland on erosional escarpments and plains	*not of concern*

3.6.2 Flora

3.6.2.1 Flora Mapping and Diversity

Initial field work was undertaken in the dry season of 2005 and comprised traverse based surveys of various vegetation types within the SoE area including those typically occurring in riparian zones. Assessment of floristic diversity and the occurrence of endangered, vulnerable or rare (EVR) species were limited by the timing of the survey (during the dry season).

Additional surveys focussed on *E. tetrodonta* (Darwin Stringybark) vegetation on the bauxite plateau between the Ina Creek area in the south and Hey Point area in the north. Survey work was undertaken predominantly during the early dry season in 2006 followed by a late wet season floristic survey undertaken in April-May 2007 to provide a seasonal comparison. An interim species list of the vascular plant flora for the SoE has identified approximately 381 plant taxa have been recorded for all vegetation types within the SoE area. The previous survey work undertaken within the Project area has resulted in a significant level of understanding of the floristic and structural composition of *E. tetrodonta* communities.

This work will be supplemented by:

- late wet season surveys within non *E. tetrodonta* vegetation communities in the SoE mine infrastructure/Norman Creek area, and, to a lesser extent, within the broader mining area, to determine floristic and structural composition and facilitate vegetation mapping;
- extensive traverses of the study area to gather non-quantitative data on vegetation boundaries to facilitate vegetation mapping;
- targeted late wet season surveys for EVR flora within non *E. tetrodonta* communities; and
- targeted late wet season surveys for EVR flora within *E. tetrodonta* communities.

3.6.2.2 Endangered, Vulnerable or Rare Flora (EVR)

Based on an assessment of database records, previous surveys and the preferred habitat of EVR species, a total of 14 significant plant taxa have been recorded or are likely to occur within the Weipa region, and potentially occur in the Project area. A search of the EPBC Act database indicates that two additional species potentially occur in the Project area, although there have been no records of these species in the immediate vicinity of the Project area.

Of the 16 EVR species that may occur in the Project area, five have been found to occur during surveys undertaken to date as listed in **Table 3-2**.

Table 3-2 EVR Flora Species found in Preliminary Assessments

Scientific Name	Common Name	NCA Status	EPBC Act Status	Preferred habitat in the Weipa region
Dendrobium bigibbum	Cooktown orchid	V	V	Epiphyte on trees in Paperbark swamp and vine forest
Dendrobium johannis	Johan's Orchid	V	V	Epiphyte on trees in Paperbark swamp and vine forest.
Nepenthes mirabilis	Pitcher Plant	E	-	Occurs in gallery forest and swamps.
Solanum dunalianum	*Beach Nightshade*	V	V	An herbaceous shrub found in closed forest habitats.
Tinospora angusta	A snake vine	R	-	A vine found in riparian habitats and *Eucalyptus tetrodonta* open forest habitats.

E – Endangered; V – Vulnerable; R – Rare; NCA – *Nature Conservation Act 1992.*

Most of the EVR flora species that potentially occur in the Project area are likely to be encountered in non *E. tetrodonta* vegetation communities, particularly riparian communities that include vine forest and heath woodland that will be largely unaffected by the Project.

Figure 3-2 Regional Ecosystems

3.6.3 Fauna

The main fauna habitats occurring within the Project area are similar to those occurring throughout the Weipa region on and adjacent to the bauxite plateau. The Darwin Stringybark open forest habitat is by far the most widespread habitat within the Project area and dominates all non-riparian and non-coastal areas.

The overall habitat condition within the Project area appears to be significantly related to fire events and feral animals. While there has been very little direct disturbance to habitat other than by exploration drill lines, some habitats have been significantly affected by the frequent fire regime and damage from feral pigs. The extent to which the current fire regime of annual burning is human or naturally induced is difficult to determine. Fire can be initiated by a range of sources, including traditional owners, tourists, hunters, hazard reduction burns and lightening.

Nevertheless the effect of the current fire regime on the Darwin Stringybark habitat is the development of a homogeneous habitat structure that varies little throughout the Project area. Furthermore, frequent fires tend to limit the availability of a robust shrub stratum, and ground microhabitat such as bark slabs and smaller branches do not persist under the frequent fire regime. These fires tend to rapidly hollow out logs and smaller tree hollows that are present, reducing the utility for shelter by smaller mammals and reptiles.

Damage from pigs comprises rooting and wallows predominantly within riparian and wetland habitats. The extent to which this adversely affects native fauna is not well understood, but pig activity reduces the availability of fringing ground habitat and open wetland habitat at different times of the year.

3.6.4 Fauna Communities

The currently known abundance and diversity of vertebrate fauna within *E. tetrodonta* dominated habitats is relatively limited. This may reflect limitations of the timing and efforts of previous surveys, but may also reflect a genuine low diversity within *E. tetrodonta* habitats. However, it is anticipated that additional fauna species from all vertebrate groups may be detected during fauna surveys conducted for the EIS.

The fauna communities within the riparian, wetland, vine forest and coastal habitats of the Project area is not well known, but is anticipated to be similar to the fauna occurring in similar habitats in the wider Weipa region. The fauna community in these moister habitats is likely to be more abundant and diverse than in the Darwin Stringybark habitats given the greater structural diversity of the vegetation, and the greater productivity associated with seasonally available water. On this basis, these habitats are likely to provide a refugial function for fauna within the Project area and provide dry season feeding opportunities for fauna that may occupy Darwin Stringybark habitats for the majority of the year.

3.6.4.1 EVR Fauna

Eight endangered, vulnerable or rare (EVR) fauna species are currently known to occur in the Project area from preliminary surveys as listed in **Table 3-3**.

Table 3-3 EVR Terrestrial Fauna Species found in Preliminary Assessments

Common Name	Scientific Name	NCA Status	EPBC Act Status
Reptiles			
Estuarine Crocodile	*Crocodylus porosus*	V	
Birds			
Radjah Shelduck	*Tadornah radjah rufitergum*	R	-
Eastern Curlew	*Numenius madagascariensis*	R	-
Beach Stone-curlew	*Esacus magnirostris*	V	-
Black-necked Stork	*Ephippiorhynchus asiaticus*	R	-
Little Tern	*Sterna albifrons*	E	-
Palm Cockatoo	*Probosciger aterrimus macgillivrayi*	R	-
Mammals			
Papuan Sheathtail-bat	*Saccolaimus mixtus*	R	-

E – Endangered; V – Vulnerable; R – Rare.

Apart from the Papuan Sheathtail Bat which was detected in Darwin Stringybark habitat at Hey Point, all of the EVR species known from the Project area have been located in riparian, wetland and coastal habitats. A number of other species also potentially occur in the Project area. A search of the EPBC Act database indicates the potential presence of the Australian Painted Snipe (*Rostratula benghalensis australis*) and the Northern Hopping Mouse (*Notomys aquilo*). The Project area is unlikely to support populations of either of these species, as the Northern Hopping Mouse has not been confirmed outside of the Northern Territory since early collections (ca 1870) of this species were vaguely labelled 'Cape York' (Woinarski, 2004), while Cape York has until recently been considered outside the normal range of the Australian Painted Snipe (Marchant & Higgins 1993, Garnett & Crowley, 2000). No reliable confirmed records for the Australian Painted Snipe, in the vicinity of the Project area, were available for the purposes of this document.

Other EVR species that may occur in the Project area on the basis of the availability of suitable habitat are listed in **Table 3-4**. As with the EVR species already recorded for the area, many of these potential species would predominantly utilise non Darwin Stringybark habitat; however, nearly all of these species (indicated in the table) may also utilise Darwin Stringybark habitat at least occasionally, and possibly as part of a seasonal habitat usage pattern.

The Northern Quoll is now very scarce on Cape York, and recent surveys in the Weipa Region have not detected the species. Nevertheless, the species may persist in the Project area, particularly in association with riparian and vine forest habitats. Raptors such as the Red Goshawk and Grey Goshawk are partly migratory and may utilise the Project area at certain times of the year. The remaining species tend to be more sedentary and are more likely to be detected during field surveys, if present.

Table 3-4 EVR Terrestrial Fauna Species Potentially occurring in the Project Area

Common Name	Scientific Name	NCA Status	EPBC Act Status	Likelihood of occurring in Darwin Stringybark habitat
Reptiles				
Rusty Monitor	*Varanus semiremex*	R	-	Likely
Burrowing Snake	*Simoselaps warro*	R	-	Likely
Birds				
Square-tailed Kite	*Lophoictinia isura*	R	-	Likely
Grey Goshawk	*Accipiter novaehollandiae*	R	-	Likely
Red Goshawk	*Erythrotriorchis radiatus*	E	V	likely
Star Finch	*Neochmia ruficauda ruficauda*	E	E	Possible
Rufous Owl	*Ninox rufa meesi*	V	V	Likely
Masked Owl	*Tyto novaehollandiae kimberli*	V	V	Possible
Australian Painted Snipe	*Rostratula benghalensis australis*	R	V	Possible
Mammals				
Northern Quoll	*Dasyurus hallucattus*	-	E	Possible
Chestnut Dunnart	*Sminthopsis archeri*	R	-	Likely
Common Spotted Cuscus	*Spilocuscus maculates nudicaudatus*	R	-	Likely
Northern Hopping Mouse	*Notomys aquilo*	V	V	Unlikely

E – Endangered; V – Vulnerable; R – Rare.

3.6.4.2 Pest and Introduced Fauna

Five species of introduced fauna are known to occur in the Project area including three species listed under the *Land Protection Regulation 2002* (class 2 pest animals), being the feral cat (*Felis catus*), dingo/dingo hybrid (*Canis familiaris dingo/ x C. familiaris*) and the feral pig (*Sus scrofa*). All of these species are commonly encountered throughout the Weipa-Aurukun area. The other two species known to occur in the Project area are the cane toad (*Bufo marinus*) and feral horse (*Equus caballus*). Surveys conducted in 2006 and 2007 found feral pigs and feral cats to be particularly common.

3.6.5 Potential Impacts on Terrestrial Ecology

The majority of the Project area is covered by *E. tetrodonta* woodlands on bauxite plateaus. Significant areas of this vegetation will require clearing for the proposed mine however the *E. tetrodonta* RE types are 'not of concern' under the VMA and are common on the Cape York Peninsula and northern Australia.

No endangered REs under the VMA or endangered ecological communities under the EPBC Act occur within the Project area.

Based on currently available information, the majority of EVR flora and fauna species are likely to occur in riparian, wetland and coastal habitats rather than on the *E.tetrotonta* woodlands which are associated with the bauxite plateaus which will be mined. Some disturbance of these habitats will be required for infrastructure such as water storage dams, mine roads, conveyors and plant infrastructure. These areas will be further investigated through the EIS to ascertain the potential for impact on EVR flora and fauna species. Typically, a buffer of *E.tetrodonta* woodland will be left between the edge of riparian vegetation and a mine pit.

3.7 FRESHWATER ECOLOGY

3.7.1 Habitats

The main aquatic habitats occurring within the Project area are similar to those occurring throughout the Weipa region on and adjacent to the bauxite plateaux. The principle surface freshwater habitats are small incised ephemeral to semi-perennial streams that drain the seasonal surface laterite aquifers during the dry season and receive surface runoff during the wet season.

In the Weipa area, these streams are characterised by low turbidity (eg median reading of 2.4 NTU for ten sites monitored during the one occasion in the dry season).

The well developed riparian vegetation generally results in moderate to high amounts of woody material (logs, branches, twigs) and leaf litter, adding to aquatic habitat complexity. Regular seasonal flushing flows prevent clogging of the stream channel with such material. The stream substrata range from hard laterite benches through boulder-cobble dominated sections to gravel bed, sandy and in places silty fine sediments. Overall, the streams, while small, support a variable habitat structure that is largely undisturbed. Habitat alteration of the stream systems is generally limited to streamside pig wallows and access points, with occasional thinning of the riparian vegetation altered by fire and/or grazing pressure from feral mammals.

The swamps are the other main freshwater aquatic habitat type in the Project area. The swamps are wetlands dominated by an overstorey of a mix of *Melaleuca* species and swamp mahogany (*Lophostemon suaveolens*). These may be isolated systems in depressions in the laterite plateau. Systems that are seasonally well connected to the stream drainage occasionally form in-line wetland complexes, particularly near the freshwater-saltwater interface at the top of the estuary of each stream system.

The Archer Bay Aggregation wetlands is located adjacent to Aurukun (Environment Australia, 2001). The wetlands mostly comprise estuarine areas of the Archer, Watson and Ward Rivers estuarine, plus some freshwater wetlands upstream of the estuaries. Some parts of the Archer Bay Aggregation wetlands on the Ward River are within the Project area.

These systems offer high value fauna habitat complexes, with variable faunal composition depending on the extent and nature of connectivity to the stream drainage networks.

Estuarine habitats range from minimal extents of essentially freshwater discharges meeting the sea at the shoreline, to the extensive Norman Creek and Ward River estuaries. Coastal dune backswamp and supra-littoral lagoons also occur. Together with the estuaries these offer a complex of habitat opportunities for aquatic biota.

3.7.2 Fauna Communities

Based on other previous sampling in the Weipa area, the aquatic ecosystems are likely to represent a distinct assemblage forming a subset of the regions species and adapted to the characteristic water quality of the surface fresh waters. For example, some bauxite plateau streams to the north of Weipa are missing some freshwater fish species, such as saratoga (*Scleropages jardini*), that occur in the adjacent Wenlock River system despite apparently suitable habitats being present in the bauxite streams. These absences probably reflect the effective isolation of the bauxite plateau streams from other drainage systems coupled with historic localised species extinctions during extended or severe droughts.

A number of regionally present migratory or highly dispersive fish species have been found to be missing from some Weipa area streams, despite an apparent lack of physical passage barriers sufficient to prevent colonisation by those species. This includes facultative freshwater resident species with marine populations, such as various mullet species, and otherwise ubiquitous freshwater species, such as grunters (*terapontidae*). It is believed that some of these species are excluded from the bauxite plateau streams because of an inability to tolerate the very low water conductivity typical of those systems.

An aquatic fauna survey will be undertaken for the EIS.

3.7.3 EVR Fauna

Five listed fish species are known to occur regionally (refer to **Table 3-5**). However, to date none have been collected from bauxite plateau streams in the Weipa region. Three are elasmobranchs (speartooth shark, freshwater stingray and freshwater sawfish) and are probably unable to tolerate the low conductivity waters of these systems. The speartooth shark could occur in estuarine habitats, with the nearest recorded in the Ducie River, around 120km northeast of the Norman Creek estuary. The remaining two fish are more typically found in very large rivers in southern New Guinea, but with patchy occurrence in larger rivers of the Cape York and Gulf of Carpentaria areas in Queensland. Based on other limited surveys of the bauxite plateau freshwater systems of the area, are not expected to occur in streams within the Project area.

Table 3-5 Aquatic Fauna EVR Species Known or Predicted to Occur in the Region

Name	Genus species	Status	Records & References	Comments
Speartooth shark	*Glyphis* sp A	Critically Endangered [1,3] Endangered [4*]	Possible. Ducie River (Burrows 2004)	Mainly estuarine and river channels in freshwater
Freshwater stingray	*Himantura chaophyra*	Vulnerable [2,3,]	Predicted – 'probably occurs in most of the larger drainages in northern Australia' (Allen *et al* 2002)	River channels in freshwater
Freshwater sawfish	*Pristis microdon*	Endangered [2] Vulnerable [1,4*]	Predicted – 'probably widespread in coastal drainages of northern Australia' (Allen et al 2002)	Mainly estuarine and river channels in freshwater
Froggatt's catfish	*Cinetodus froggatti*	Data deficient [2,3]	Predicted – Recorded from Edward River and Estuaries of western Cape (Herbert & Peters 1995)	Rare in Australia, common in southern PNG. Mainly estuarine and river channels in freshwater
Giant freshwater anchovy	*Thyrssa scratchleyi*	Data deficient [2,3]	Predicted – Recorded from Archer River (Herbert & Peters 1995, Allen 2002)	Patchy distribution and uncommon in Australia, PNG fauna affinity. Occurs in both wetland and river channel habitats.

[1] EPBC Act [2] IUCN Red List [3] ASFB Threatened Fishes List [4] NCA [*] Nominated.

3.7.4 Other Fauna

A number of unlisted aquatic species with patchy or restricted distributions are known to occur in the region. Species commonly found in the bauxite plateau streams north of the Embley River include Black-banded rainbowfish, spotted blue-eye, poreless gudgeon, swamp eels and crayfish *Cherax rhynchotus.* The black-banded rainbowfish has been observed in streams within the Project area during a reconnaissance inspection.

3.7.5 Potential Impacts on Aquatic Ecology

Potential impact on aquatic species from the building of water storages and the potential changes to the downstream hydrological regime will be investigated during the EIS.

3.8 MARINE ECOLOGY

3.8.1 Marine Sediments

The initial stage of the SoE port development would require dredging of approximately 250,000m^3 of marine sediments. The future addition of another berth would require the dredging of approximately 90,000m^3 of material. Dredge material from the SoE port would be disposed at a proposed new spoil ground approximately 15km west of the port site. About 15,000m^3 of marine sediment would be required to be dredged for the Hornibrook Point Barge/Ferry Terminal and around 6,000m^3 from the Hey River Barge/Ferry Terminal. This dredged material would be disposed either onshore or at the existing Weipa spoil ground in Albatross Bay. .

Several sediment surveys have been undertaken by PCQ and RTA (GHD 2005; SKM 2005a; SKM 2005b) for dredging projects within Albatross Bay and the Embley River. These studies provide information more relevant to the Weipa area rather than the SoE port development area to the south of Albatross Bay, nevertheless they provide the closest detailed studies regarding sediment quality. After assessing the dredge spoil according to the framework prescribed in the National Ocean Disposal Guidelines for Dredged Material (NODGDM; Commonwealth of Australia, 2002), the various studies concluded the material dredged from the abovementioned areas was suitable for unconfined placement of material at sea and the operations were granted Sea Dumping Permits under the Commonwealth *Environment Protection (Sea Dumping) Act 1981*. The spoil from these dredging projects was placed within the Port of Weipa spoil ground in Albatross Bay, 30km from the SoE port development site.

Studies by Munksgaard and Parry (2002) and Cox and Preda (2003) provide information at a more regional level. As part of a wider northern Australian survey, these studies found moderate variability of concentrations of metal and metalloids in sediments across the Gulf of Carpentaria which they assessed to be naturally occurring and sourced from adjacent geological formations, particularly in areas with adjacent exposed landforms. In some cases, average total concentrations of some metals (eg nickel) were found to be above NODGDM screening levels although testing of the bioavailable components subsequently found concentrations below screening levels (Munksgaard and Parry, 2002). These studies provide useful data for comparison against site specific baseline metals and metalloid contaminant concentrations at the SoE port development site.

RTA has undertaken an assessment of sediment quality within the proposed SoE port development site. Sediment samples were collected using vibrocore and analysed initially for trace metals, nutrients, organotin compounds, total organic carbon, acid sulfate soils and particle size distribution. Calculation of the 95% upper confidence limit (UCL) for each contaminant (representing the overall quality of sediment to be dredged) identified that all parameters analysed from the dredge area were generally compliant with NODGDM screening levels, with the exceptions being nickel and antimony. Nickel concentrations are naturally high in northern Australian sediments (Munksgaard and Parry, 2002) but no data exists on background antimony concentrations. Further analysis was undertaken of samples for potential metals toxicity in water (via elutriate analysis) and metals bioavailability (via dilute acid extraction) determined that metals had low bioavailability and dredge spoil would be more than adequately diluted by the receiving water at an offshore spoil ground upon release to comply with water quality guidelines. Acid sulfate soils were not present in the sediment samples.

Based on the analyses undertaken, the material to be dredged at the port is considered suitable for unconfined placement at sea. Characterisation of material to be dredged at the Hornibrook Point Barge/Ferry Terminal and the Hey River Barge/Ferry Terminal will be conducted for the EIS.

3.8.2 Marine Habitats

Overall, the Gulf of Carpentaria predominantly consists of un-vegetated sand and mud environments (eg Somers and Long, 1994); although other important habitat types are present. No Fish Habitat Areas under the *Fisheries Act 1994* currently exist at or adjacent to the proposed development locations, however a new Fish Habitat Area has been recently proposed for Albatross Bay. No State or Commonwealth Marine Parks are currently declared in the Project area. Wetlands included in the Commonwealth Directory of Important Wetlands (Environment Australia, 2001) occur at the southern end of the Project area (Ward River and associated tributaries).

Mixed species seagrass habitats are known to occur at the Port of Weipa in Albatross Bay, specifically in the Embley, Hey and Pine Rivers (Poiner *et al.*, 1987; Roelofs *et al.*, 2006). The proposed port site between Pera Head and Boyd Point is not identified as containing seagrass beds (Coles *et al.*, 2004; Baker and Sheppard, 2006). Field survey has verified that this is the case. Mangrove habitats occur extensively in the rivers and creeks that drain into Albatross Bay (Wightman *et al.*, 2004), but they too are absent from the foreshores at and adjacent to the port development site (Baker and Sheppard, 2006).

The SoE Project also includes barge landing facilities on the north shore of the Embley River estuary at Hornibrook Point and at a location on the western bank of the Hey River (refer to **Figure 2-1**). Scattered fringing mangroves were observed near both locations during field surveys. No seagrass beds were found near the proposed Hornibrook Point Barge/Ferry Terminal. Seagrass is also known to occur within Hey River (Roelofs *et al.*, 2006) and was found near the Hey River terminal location during field surveys.

While the vast majority of the sub-tidal region of the Gulf of Carpentaria is sand and mud, it is known that some reef habitat occurs (Harris *et al.,* 2004). This reef habitat is well below the sea surface and consists of a thin and patchy veneer of live corals (Harris *et al.,* 2004). Some areas of fringing coral occur along the foreshores at Weipa including Boyd Point (Veron *et al.,* 2004; Baker and Sheppard, 2006). The presence of small fringing reefs at Boyd Point and at Pera Head was confirmed by field investigations which revealed the presence of a reef assemblage consisting of common inshore coral and soft coral species. Common hard coral taxa encountered included *Montipora, Acropora, Fungia, Platygyra, Turbinaria and Favia*. Soft coral taxa encountered included *Sarcophyton* and *Dendronephthya*.

3.8.2.1 Fish Assemblages

The fish assemblages of Albatross Bay have been well studied and much of this work has focussed in or directly adjacent to the Embley River estuary (eg Blaber *et al.,* 1989, 1990). A total of 127 species were recorded by Blaber *et al.* (1989) with differing fish assemblages occurring in the habitats sampled. The fish biomass estimates obtained by Blaber *et al.* (1989) for open water channels, sandy beach habitats and mangroves creeks were found to be similar to previously published estimates from tropical estuarine areas. In contrast, the fish biomass of seagrass habitat was lower than that estimated for other tropical estuaries.

Along the foreshore, just south of the Embley River estuary, the dominant species caught by gill netting were queenfish, milkfish and blue salmon (Blaber *et al.,* 1995). Overall, Blaber *et al.* (1995) found that fish catch rates along the Weipa foreshore were less than in the adjacent estuary and offshore waters. Nonetheless, Blaber *et al.* (1995) identified the area as a transition zone between estuarine and offshore waters for some species. In offshore waters, the dominant families of fish were those that occurred at similar depths and distance from the coastline throughout the eastern and south-eastern region of the Gulf of Carpentaria.

3.8.2.2 Prawns

Albatross Bay is known to be an important nursery area for the juvenile tiger and banana prawns that are the principal target species in the Northern Prawn Fishery area.

Banana prawns spawn between September to November and March to May and use mangrove/mud habitats. At low tide, they are most abundant in small tidal creeks and gutters that drain mangrove forests (Vance *et al,* 1998; Kenyon *et al*., 2004).

The brown tiger prawn and the grooved tiger prawn are abundant in the Gulf of Carpentaria. Brown tiger prawns spawn throughout the year, with peak spawning occurring during August to September (Kenyon *et al*, 2004). Grooved tiger prawns peak in spawning between August and October with a minor peak in the months of January and February. Juvenile tiger prawns are generally associated with vegetated habitats (particularly large seagrass beds) in the vicinity of estuaries (Rothilsberg *et al*., 1996; Haywood *et al*, 1995).

3.8.2.3 Macrobenthic Infaunal Assemblages

Long and Poiner (1994) examined the infaunal benthic assemblage in sub-tidal areas of the Gulf of Carpentaria. Species assemblages consisted primarily of overlapping species distributions rather than highly structured, discrete communities with well defined characteristics of the community. Overall, the work of Long and Poiner (1994) suggests that the macrobenthic infaunal assemblage in the vicinity of the proposed new off-shore dredge spoil disposal location and the existing Albatross Bay location are likely to be similar to that occurring in most of the southern and eastern Gulf of Carpentaria. A field survey at the proposed new spoil ground found a muddy substrate with occasional seapens.

3.8.2.4 Marine Turtles

While the coast from the Watson River to the Embley River is not recorded as supporting significant marine turtle nesting sites (Abrahams *et al* 1995), several species of marine turtle are known to nest on the beaches in the region (Bell 2004, GHD 2007) and feed in the surrounding waters.

Of the six turtle species listed under the EPBC Act as threatened species and migratory species, the flatback turtle is the most common species to nest in the area.

Flatback turtles nest on beaches from Mon Repos (near Bundaberg) northwards and across northern Australia to Western Australia. Like other marine turtle species, flatback turtles are known to repeatedly return to the same beach or even the same section of beach for nesting (Limpus *et al.,* 1984). The most significant nesting site is Crab Island in the north-eastern Gulf of Carpentaria which is approximately 200km from the SoE port development site (Limpus *et al.,* 1983). Other significant rookeries in the southern Gulf of Carpentaria include the Wellesley and Sir Edward Pellew Islands (Cogger and Lindner 1969). In the north-western Torres Strait, significant rookeries occur at Deliverance Island, Kerr Islet and Turu Cay (Limpus *et al.,* 1989).

Surveys between Pera Head and Boyd Bay during May to July have found nesting activity by flatback turtles and also apparently olive Ridley or hawksbill turtles (GHD, 2007).

Hawskbill turtles feed in the vicinity of Boyd Point and may also nest in low densities in the vicinity of the proposed development area. A further three marine turtle species, the loggerhead turtle, the green turtle and the leatherback turtle also feed in the waters surrounding the port site but do not nest on the beaches. Marine turtles are likely to be present in waters in the vicinity of Boyd Point all year round.

Studies by Bell (2004) provide information on nesting location and frequency from Archer River to Skardon River, with pertinent information summarised in **Table 3-6**. These studies found that egg predation by feral pigs has a significant impact on nesting success, while entanglement in marine debris (e.g. discarded fishing nets) was also identified as having a significant impact on adults and hatchlings.

Table 3-6 Turtle Nesting Tracks - Weipa Coast

Location	Beach Length (km)	Turtle Nesting Tracks
Archer River to False Pera Head[1]	35	35 flatback
False Pera Head to Boyd Bay	38	41 flatback 2 olive Ridley/hawksbill
Pennyfather River to Port Musgrave	39	60 flatback 1 olive Ridley/hawksbill
Port Musgrave to Skardon River	35	95 flatback

The survey described in **Table 3-6** was conducted in late August and early September and nesting turtles were clearly present. It is uncertain based on information available though as to whether this represents a peak nesting period in the region.

For flatback turtles, there is considerable geographic variation in the timing of nesting as illustrated in **Table 3-7**.

Table 3-7 Flatback Turtles Nesting Season

Location	Nesting Season	Reference
Mon Repos	Nesting period extends from mid October to late January and is similar to other southern Great Barrier Reef locations including Wild Duck Island, Peak Island and Curtis Island.	Limpus *et al.* (1984)
Crab Island (north-eastern Gulf of Carpentaria)	The main nesting season is August to October but substantial nesting occurs year round.	Limpus *et al.* (1983)
North-western Torres Strait	Nesting occurs year round but with a peak in the 'early part of the year'. Low density nesting in August was notable at one major rookery (Deliverance Island).	Limpus *et al.* (1989)
Central Queensland	Nesting is focussed on late spring and summer with a peak occurring in late November and early December.	Limpus *et al.* (2002, 2006)
Northern Territory	Year round nesting that peaks in April-May.	Cogger and Lindner (1969)
Dampier Archipelago	Nesting season is from October to February with a peak in December and January.	Apache Energy (2007)

No concentrated nesting of olive Ridley turtles is known to occur in Australia, although low density nesting occurs at a number of locations including the Gulf of Carpentaria. The key nesting location in the Gulf of Carpentaria is from Kowanyama to Bamaga, however there has been no recruitment of new animals into the nesting population for approximately two generations as a result of feral pigs and wild dogs (Dr Colin Limpus – EPA, pers. comm.). Only limited published information is available on the timing of nesting of this turtle species. Whiting *et al.* (2007) indicated that in the Tiwi Island region (Northern Territory) nesting occurred from February to November with a clear peak in April and May. It is currently uncertain whether the nesting season is similar elsewhere in Australia.

Although some uncertainty exists in relation to the timing of the turtle nesting seasons, flatback turtles especially are relatively common along the coastline of the Project area.

[1] False Pera Head is approximately 20km south of Pera Head.

3.8.2.5 Dugongs

Dugongs are found at many locations in the Gulf of Carpentaria and are often closely associated with seagrass beds. A major proportion of dugongs in the Gulf of Carpentaria occur in the region of the Wellesley Islands, the Sir Edward Pellew Group, and Blue Mud Bay (Saalfield and Marsh, 2004), all of which are some 500km from Boyd Point. Dugong are known to occur in low densities in Albatross Bay and the seagrass beds in the area constitute important feeding areas (Saalfield and Marsh, 2004; Baker and Sheppard, 2006). Seagrasss beds do not occur at the SoE port site or the Hornibrook Barge/Ferry Terminal, although seagrass was found near the Hey River Barge/Ferry Terminal.

3.8.2.6 Dolphins and Whales

There are a number of dolphin species known to occur in the Gulf of Carpentaria, including the Indo-Pacific humpback dolphin (*Sousa chinensis*), inshore (*Tursiops aduncus*) and offshore (*Tursiops truncatus*) forms of the bottlenose dolphin, and the Australian snubfin dolphin (*Orcaella heinsohni*). One whale species, Bryde's whale (*Balaenoptera edeni*), is also known to occur.

Based on their known biology, the Indo-Pacific humback dolphin, the inshore bottlenose dolphin and the Australian snubfin dolphin are likely to occur in the vicinity of the proposed development site. The Indo-Pacific humpback dolphin and the inshore bottlenose dolphin are considered to be relatively common in the proposed development area. Both usually inhabit shallow coastal waters of less than 20m depth and are often associated with rivers and estuarine systems, enclosed bays and coastal lagoons (Corkeron *et al.*, 1997, Hale *et al.*, 1998, Jefferson, 1999). On the east coast of Australia, the inshore bottlenose dolphin inhabits estuaries and shallow offshore waters (<30m) (Hale *et al.*, 1998, Hale *et al.*, 2000). The Indo-Pacific dolphins and Australian snubfin dolphins are known to co-exist with coastal development such as with port infrastructure at Cleveland Bay, Townsville (Parra, 2006) and the Indo-Pacific dolphin also occurs in the Brisbane River (Hale *et al.*, 1998).

3.8.2.7 Sawfish

Increasing conservation attention is being paid to sawfishes (Family *Pristidae*). The International Union on the Conservation of Nature (IUCN) shark specialist group (Cavanagh *et al.*, 2003) categorised Australian sawfishes as endangered on the basis of their rapid decline in range. In recognition of global concern about the status of sawfish populations and other threatened sharks and rays, a National Plan of Action (NPOA) has been established (Anon, 2002).

Four sawfish species, *Pristis microdon*, *P. zijsron*, *P. clavata* and *Anoxypristis cuspidata* are distributed throughout the Queensland section of the Gulf of Carpentaria, Australia. *Pristis microdon* inhabits both freshwater and estuarine environments (generally the upper reaches) and is listed as Vulnerable under the EPBC Act. *Pristis zijsron* occurs only on the sand and mud flats outside river mouths while *P. clavata* inhabits sand, mud flat and upstream estuarine habitats. *Anoxypristis cuspidata* is predominantly an offshore species that inhabit depths of ten metres or greater (Peverell, 2005). Both *P. zijsron* and *P. clavata* are likely to occur along the foreshore of the proposed port development (Peverell, 2005), while *A. cuspidata* is likely to occur in the vicinity of the possible off-shore spoil disposal grounds.

3.8.2.8 Sea Snakes

The Gulf of Carpentaria contains a diverse and abundant assemblage of sea snakes. The most common species occurring in the eastern Gulf of Carpentaria are *Hydrophis elegans*, *Lapemis hardwickii*, *Disteria major* and *H. ornatus*, although up to 12 other species may occur (Redfield *et al.*, 1978; Wassenberg *et al.*, 2001; Guinea *et al.*, 2004). At the survey transect sampled by Redfield *et al.*, 1978) that was closest to the proposed development location, *L. hardwickii* was the dominant species. Other species recorded were *Acalyptophis peronii*, *Aipysurus duboisii*, *Aipysurus laevis*, *Astrotia stokesii*, *Enhydrina schistosa, H. elegans* and *H. ornatus*. There are significant data gaps in publicly available records on the distribution, abundance and biology of the various sea snake species.

3.8.3 Fishery Resources

Albatross Bay supports productive and highly valuable commercial and recreational fisheries (Baker and Sheppard, 2006). The area is accessed by a range of commercial fisheries including prawn trawl vessels operating in the Commonwealth managed Northern Prawn Fishery. There are also commercial crab, net and line fishers managed by the Queensland State Government.

The rivers and creeks flowing into Albatross Bay are closed to commercial net fishing, but the foreshores remain open. Recreational tourism in the form of recreational, traditional, charter and guided fishing occurs in the area. Charter and guided fishing is identified as a growth sector that is attracting international tourists to Weipa (Baker and Sheppard, 2006).

The Northern Prawn fishery is one of Australia's most valuable fisheries with an annual Gross Value of Product (GVP) of approximately $70 million. As part of the *Securing our Fishing Future Initiative,* the Commonwealth Government has invested approximately $68 million in the last financial year to restructure the fishery. The fishery occurs in the northern part of Australia from Cape Londonderry (Western Australia) east to Cape York. For monitoring and assessment purposes the fishery is divided into 15 statistical areas with the Weipa statistical area being the one relevant for the proposed development. In 2006, the Weipa statistical area was the third most important production area for banana prawns but only very small amounts of tiger prawns were captured (Raudzens, 2007). Catches of banana prawns are highly variable due to the influence of climatic factors, in particular the timing and volume of rainfall (Raudzens, 2007). Most prawn trawling occurs in the Weipa area in the offshore part of Albatross Bay and directly adjacent areas. Given the extensive area worked by the prawn trawler fleet, the existing Albatross Bay spoil ground and the proposed new spoil ground are likely to be located within trawling grounds.

The creeks and rivers that drain into Albatross Bay are the most important commercial and recreational harvesting areas for mud crabs in the Gulf of Carpentaria (Williams, 2002). The proposed development is remote from these areas and therefore will not impact on mud crab populations or access to the mud crab fishery.

While the rivers and creeks that drain into Albatross Bay are closed to commercial net fishing, the foreshore and inshore areas are accessed by commercial net fishers using an N3 endorsement. This fishery is permitted to operate in most inshore areas of the Gulf of Carpentaria from the shoreline out to seven nautical miles. Annual GVP from this fishery was estimated to be $11 million in 2005. Species targeted include blue salmon, barramundi and various shark species. From available information, the proposed development should not impact the commercial N3 net fishery as there is little spatial overlap between this fishery and the proposed development. Consultation with the Gulf of Carpentaria Commercial Fishermen's Association and the DPI&F will be undertaken as part of the EIS.

The commercial line fishery in the Weipa area principally targets Spanish mackerel. Although the spatial scale of the compulsory commercial fisheries logbook data is too coarse for validation, the Pera Head region is considered a favourable location for this fishery as it represents productive habitat in close proximity to Weipa. The recreational fishery at Pera Head targets Spanish mackerel as well as other pelagic species such as longtail tuna and queenfish.

3.8.4 Potential Impacts on Marine Ecology

Turbidity plumes arising from dredging and spoil disposal activities may temporarily decrease available light conditions at the sea bed, increase suspended sediment concentrations within the water column, and increase deposition of fine sediment over adjacent benthic habitats. Organisms requiring light for photosynthetic processes (eg seagrass, macroalgae, coral) can be adversely impacted by increased turbidity and associated patterns of deposition. Benthic organisms may be affected by deposition of increased sediment loads.

The proposed new spoil ground has a muddy substrate with occasional seapens and sediment analyses indicate the material to be dredged is suitable for unconfined placement at sea. The proposed works are not likely to have any significant impact on fish assemblages due to their wide distribution through tropical regions. Similarly, the Project is not likely to have any significant impact on prawn species that are the key target species in the Northern Prawn Fishery as the proposed location for the new offshore spoil ground is not suitable juvenile prawn habitat, although it may be utilised by adult prawns to some degree.

The proposed development is unlikely to have any significant impact on cetacean species. A large amount of current scientific literature is available showing that cetaceans are able to coexist in areas of extensive port infrastructure.

There is currently limited available information on sawfish and sea snake biology. Further information review and consultation with specialists will be undertaken as part of the EIS process to determine the full extent of potential impacts to these species. From literature that has already been reviewed there is no information that suggests any impacts to these species from the proposed development.

The proposed development may have the potential to cause disturbance to turtle nesting during port construction and to disorientate hatchlings during operations due to the effects of artificial lighting. Impacts from boat strikes and contact with the dredge are also possible.

The EIS will include mitigation strategies to minimise the impact of activities upon the turtle species that utilise the Project area (eg light attenuation to minimise disorientation) and measures to reduce existing threats (nets, pig predation).

No seagrass communities occur at the proposed port site or Hornibrook Point Barge/Ferry Terminal. A small quantity of dredging would be required for the Hornibrook Point Barge/Ferry Terminal and the Hey River Barge/Ferry Terminal. Impacts on dugong habitat are considered unlikely due to minor quantities of dredging required. Turbidity plume modelling will be used to assess whether small fringing reefs at Boyd Point and Pera Head would be affected by dredging.

3.9 COASTAL PROCESSES

The coastline to the south of Boyd Point, where the proposed port is to be located, is a relatively straight section of shoreline. The beach at the proposed port site is backed by an escarpment approximately 7.5m high and is located within a relatively stable section of coastline between two headlands, being Boyd Point and Pera Head.

A review of bathymetric data indicates that offshore contours are relatively straight and uniform to ten metres water depth in the location where dredging is proposed to start on the berth pockets and batters. The slope of the near shore zone is approximately 1 in 50 to the ten metre contour then transitions to a flatter slope of 1 in 250 to the 15m contour. Sediment analysis is required to confirm sizes of near shore sand and mud particles and the composition of bed material. Previous survey studies across the Gulf of Carpentaria by Somers and Long (1994) indicate that less than 20 per cent mud (< 64µm) is expected in surface sediments near Boyd Point. This proportion may be influenced by sources of sediments such as the Embley and Mission Rivers to the north and the Watson and Ward Rivers to the south. The bed material mobility is central to gaining an understanding of coastal processes in the Project area as it affects dredging characteristics, the potential siltation of berths, and the response of the coastline to the proposed development taking into account wave and current conditions. Sediment characterisation work is being undertaken as part of the EIS investigations.

Australian hydrographic chart 301 shows ebb currents of one knot flowing to the west offshore from Albatross Bay and the flood current direction moving almost southwards. Previous hydrodynamic modelling by Wolanski (1993) has shown that the Gulf waters can become temperature stratified in summer before tropical cyclone activity that causes the waters to become well mixed vertically. Meteorology has a strong influence on water levels in the Gulf and produces seasonal anomalies that drive surface currents and circulation within the coastal waters.

Tides in the Gulf of Carpentaria are driven by both the Arafura Sea and the Coral Sea. Semi-diurnal components diminish gradually upon entering the Gulf. The diurnal tides however, propagate freely into the Gulf and rotate in a clockwise direction about a node near its centre. Strong tidal and wind driven currents generate circulation patterns parallel to the shore in shallow waters of less than 20m that tends to trap coastal waters for long periods of time. This is particularly relevant in the monsoonal season when turbid water from river outflows can persist inshore through the trapping circulation patterns. Apart from extreme conditions developed by tropical cyclones and monsoon winds, the wave conditions in the Gulf of Carpentaria are predominantly locally generated, short period sea waves.

Hydrodynamic and coastal processes modelling will be undertaken as part of the EIS to determine the potential for:

- changes to the beach and alongshore profile as a result of coastal structures interfering with the longshore sediment transport;
- erosion or accumulation of beach sediments, slope instability of the escarpment; and
- increased turbidity in the nearshore waters as a result of dredging and the potential to concentrate (sort) sediments in particular locations such as the berth pockets and the dredge placement areas.

Appropriate mitigation measures will be investigated where potential impacts are identified through the EIS.

3.10 HYDROLOGY

3.10.1 Existing Hydrology

The SoE Project area is drained by the following key creeks and rivers (refer to **Figure 1-1**):

- Winda Winda Creek, which drains the Hey Point Area, at the northern extent of the area of interest;
- Norman Creek, which drains the central area lying immediately south of Pera Head;
- Ina Creek, a drainage to the south of Norman Creek;
- Ward River, with tributaries Coconut Creek and Tappelbang Creek, which drain the southern extent of the area of interest; and
- Watson River, which drains the southern extremity of ML7024.

The Watson River, Hey and Embley Rivers are major drainages in the region. The headwaters of Hey and Embley Rivers lie to the east of the area of interest and drain into Albatross Bay between Hey Point and the Weipa Peninsula. The Embley and Hey River catchments extend south and adjoins the Watson River catchment. Estuaries are associated with the Ward, Watson and Embley Rivers and Norman Creek.

Seasonal variation in the upper ephemeral reaches of rivers is pronounced with wet season discharge typically commencing from mid to late December. The dry season retreat of stream flow over the ephemeral sections can occur from early April. The underlying shallow aquifer is able to sustain baseflows well into the dry season over the lower reaches of the major water courses.

3.10.2 Potential Impacts on Hydrology

Two potential water storage dams are proposed initially on the Norman Creek (main creek and tributary). Increases in production above 15Mdptpa are likely to require additional dams in the Norman Creek and Ward River catchments. The location, size and number of additional dams will be determined during feasibility studies. The extent of impoundments and potential ecological impacts of changes to the flow regime will be investigated during the EIS, including the need or otherwise for the release of environmental flows from the dams, based on downstream habitat requirements.

3.11 HYDROGEOLOGY

Both artesian and shallow aquifer groundwater are thought to be present in the SoE Project area. The geology over much of western Cape York, and in the area of interest, consists of sedimentary rocks and unconsolidated sediments, which have filled in basins in the basement rocks. As the profile varies with depth, superficial lateritic weathering gives way to shallow aquifers, which can be high yielding, as in the case of the Weipa Peninsula to the north. The shallow aquifers where they occur are important resources for sustaining creek baseflows into the dry season. Investigative boreholes were installed in 2006 (25 bores) and 2007 (19 bores) in the SoE area. In contrast to the hydrogeological regime of the current Weipa operations, a substantial shallow aquifer was not intersected.

Artesian groundwater is present in the Gilbert River Formation (and to some extent in the overlying Garraway Beds). Typically, water bearing formations in the area are located at depths of between 750m to 1,000m below ground level, and groundwater flow is towards the west. Artesian conditions occur from the coastal margin inland to areas where topography lies below 30m to 40m above sea level.

It is believed that the majority of the artesian recharge occurs in the Dividing Range area via fractured sandstone in the Gilbert River Formation during annual rainfall events, particularly along watercourses.

Experience of similar aquifer conditions in the Weipa area, and test pumping in the Aurukun area, indicates the aquifer transmissivities tend to lie in the range 180m^2/d to 300m^2/d, and storativities, in the range ~10^{-4}[2].

There is geophysical evidence (Bain and Draper, 1997) to suggest that the Gilbert River formation, which is host to the artesian aquifer, pinches out in the Gulf of Carpentaria at a depth in excess of approximately 1,000m, about 150km to 180km to the west of the Weipa Peninsula.

RTA is the only major user of deep artesian groundwater in the area, relying on a network of 9 bores at Weipa and Andoom to meet demand. Artesian usage by the SoE Project operations will need to be managed within prevailing statutory requirements to prevent any conflicts with existing usage at Weipa and Andoom.

3.11.1 Potential Impacts on Hydrogeology

The pentiometric surface of aquifers may drawdown as a consequence of extraction of artesian waters for process water supply. The vertical and radial extent will be investigated through the EIS. Extraction of the bauxite layer may alter the baseflow contribution to watercourses from groundwater stored within the bauxite matrix. This will be investigated in the EIS along with potential impact on riparian ecology.

3.12 WATER QUALITY

3.12.1 Surface Water

No historical surface water data is available for the SoE Project area prior to 2007. A programme of water quality sampling is being undertaken for the baseline assessments required for the EIS. The first round of water sampling was undertaken in August 2007 through collection of grab samples from ten sites in the Project area. The results of the sampling found that natural bauxite mineralisation is showing a strong influence on aluminium concentrations with dissolved aluminium above ANZECC/ARMCANZ (2000) guideline values at most bauxite plateau sites but lower in clay-hosted pools in Winda Winda Creek and the estuary of Norman Creek.

The hardness found in local waters is much lower than the hardness correction range provided in the ANZECC/ARMCANZ (2000) guidelines. Consequently, when concentrations of some metals (including zinc and lead) are corrected for hardness, the natural background concentrations sometime exceed guideline values.

The samples typically had low turbidity (mean 2.4 NTU's) and low conductivity.

[2] Unit less dimension.

3.12.2 Groundwater

Little historic information is available regarding the quality of the water emanating from the shallow aquifers. However, as these aquifers feed the base flows of the creeks in the dry season, it can be expected that water quality would be of similar standard to the local surface water quality. The only expected difference would be depleted levels of oxygen in groundwater. Periodic sampling and analysis of shallow aquifer water chemistry will be carried out for the EIS.

With regards to the water quality in the artesian system, experience of similar aquifer conditions in the Weipa and Andoom areas indicates that the artesian water has elevated chloride levels.

3.12.3 Marine/Estuarine

Water quality within the proposed Project area varies substantially depending on location. The proposed port site is in an open coastal environment whereas the barge and ferry terminals at on the Embley and Hey Rivers are estuarine. Conditions adjacent to the proposed port are directly influenced by prevailing wind and wave action. The exposed nature of this system drives ambient water quality, contributes to sorting of fine sediments and increases coarse sediment fractions. Considering these features, this area is expected to maintain reduced ambient turbidity compared to estuarine waters. Both Embley and Hey Rivers have water quality influenced by a more sheltered condition, reduced wave action and increased tidal velocities. Elevated turbidity and fine sediment mobilisation and deposition, are commonly associated with these mangrove community habitats. Broad fluctuations in physicochemical water quality (pH, salinity, turbidity etc) can be expected at both Hornibrook Point and the Hey River during the wet season with flushes from the catchment.

3.12.3.1 Marine Water Quality

Sea depth adjacent to the port development site near Boyd Point gradually increases from the shoreline to approximately 20m. Off-shore marine water quality studies undertaken within the Gulf of Carpentaria have identified a relatively low turbidity regime, ranging between 0.05 to ~2.4NTU (Somers and Long, 1994). Shallower coastal areas have been shown to be influenced by episodic moderate/high wind events which cause the mobilisation of sediments and a corresponding increase in turbidity (GHD, 2004).

Recently acquired turbidity data recorded from an area offshore from Boyd Point indicated substantially higher turbidity regime than reported by Somers and Long (1994), with mean results in the order of approximately 27NTU - 30NTU (GHD, 2007). During this four month study period, strong correlations were observed between high turbidity events and the mobilising forces of spring tides and elevated wind conditions (GHD, 2007). The marine waters of the Gulf of Carpentaria are generally well mixed (Somers and Long, 1994). Surface sea temperatures range between 24^{o}C and 31^{o}C annually in response to seasonal changes in air temperature (URS, 2002) while salinity is likely to remain relatively constant (33ppt - 34ppt) due to the absence of freshwater sources in the study area.

3.12.3.2 Estuarine Water Quality

The Embley and Hey Rivers represent an estuarine environment that is adapted to increased flow velocities, elevated turbidity and periodic freshwater inputs. Low energy coastlines, high flow conditions and increased fine sediment loads from the Hey and Embley River catchments are likely to result in a naturally elevated turbidity regime. This effect is likely to be further influenced by seasonal rainfall differences. High rainfall during the wet season (December – March) will increase levels of sediment from the catchment compared with dry season conditions. Salinity has also been found to decrease during rainfall events to 27-28ppt from 34ppt as a result of freshwater inputs to the system (URS, 2002).

3.12.4 Potential Impacts on Water Quality

Dredging and disposal of spoil has the potential to impact on marine water quality through an increase in turbidity. The potential for the release of contaminants that may already exist within the SoE port spoil material is considered negligible due to the remoteness from anthropogenic sources and the results of sediment analyses (refer to **Section 3.8.1**).

Modelling the extent of turbidity plumes potentially generated at the SoE port dredging site and spoil disposal area will be conducted as part of the EIS. Turbidity plume modelling outputs will be used to assess potential impacts on water quality and marine ecology (refer to **Section 3.8.4**) in the vicinity of the dredging and spoil disposal areas. If onshore disposal is undertaken, management of release waters would be required to minimise potential for impact on receiving water quality.

Erosion rates from active mining areas are higher than from unmined areas however, due to pit layout, rainfall runoff is largely retained within the mined areas. The EIS will assess the impacts of treated sewage disposal, tailings disposal, stockpile and infrastructure area runoff and describe management control measures.

3.13 NOISE, VIBRATION AND AIR QUALITY

There are no permanent habitations or noise sensitive places close to the mining, processing or port areas. The ambient noise environment is reflective of a remote and relatively undisturbed area and existing air quality in the SoE Project area is good, apart from occasional smoke from dry season fires.

3.13.1 Potential Impacts on Noise, Vibration and Air Quality

The mining, process and port activities have the potential to generate noise and dust emissions. Blasting is not required for bauxite mining.

Potential air quality impacts could arise from:

- dust generated from mining, haul roads, ROM and product stockpiles, beneficiation plant and conveyors; and
- nitrogen oxide (NOx) and sulphur dioxide emitted from the diesel fuelled power station.

The proposed SoE Project is likely to have minimal impact on noise, vibration and air quality at sensitive places due to its remote location. The potential for noise and vibration to affect turtle nesting will be assessed in the EIS.

Greenhouse gas emissions arise from diesel consumption in light vehicles, heavy vehicles and the power plant, and vegetation removal and will be quantified in the EIS.

3.14 VISUAL AMENITY

The proposed mining activities are located in a remote area with an absence of permanent residences and very few roads and largely not visible to the general public. The coast in the Pera Head area has an extensive and aesthetically prominent landscape comprising cliffs of red bauxite overlaying white kaolin. The proposed port will be built in this area and will be visible from vessels in nearby Gulf waters. The visual exposure will be assessed as part of the EIS.

3.15 NATIVE TITLE

RTA has valid MLs (ML7024 granted 1 January 1958) and ML6024 (granted 25 July 1985) from a native title perspective.

The Western Cape Communities Co-existence Agreement (WCCCA) is a registered ILUA (QIA2001/002) under the Commonwealth *Native Title Act 1993* between RTA, the State of Queensland and relevant Aboriginal parties.

The WCCCA recognises and respects the rights of Traditional Owners and allows for consultation over future development of mining operations. The WCCCA validates RTA's mining leases (ML7024, ML6024), property rights and any right or interest granted under the Agreement Act. RTA will continue to engage with the traditional owners under the provisions of the WCCCA.

Where any proposed activities are outside the ILUA area, to the extent that native title has not been extinguished in relation to those areas, RTA intends invoking the relevant process under the *Native Title Act* if applicable.

3.16 CULTURAL HERITAGE

The WCCCA provides for a system for cultural heritage management over the area covered by the ILUA. This area includes all land and waters on ML7024 and ML6024. Because of that system and due to the operation of Section 86 of the *Aboriginal Cultural Heritage Act 2003*, no cultural heritage assessment or cultural heritage management plans in addition to those already provided for would be required under Queensland legislation for any new permits or approvals required for development works on land or waters subject to the ILUA.

RTA personnel held discussions with relevant Aboriginal parties, in accordance with WCCCA communication protocols prior to, and during, the resource-drilling programme that took place south of the Embley River during 2006-2007. The Wik and Wik Way Traditional Owners took part in cultural heritage clearance work under WCCCA protocols as part of that programme and such clearance work would continue ahead of physical works for the SoE Project.

3.16.1 Potential Impacts on Cultural Heritage

New ground disturbing works have the potential to impact on Aboriginal cultural heritage where disturbance has not occurred before. RTA will continue with work with traditional owners to avoid or minimise the potential for impact on Aboriginal cultural heritage. Studies to date indicate that majority of Aboriginal cultural heritage sites are located in coastal and estuarine areas and away from the bauxite plateau and future mining areas.

Cultural heritage clearance work will continue to occur under WCCCA protocols before physical works take place. Sites are managed under the cultural heritage protocols of the WCCCA.

3.17 TRAFFIC AND TRANSPORT

The principal road access to Weipa from Cairns and Cooktown is the Peninsula Development Road. The Peninsula Development Road is only partially sealed and is also prone to flooding and closure during the wet season.

Weipa has an all weather airstrip that receives daily scheduled flights from Cairns. Aurukun has a tarmac airstrip, and is serviced by a light plane five times per week. There is also a weekly barge service to Weipa which delivers goods and general cargo from Townsville.

The area south of the Embley River has no made roads at present, only minor vehicular tracks. Current access to the site is from the Peninsula Development Road via the Aurukun Road and the Amban Access Road.

New access to the mine infrastructure areas will be provided via a ferry and roll-on roll-off barge terminal at Hornibrook Point on the northern bank of the Embley River to a similar terminal on the western bank of the Hey River on ML6024. An access road approximately 40km long with all-weather sealed 7m wide pavement will be constructed from the Hey River terminal to the mine infrastructure area. At 15Mdptpa production, bauxite shipments from the SoE port would total approximately 200 ships per annum.

A traffic/transport impact assessment will be undertaken including a review of the proposed Project during both construction and operational stages for external impacts on the existing road network at the required design horizons.

3.18 WASTE

The principal mineral waste at the site will be tailings from the processing of the bauxite. Beneficiation produces tailings consisting of water, fine bauxite pisolite, sands and clays. The tailings are benign and are not hazardous under the EPA criteria for *Determining Dams Containing Hazardous Wastes*. No chemicals are added to the process. Tailings are disposed of in “turkey’s nest” dams where solid materials settle; the water is decanted, and recycled through the process.

A tailings dam will be built near the beneficiation plant and will hold tailings for the initial years of the mine’s operation. Subsequently, new tailings dams will be constructed on previously mined areas then decommissioned once they are full and rehabilitated. Approximately 1Mt of tailings would be produced for every 3M dry product tonne.

Non-mineral wastes produced will include general wastes (eg food waste, paper, glass, plastics, scrap metal, wood) and regulated waste (tyres, waste oil, batteries). Recyclable wastes will be separated at source. Felled vegetation will be windrowed or burnt in line with the current practices.

Sewage generated at the site will be treated using a biological aerobic modular sewage treatment plant.

3.18.1 Potential Impacts of Waste

Waste disposal is unlikely to present a significant risk to the environment. Potential impacts on ground and surface water from the tailings dams will be investigated through the EIS.

3.19 REHABILITATION AND DECOMMISSIONING

The rehabilitation and decommissioning of the mine will form part of the SoE Project plan. Rehabilitation will be undertaken progressively during the life of the mine. Mined out areas are likely to be rehabilitated to native woodland, however the final land use options will be developed and agreed with relevant stakeholders, including Traditional Owners. The methods used for rehabilitation of disturbed areas following the removal of bauxite will be discussed in the EIS, drawing on experience gained by the existing Weipa operations.

At final decommissioning, plant, equipment and buildings will be dismantled and removed unless regulatory authorities and relevant community stakeholders otherwise agree.

Ongoing closure planning will occur during the life of the mine, involving consultation with the community and the relevant regulatory authorities.

3.20 HAZARD AND RISK

The SoE Project is unlikely to present hazards to the environment or the community due to its remote location and the absence of harmful materials used for bauxite mining and processing. Any potential hazards to the environment or the community will be assessed in the EIS.

3.21 COMMUNITY CONSULTATION

RTA recognises the importance of this Project to the local communities, as well as others who might potentially be affected by the development.

Project briefings and consultation will occur with Traditional Owner groups (under the auspices of the WCCCA) and other local stakeholders such as the Weipa Town Authority, Napranum, Aurukun and Cook Shire Councils, the Cape York Peninsula Development Association, pastoralists, fishing groups and tourist operators.

Consultations will be undertaken with key local stakeholders to develop the scope of works for the social impact study. The social impact assessment will examine the positive and negative impacts on affected persons, regional impacts and benefits and mitigation and benefit maximisation measures and strategies.

Consultations will be undertaken with lead Government agencies such as the Department of Infrastructure, EPA, Department of Mines and Energy, DNRW, DPI&F and DEWHA.

Project information workshops will be held and Project newsletters released periodically. The draft ToR and EIS will be available for public comment in accordance with the formal statutory EIS process.

3.22 SOCIO-ECONOMIC

The key centres that will be affected by the SoE Project include Aurukun, Napranum, Weipa Town, plus pastoralists in the adjacent Cook Shire.

Aurukun has a population of 1033, Napranum has a population of 841 persons, and Weipa town, a population of 2,830 (ABS 2006a, ABS 2006b and ABS 2006c). The populations of Aurukun and Napranum are predominantly indigenous (91.6 per cent and 92.7 per cent respectively), while 17.6 per cent of the Weipa population is indigenous. Relative to major regional centres, the towns experience isolation due to their remoteness, although Weipa town is considered a service hub for the Western Cape. In contrast to Napranum, Aurukun has been isolated from bauxite mining operations to date.

The small populations of the areas affected by the SoE Project and their remoteness make it difficult to achieve sustainable economic and social development, resulting in a low level of economic integration with the broader Queensland economy.

A social impact assessment and economic assessment of the SoE Project for construction and operational phases will be carried out for the EIS. The scope of the assessment will be developed in consultation with stakeholders, including Traditional Owners. The assessment will include the impact of mining on access to land in the SoE Project area by Traditional Owners.

Employment generated from the combined operations north and south of the Embley River will average 870 direct employees (of which about 400 would be employed SoE), which is slightly more than the current East Weipa/Andoom operations. Systems currently implemented at Weipa operations include support programs to assist local indigenous people to successfully transition into employment in the mining industry. It is anticipated that there would be continued employment and training opportunities for both indigenous and non-indigenous people with the South of the Embley Project.

The South of the Embley Project would continue to work together with local communities to build on the economic benefits generated by our mining operations in the Western Cape region. This includes opportunities for locally owned and operated businesses, assisting local Indigenous business development and providing employment for local residents.

Approximately $55million per annum in royalties, payroll tax, stamp duties and other fees and charges would flow to the State Government from the combined operations north and south of the Embley River.

3.22.1 Potential Impacts on Socio-Economics

The SoE Project will enable the socio-economic benefits of mining to the Weipa region to continue. RTA would invest some A$900 million for the construction of the mine. Potential adverse impacts on local communities will be assessed during the EIS through a detailed social impact and economic study.

4 ENVIRONMENTAL MANAGEMENT

It is the proponent's intention to ensure that the Project would be constructed and operated in such a way as to minimise, mitigate or remediate any unacceptable effects on the environment.

The current Weipa operations have an Environmental Management System (EMS) which is certified under the international standard *ISO14001:2004 Environmental Management System*. This EMS will be extended to include the SoE Project operations. Construction and operational activities will be managed in accordance with a Plan of Operations and Environmental Management Overview Strategy[3] under the relevant legislation. Proposed environmental management measures will be set out in the EIS.

[3] Now referred to as Environmental Management Plan in current version of the EP Act.

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